



UNITED NATIONS ENVIRONMENT PROGRAMME



*Coastal and marine  
environmental problems of  
the United Republic of Tanzania*

*UNEP Regional Seas Reports and Studies No.106*

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## PREFACE

The Government of the United Republic of Tanzania approached UNEP in late 1987 with a request for assistance in assessing the coastal and marine environmental problems of the country and in drawing up a national action plan for the protection, management and development of its marine and coastal environment.

In response to this request, and in close co-operation with the Tanzanian National Environmental Management Council (NEMC), a mission was organized by UNEP. The terms of reference of the mission was to:

- review the status of the United Republic of Tanzania's capabilities in the field of marine sciences including the identification and description of national institutions engaged in marine science and pollution studies;
- survey coastal and marine living resources;
- identify species, habitats and ecosystems that may require protection in order to:
  - (i) maintain essential ecological processes and life supporting systems and the preservation of genetic diversity;
  - (ii) ensure the sustainable utilization of living resources;
- identify possible sites for the establishment or improved management of specially protected areas such as marine parks and reserves;
- identify major sources of marine and coastal pollution and assess the present levels of marine pollution in the coastal areas including identification of changes in the environment that may be ascribed to pollution; and
- make an inventory of major ongoing and planned development activities which have or may have an impact on the quality of the coastal and marine environment.

The surveys were undertaken in late 1987. They were carried out in consultation with local experts, to ensure that proper consideration was given to local, regional and national problems and priorities in the drafting of the National Action Plan.

The report consists of a summary describing specific coastal and marine environmental problems of the United Republic of Tanzania such as, coral reef destruction, mangrove cutting, fisheries over-exploitation and unnecessary intrusion in and disturbance of marine reserves. This summary is based on six sections on various regions of the United Republic of Tanzania, with their findings and recommendations; and of a proposed Action Plan for the protection, management and development of the marine and coastal environment of the United Republic of Tanzania, developed in the context of the regional Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region.

Dr. M. Pearson (Institute of Marine Science in Zanzibar) carried out the surveys and wrote the six sections of the report. Mr. P.K. Akiwumi prepared the consolidated report. The assistance of the national authorities and counterparts of the United Republic of Tanzania is gratefully acknowledged.

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## A. PHYSICAL ENVIRONMENT

Tanzania lies south of the equator between the Great Lakes (Victoria, Tanganyika and Nyasa) and the Indian Ocean, stretching from the border of Kenya to Mozambique. There are five coastal regions: Tanga, Dar es Salaam, Coast, Lindi and Mtwara. The coastline stretches 800 km along the Indian Ocean from the Kenyan to the Mozambiquan border with a 200 nautical mile (nm) wide Exclusive Economic Zone. The coast has a very narrow continental shelf varying from approximately 3.2 nm wide to a maximum of 34.5 nm at areas around Mafia, Zanzibar and Pemba Islands. The coastline is primarily characterized by sweeping sand beaches, rocky outcrops, and developed fringing coral reefs and is also punctuated by extensive growths of mangroves particularly near the mouth of larger rivers (L.Berry, 1980).

### 1. GEOMORPHOLOGY OF THE COASTLINE

The coastline of Tanzania can be divided into three main categories, these are:

- (i) indented coastlines with off-lying reefs and islands;
- (ii) shallow bank coastlines, little indentations with off-lying large islands;
- (iii) indented coastlines with narrow shelf fringing reefs with deep oceanic waters to seaward.

From the Kenyan border southwards to Pangani the coastline is indented with off-lying reefs and islands with shelves extending to the western coast of Zanzibar (Figure 1, annex X). From Dar es Salaam (Ras Ndege) to Ras Buyuni the coastline is indented with narrow shelf fringing reefs and deep oceanic waters to seaward. The coastline from Ras Buyuni to Kilwa Masoka (Ras Tikirini) is a bank area of deltaic origin indented by deep channels and interspersed by coral reefs (patch reefs) and coralline islands of pleistocene origin. This area is influenced by the Rufiji rivers north and south deltas depositing sediments of alluvial origin and by carbonate sediments of reefal origin. South of Mafia island and to the east of the southern delta of the Rufiji is a bank and patch reef area extending 16 nm to a series of islands to the east: Okuza, Nyuni, Limbi, Fanjore and Songo Songo. All the islands are fronted by extensive fringing reef formations. The 100 fathom line (600 ft or 300 m) is located immediately to seaward of these islands and approximately 2 nm to seaward of Mafia and Zanzibar. The 100 fathom line can be 4 nm offshore in the latter. South of Kilwa the coastline is indented with a narrow shelf, fronted by fringing reefs with the 100 fathom line lying 1 to 3 nm offshore. From Mtwara to Ruvuma (Mozambique border) the coastline is a narrow banked area fronted by fringing reefs and islands leading to the Ruvuma estuary south of Ras Matunda.

Pemba (Figure 2a, annex X) is a true oceanic island surrounded on all sides by deep oceanic waters with a maximum depth of 546 fathoms (1,276 ft or 630 m) in the Pemba channel which separates the island from the mainland coast. The east coast of the island consists of a narrow fringing reef with the 100 fathom line lying 1 to 2 nm offshore. Between Ras Kiuyu to the north and Ras Upemba to the south, low lying pleistocene reef structures are found along the coast with three breaks fronted by low islands well covered by undisturbed mangrove forests. The south consists of a drying bank and a series of coral islands (pleistocene) to seaward with the coast dropping off very rapidly to 200 fathoms less than 1 nm offshore. The west coast is a unique indented coastline fronted by low lying coral islands and fringing reef formations which are dissected by five passes characterized by high water flows during the ebb and flood tides. *The area contained within these reefs and islands consist of patch reefs and seagrass beds bordered by dense mangrove cover.*

Zanzibar (Figure 2b, annex X) consists primarily of an exposed pleistocene platform backed by an extensive bank formation to the mainland of Tanzania. There are no rivers in Zanzibar.

Several islands of pleistocene coral origin can be found to the west, they are Kepandiko, Chapani, Chango, Bawi, Chumbe, Kwale and Pungume. To the north lies the island of Tumbatu. It may once have been attached to the main island but is now separated by a channel 1.5 to 3 nm wide with a maximum depth of 8 fathoms and a minimum depth of 1 fathom. The east coast is generally straight on a northwest-southeast axis. To the north is a small pleistocene coral island (Mnemba) surrounded by extensive coral formations and deep water to seaward. At Chwaka there is a large embayment of shoaling water. The bay is covered primarily by Thalassia and Thalassodendron and is surrounded by mangrove forests on its southern fringes. From Ras Mungwe to the north and Ras Kizimkazi to the south, the coastline is fronted by a fringing reef. This is a high energy reef, backed by a small back reef/lagoon system that may dry at low water springs. No information was available on the geomorphology of Mafia Island.

## 2. CLIMATE, CURRENTS AND HYDROGRAPHIC CONDITIONS

The primary influencing factors affecting the climate, currents and hydrographic conditions of the coast of Tanzania are the seasonal monsoon winds (Figure 3, annex X). The climate of the region may be described as moderately warm tropical.

Between the months of May and November the monsoon winds known as the southeast trade winds approach the coast of Tanzania from a south, southeast direction. They are then deflected along the coast in a northerly direction. Besides the incidental conventional precipitation frequently associated with the coast and islands, (Figure 4, annex X), rainfall pattern is closely associated with the southeast trade winds which blows over a large body of water, (Indian Ocean), and has the greatest impact on the region. Most of the moisture carried by the winds falls in the southern and central parts of the East African coast and is depleted of much of its moisture by the time it reaches northern Kenya and Somalia. Between the months of December to April the prevailing monsoonal winds, are from the northeast. These northeasterly trade winds are principally continental in nature and therefore relatively dry except for the moisture picked up in the northern Indian Ocean and the Arabia Sea. Northeastern Tanzania benefits from the water deposited by these winds. Because of the effects of the two trade winds and Tanzania being close to the equator it has one long and one short rainy season.

The principle ocean currents affecting the Tanzanian coast are the South Equatorial Current, the East African Coastal Current and the Somali Current (Figure 3, annex X). As the South Equatorial Current approaches the African continent it splits to form two coastal currents, the Mozambique Current which flows southwards and the East African Coastal Current (EACC) which deflects along the African continent flowing northwards.

Between the months of May to November the EACC is under the strong influence of the southeast trade winds which causes it to flow northwards. The current continues to flow along the Somali coast but due to strong offshore winds north of the equator results in the upwelling of cold nutrient rich water. The northeast trade winds generates the southward flowing Somali current which meets and reverses the EACC. The currents deflect to the east usually at or just south of the equator (Newell, 1957).

It has been found that inshore coastal features such as banks, reefs and islands all influence the flow of the EACC, creating eddies, vortexes and layer counter currents all within the depth of shallow biological features, Harvey (1977), Newell (1957), Mwaipopo (in press).

The temperature of the coastal waters average at 27°C but may reach 25°C during July to September and rise to 28°C to 29°C in shallow areas during January to March. The average value of salinities was measured at 34.50/oo.

To date, there has been no study of the mixing characteristics of the Rufiji waters and that of other major rivers with off-lying saline coastal waters and the patterns of sediment fallout along the Tanzanian littoral. There is a need for such studies to be undertaken in order to

## B. SPECIFIC MARINE ENVIRONMENTAL FEATURES AND PROBLEMS

### 1. ASSESSMENT OF THE CONDITIONS OF THE MARINE ENVIRONMENT

#### 1.1 Coral Reefs

Fringing reefs are the main characteristic reef formation of the Tanzanian coastline. Due to the narrowness of the continental shelf all the coral reefs of the region are close to land and as a result are strongly subjected to natural and human influences and are particularly vulnerable to changes in land use and coastal development.

The coral reefs of the United Republic of Tanzania showed severe damage due to the use of explosive fishing techniques. The extensive and continued practice of this fishing method has reduced much of the substrate normally suitable for recolonization to unconsolidated rubble. This rubble is now colonized extensively by soft coral species inhibiting the possible settlement of the more energetically important scleractinian species.

The soft coral species having a faster growth rate tend to reduce available substrate for settlement and overgrow juvenile colonies. In severely damaged areas, soft coral cover was estimated at 60-80%. The areas contained by Mhasani bay to the south and northwards to Ras Kirimoni is one example of a reef area being subjected to continuous explosive fishing, up to three impacts per hour were observed. The use of explosive fishing techniques is carried out quite openly during daylight hours and in close proximity to residential areas. Action is seldom taken to prevent this activity.

Explosive fishing does not only cause direct destruction to the reef. When used on sand areas adjacent to patch reefs considerable volumes of sediment are lifted which then settle heavily on the adjacent coral. Mortality of corals due to smothering by sediments was observed with high reef mortality due to this method on the reefs of Oduza Island. There are areas, however, where no explosive fishing activities have been reported such as in the reef and bank areas south of Mtwara, from Ras Msimanku to the Ruvuma river. The general reasons given for the increase in explosive fishing are the shortage of fishing gear available and the noticeable decrease in available fish stocks when traditional fishing methods were used. The coral diversity is, however, good but the cover is low, with no major frame building coral observed in its juvenile stages.

Damage to the reef attributed to explosive fishing is also increased by mangrove poles, crushing and abrading coral surfaces on certain reefs. Mangrove poles are cut illegally as in the centre of Karange island and transported by canoe and then unloaded onto the reef in heavy weather. In addition, the reefs have been subjected to storm surge damage. It has been suggested that through the use of explosive fishing techniques the reefs have been altered and that damage due to storm surges has increased due to the movement of fractured colonies that then impact living colonies. Further damage has been due to anchoring techniques employed by artisanal fishermen. Fishermen using anchors carved from limestone (Pleistocene coral reef) crush and drag colonies when anchoring over their fishing grounds. As the anchors drag on the substrate, they push coral rubble before them which then fall down the fore reef slope damaging deeper corals which would otherwise be immune to the immediate effects of explosive fishing.

The Tanzanian coral reefs and tidal flats suffer further damage from reef walking by fishermen at low tide. This constitutes an important element of the artisanal fishery for molluscs and octopus. In the Tanga region, Niule reef was observed to be under intensive fishing pressure during low tides with 30-40 fishermen observed searching for octopus and mollusc species both day and night. Artisanal fishing traps have also caused damage to the coral reefs. The traps are being selectively dropped on or in the vicinity of living coral. From Ras Buyuni to Samanga in the Coast region, artisanal fishermen have constructed fixed traps throughout the



Intertidal area, an average of 21 traps were counted in a 0.54 ha area. Fishing pressures have also upset finfish fauna which has resulted in an increase of herbivorous species. The Domacentrus and Chaetodon spp. have grazed on coral surfaces leaving lesions which are causing bacterial infection and mortality of the coral Montastrea spp. and Favia spp. In some areas such as Mesali Island reef 70% of these genera have been infected. Beach seining operations have also been observed to cause damage to the bottom fauna.

The reef structures of Chale bay is unique and maintains a good diversity with 32 genera observed. Although there was no observed damage which could be attributed to explosive fishing, there was a scarcity of finfish species which supports the view that these areas are being overfished using traditional artisanal fishing techniques. Damage to islands and their ecosystems by transient fishermen who have erected temporary camps thereby destroying the natural vegetation and causing erosional problems were also observed. The important nesting sites of turtles on Okuza island have been destroyed by the presence of these transient fishermen.

The indiscriminate extraction and unregulated collection of coral species and shells by tourists and for trade and export and the removal of massive frame building corals Porites spp and Parona spp, for the production of lime or for the use of construction material has also contributed to the destruction of these ecosystems. In the Coast region, coral is either burned to produce lime or is broken to be used as a building material. Shell and coral collectors from Mtwara are to be seen constantly on Nyani island. Shell dealers have lucrative export markets in Hong Kong, Japan, India, W. Germany, China, Canada, Singapore, France and the United Arab Emirates.

Reef mortality as observed in the Tanga region may also possibly have been due to the presence of Acanthaster planci (Crown of Thorns Starfish). Seven species of Acanthaster were observed in larger numbers than on any other coral reef surveyed in the United Republic of Tanzania. However, it has been reported that localized population explosions of Acanthaster have occurred in Zanzibar, the most recent being in 1979.

The reefs have also been subjected to heavy sedimentation which may account for the decrease in coral cover with the increase in depth. It was observed that colonies with surface lesions were unable to clear sediments adequately, while those uninjured colonies were well cleared of sediments. The increase in sediments also reduce light penetration on the back reef areas. Between Ras Bayuni and Koma island in the Coast region patch reefs are infrequent due to high sediment and turbidity levels. However, to the west of Pange, living corals did not show sediment accumulation although the sediment load was high. These coral colonies seem to have adapted to low light levels. The increase in sediments along the coast and from rivers has been due to sand extraction in beach areas although prohibited, and to the destruction of the natural vegetation within the coastal drainage basin.

There are no major industries in the Coast region. The few small scale industries that do exist have not created a pollution problem. However, the other regions have serious pollution problems. The area from Ras Kan Kadya to Ras Mdege has the most serious levels of pollution both urban and industrial in the United Republic of Tanzania. The effect and sources of pollution will be discussed in detail in Section 8.2.

## 1.2 Mangroves

Mangroves are characteristic littoral plants (trees or shrubs) occupying estuarine areas, bays of islands, and sheltered tropical coasts. "Mangrove forest" as they are sometimes referred, serve as a habitat for a good variety of fauna and flora and also as a breeding, nursery and feeding ground particularly for crustaceans. The extensive mangrove forests in Tanzania occur mainly in the deltas of main rivers like the Rufiji and Pangani (Figure 8, annex X).

It was observed that in all the mangrove areas surveyed along the Tanzanian coastline including the islands of Pemba and Zanzibar, the mangroves were in good health and were not being threatened by any major factor.

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It was observed that in all the mangrove areas surveyed along the Tanzanian coastline including the islands there was significant damage to the mangrove forests.

material, firewood and also as fuel for the salt industry. Mangrove areas in the urban regions are not only subjected to cutting which has led to coastal erosion, but also to urban and industrial pollution. Industrial and development zones have been planned in areas fronted by mangrove forests yet no treatment facilities have been planned, to deal with the effluent discharged even from existing industries into water courses leading to mangrove areas.

Salt production is the major industry associated with mangrove areas in Tanzania. In the Tanga region this is primarily associated with the combustion technique. It has been estimated that these operations carried out by small artisanal units spread over the entire coastal areas consume and remove the equivalent of 25-30% years of mangroves otherwise destined for use as firewood in the Tanga Region.

On the islands including the mangrove areas of Mafia, no serious cutting was observed. Five species of mangrove following normal successional patterns from shore to the seaward edge, were observed at Chole Bay and south of Ras Mkumbi. The district officials at present on Mafia have no policy to follow regarding mangroves.

The major mangrove areas of the Rufiji Delta cover a reported area of 1,000 km<sup>2</sup>. The cutting of these mangrove forests were observed towards the interior where forest areas have been removed to make room for rice and salt production. It is, however, illegal to clear further areas for these purposes without licence but existing isolated areas seem to be expanding due to the difficulty in, and lack of, enforcement. Reports from the University of Dar es Salaam indicate that pesticide use of DDT is high in the Rufiji Delta rice production areas. Further investigation is required to assess the long term effects it may have on the area and whether other insect control options exist.

Of the two mangrove areas identified in the Dar es Salaam region, there has been severe cutting in the Kunduchi area. The inner Dar es Salaam mangrove area is in better condition with larger specimens and a greater diversity (3 species were observed). However, these mangroves are subjected to continuous urban pollution waste flowing from the Yenbo River, chemical waste from the Changombe area, oil spillages from the refinery at Kigamboni and ship oil and waste from the harbour.

Mangrove areas in the Lindi region have also suffered similar consequences as previously described. It became apparent during the survey that although the Division of Forestry under the Tanzanian Ministry of Natural Resources and Tourism consider all mangrove areas to be forest reserves, the Ministry of Industry promotes regional development by issuing licences to operate salt works without consulting the Division of Forestry as to the selection of sites. It is clear that there must be effective liaison between the two Ministries in this regard. The coastal zone of Pemba is well covered by mangrove forests of mixed species. This area is not under heavy cutting pressure and licences are issued for selective cutting for personal use in one of three areas in rotation every 5 years.

### 1.3 Seagrass beds

Seagrass beds were found in all bays and on the western side of all reefs and islands lying off the mainland of the Tanzanian coast. The dominant genera found along the Tanzanian coast and islands are Cymodocea, Thalassia and Thalassodendron which are all subjected to heavy traditional artisanal fishing techniques. These include bottom traps and beach seines as well as explosive fishing techniques, causing considerable damage to bottom flora and fauna. The damage caused by explosive fishing carried out on seagrass areas, unlike coral areas, is restricted to compact craters with little apparent damage to adjacent areas. The lack of a hard substrate allows shock waves to pass unimpeded whilst the coral substrate forms a barrier and is thus damaged. The diversity and density of fish species normally associated with seagrass areas were absent in all the areas. This is evidence of extensive fishing pressure. Apart from the genera of seagrass observed, all coral areas and diving reef flats were covered extensively by Sargassum

Samples of Euchema were also observed, suggesting the possibility of a natural stock of Euchema available for mariculture development programmes in selected embayments.

#### 1.4 Fisheries

In the United Republic of Tanzania the marine fisheries are still mainly artisanal. Fishing activities are concentrated inshore and around the islands of Zanzibar, Pemba and Mafia (Figure 10, annex X).

In Tanga region, artisanal fishing has contributed to the severe degradation of the marine environment with reduced catches already apparent (Table 1, annex IX). Data from the Statistics Gathering Programme of the Fisheries Division in the Ministry of Natural Resources and Tourism show that there has been a decrease in catch with an increase in fishermen and fishing gear from 1981 to 1985 (Table 2, annex IX). There has also been a shift in the type of fish caught from inshore demersal fish normally found on reefs and coastal areas to pelagic species migrating in the offshore fishing grounds. This data corroborates the observations made of the low density and diversity of reef fish species.

Artisanal fishing is an important activity of the coastal population. In the Coast region there has been a reduction in the number of registered artisanal fishermen and catch. Data from the Statistics Gathering Programme of the Fisheries Division show that there has been a shift away from gill-netting towards share-netting operations (Table 3, annex IX). This indicated the greater effort that has been made in catching high value pelagic species. The two main prawn fishing grounds in the United Republic of Tanzania are found in the Coast region. These areas are Bagamoyo and the areas adjacent to the Rufiji Delta. The problem associated to these fishing grounds is that no stock assessment have been made prior to fishing licences being issued to foreign operators (Table 4, annex IX).

A Kenya based fishing company is presently fishing on the Rufiji grounds an average of 21 days per month and may be landing up to 1 ton of prawns per haul. Inconsistencies have arisen as to the methods employed by this company and as to the distribution of their catch. At present their catch is not being made available to the local population as stipulated in their licence agreements.

The lobster fisheries in the region is extensive and is carried out by local artisanal fishermen and small scale commercial operators from Dar es Salaam. There are no regulations concerning this fishery and no stock assessments have been made. The unregulated fishery of turtles, which is illegal, and the capture of edible Molothurian (sea cucumber) species are also being carried out.

The data from the Fisheries Statistics of the Dar es Salaam region although incomplete, suggest that there is a high density of registered fishermen in the region and that a large proportion of the landed catch consists of pelagic species. In 1984, pelagic species accounted for 22.19% of the landed catch, while in 1985, it increased to 26.35% reflecting the increase in fishermen. The fishing effort in the Dar es Salaam region is represented in (Tables 5, annex IX), but is incomplete and the differences suggest inconsistencies in the data gathering process. It is therefore clear that an independent survey is required.

The Lindi region having no inshore bank areas but a narrow fringing reef system has, as a result, fewer numbers of registered artisanal fishermen. Although data is collected on a regular basis by the Statistics Gathering Programme of the Fisheries Division, it was reported that the data gathering system was inaccurate and thus rendering the catch data presented unreliable. (Table 6, annex IX). An independent survey of the Lindi region with regards to fishermen, catch, type and number of fishing gear used is essential.

As in the Lindi region, the data available for the Mtwara region, (Table 7, annex IX), is inconsistent and unreliable. An independent survey of the region's fishermen, catch, type and number of fishing gear used is required.

In Zanzibar, fish protein accounts for approximately 90% of the annual intake of animal protein. Due to the high consumption of fish by the general population, it has been Government policy to increase the supplies of fish by encouraging the development of the artisanal fishing sector. This policy has been implemented by making fishing gear and outboard motors available to fishermen and by developing a distribution infrastructure to make the catch available to the rural population. The Government in addition, seeks to stabilize prices at a low level and provides storage facilities for fish (mainly sardines and mackerel) caught by the State Fishing Company (ZAFICO). ZAFICO operates a small fleet of commercial vessels with a modest catch (169 tonnes during the first quarter of 1987). The statistical data collected at designated landing sites (Table 8, annex IX) by the Ministry of Marine, Tourism and Forestry do not give details of species caught which makes it difficult to assess the importance of the various species caught. However, the main types of fish caught are demersal fish (breams, parrotfish, emperors, snappers, mullets, groupers, sharks, rays etc.) which are caught with hand lines, traps and nets; the small pelagic fish (sardines, anchovies and mackerels) which are caught with purse seines, scoup nets and beach seines and the larger pelagic fish (tuna, kingfish, rainbow runner, sailfish, marlin, etc.) which are caught by lines, drift gill nets and purse seines (FAO, 1987).

The artisanal fishing pressure is substantial particularly with the increase in both fishing vessels and gear. It was noted that in line with the Government's policy prohibiting their use, there was a temporary decrease in the number of beach seines in both Zanzibar and Pemba.

Other fishing activities include the destructive method of shell collecting carried out on all the coral reefs of Zanzibar and Pemba, and the sea cucumber harvesting, but no assessment of stocks have been carried out. It is, however, important that this be carried out in order to assess resource potential and to assist in the formulation of management policies.

#### 1.5 Marine Mammals

The marine mammal fauna of the East African region is not well known. On the whole, there are very few existing records on the subject matter.

During the survey, large schools up to 50 to 70 common porpoises were observed off Lindi Bay, however, smaller groups up to 10 porpoises were commonly seen. There were no reported dugongs in the region although they were expected to be seen in the Kilwa area. Marine mammals are not commonly caught in the Tanzanian waters.

#### 1.6 Marine Reserves

For a list of the existing marine reserves along the Tanzanian coastline see annex VII.

An inventory of marine resources and habitats of the regions contained in the Action Plan will identify areas suitable as genetic reserves and protected areas. These areas may serve as genetic pools for the resettlement of damaged areas and the improvement of the fisheries potential. The necessary legislation to establish such sites when identified already exists (annex VII). Other areas suitable for establishment as reserves would be identified during the course of a quantitative resource and habitat inventory to be executed as part of the initial phases of the Action Plan and these should include identified prawn breeding and nursery areas at both the Rufiji and Bagamoyo grounds which would be zoned as closed areas.

Whilst the survey of the Tanga region failed to identify suitable areas for special protection it is felt that the proposed Tanga Coral Gardens Marine Reserve no longer warrants

implementation. In the Coast region, however, three areas were identified that could be declared marine reserves and protected areas (Action Plan), these are the:

- (i) Proposed Mbegani Marine Protected Area.
- (ii) Proposed extension of the Ras Buyuni close mangrove forest area to include offshore reefs and Ras Buyuni Bay.
- (iii) Proposed extension of the Chole Bay, Tutia reef declared a marine Reserve to include the reefs south of Mafia and Bwejuu Island.

These proposed areas would be zoned in accordance with the Action Plan.

In the Dar es Salaam region four marine reserves have been declared which include the Islands of Mbudya, Bongoyo, Pangavini and the reef and sand bank formations at Yasin. Though gazetted in GN 137 of 1975 none of these reserves have been implemented and the public is not aware of their status. These reserves have been subjected to continued fishing pressure and the removal of living specimens by visitors. This has resulted in the gradual deterioration of bottom fauna and associated finfish species to the present depleted levels. No new reserves have been planned for this region.

The protected inshore area from Njao Gap to Port Cockburn is a highly productive area. Coral cover is restricted to very isolated patch reefs, however, the entire area is extensively covered by algal and seagrass species. Bearing in mind the high productivity levels the area would be highly suitable for diverse mariculture developments, in particular Euchema and the Oyster Crassostrea.

At present, Zanzibar has no marine parks, reserve areas or managed areas, but it is the Government's policy that these be identified and gazetted in 1988. As a result of this mission several suitable areas have been identified (Action Plan). The identified areas are:

- (i) Latham Island
- (ii) Zanzibar Reef and Islands
- (iii) Mwenba Island Marine Reserve
- (iv) Mesali Island Marine Reserve - Pemba
- (v) Mtangani Marine Reserve

## 2. MARINE POLLUTION

### 2.1 Industrial Pollution

The National Environment Management Council (NEMC) has produced an inventory of the sources of pollution in the Tanga region. These sources were verified during the survey.

The Tanga Fertilizer Company which lies immediately to the South of Ras Kazone causes serious pollution problems to coastal areas to the north and south of its outflows. The company produces sulphuric acid and phosphoric acid. It was determined by NEMC that for every tonne of sulphuric acid produced, 55 kg of SO<sub>2</sub> and 2.1 kg of SO<sub>3</sub> are emitted into the atmosphere. Effluent emitted into the sea is roughly 700m<sup>3</sup>/h, containing acid leakages, fluoride, phosphorous, nitrogen, small amounts of cadmium in solution and gypsum in suspension. It was found that sulphur particles were common on the beach extending at least 1 km north, with no infauna seen either in the intertidal or subtidal zone, however, the mangrove stands adjacent to the outfall seemed unaffected. The chronic pollution has also resulted in anoxic sediments 2 mm below the surface. The Sabuni Industry for the manufacture of soap and detergents emits sulphur dioxide into the atmosphere and waste water is discharged into the local storm drain system. The

Soap and Glycerine factory also discharges the waste products of soap and spent lye directly in the storm drain systems. Pollution from the Anboni sisal factory has built up banks of waste material in the Sigi river 2 km from its mouth.

Although no adverse effects were observed on the mangrove forests adjacent to the Sigi river mouth, secondary effects may be present from the increased levels of productivity due to this high nutrient load, increased turbidity and increased sedimentation.

The Commercial Industries and Combine Ltd. (CIC) and integrated mill where carding, spinning, weaving, dyeing, finishing and garment making are carried out, utilize 15,000 to 16,000 m<sup>3</sup> of water per month discharging an equal amount of effluent into the storm drains that flow into the sea south of Tanga.

In the Coast region, there are no large urban areas and no major industries. Nevertheless, small scale industries, mainly metal work and soap production, have been developed. Due to the scale of operations and their locations, these small industries have not created a pollution problem.

The integrated coconut plantation processing plant and a dairy farm are the major employers on Mafia. The by-products of the processing plant are spread away from watercourses, however, the dairy plant discharges small quantities of washing compounds directly into watercourses leading to the beach.

Dar es Salaam (Figure 9, annex X) has the highest levels of pollution in the United Republic of Tanzania. The effluents from industrial discharges are made directly into the sea, or watercourses and drainage system leading into it. An inventory of polluting industries has been carried out by the National Environment Management Council (NEMC), presented in UNEP Regional Seas Reports and Studies No. 8, 1982. NEMC is currently continuing this inventory and maintaining monitoring stations. Water analyses are being carried out by the University of Dar es Salaam, the Government Chemical Laboratory, or abroad under SIDA's assistance programme to NEMC.

In the Lindi region, there are no major industrial developments. Existing cashew nut processing factories are no longer functioning and a small industrial complex now in operation produces no effluents at the moment. In the Mtwara region, there are also no operational industrial developments. Its cashew nut processing factories have been closed now for several years. A small industrial estate is currently under construction but arrangements for the handling and treatment of effluents and discharge are unknown. However, on the island of Songo Songo, a planned natural gas/ammonia/urea industrial complex will, in addition to the waste water discharged directly into the sea from the Natural Gas plant, add considerable pollution to the area. Moreover plans for the complex to utilize the Maldor Topsoe ammonia and the Snaprogetti urea processes will reportedly add 500 kg of ammonia and 1000 kg of urea to the discharged water per day. The waste water will also be discharged directly into the sea.

NEMC's recent survey of polluting industries in Zanzibar include, the State Leather and Shoe Factory, Cortex Textile Mill Afrochem Ltd., Aluminium Utensils Factory, Soap Factory, Coconut Oil Factory and the Mahonda Sugar and Perfume Corporation.

The State Leather and Shoe Factory which used chromic acid in its tannery operation, although closed in 1984, discharged effluents into a stream 100 m from the sea. The Cortex Textile Mill when operating at full capacity consumes 300 m<sup>3</sup> of water per day and discharges into the same stream, waste of the equivalent volume containing hydrogen peroxide, soda ash, caustic soda and various dyes. There are no treatment facilities at this mill.

The Mahonda Perfume factory discharges waste water into a small river. In recent years 2 to 3 fish kills have been reported, however, the causes of death are unknown since there have been no analyses of the effluents. Although there has been no direct discharge into rivers and coastal



areas from the Mahonda Sugar Corporation, two pesticide stores containing a mixture of different pesticides were observed to be leaking.

## 2.2 Urban Pollution

At present, 33% of Tanga is currently served by a central sewage system, the remainder is served by septic tanks. There are no treatment facilities whatsoever, and raw sewage from the central system as well as from the septic tanks are discharged directly into the sea. The development plan for Tanga up to the year 2005, makes provision for sewage treatment facilities but the land that had been allocated for the construction of the treatment plant has already been subdivided and allocated as residential plots. The Bombo Hospital situated south of Ras Kazone within the coastlines of the Tanga Harbour, empties its effluents into several septic tanks and soak pits. However, they are at present overflowing and this discharge is washed into the harbour area during the wet seasons. The present situation creates a real risk to inshore marine habitats and a serious public health risk.

In the Coast region, there are no large urban settlements, but the main coastal settlement are Bagamoyo and Kilindoni on Mafia and as a result, urban waste is not a major problem.

As mentioned in section 2.1, Dar es Salaam has the highest levels of pollution in the United Republic of Tanzania. This level of pollution is not only attributable to industrial discharge but also to urban wastes from both planned and unplanned residential areas. Urban sewage is discharged without treatment into the harbour area at Kako, Kurasini, Mtoni, Shimo la Udongo and via large pipes to the mud flats fronting Ocean Road to the north of Banda Beach. At these locations, accumulated faecal wastes were seen on the beaches. There is also an increase in primary productivity associated with the continuous injection of organic material. The increased productivity has likewise led to increased turbidity, siltation of detrital material and a foul smelling accumulation of rotting algal and faeces material on the beach and sand flats fronting the Selander Bridge. A survey of the Dar es Salaam waters to assess the coliform bacteria content was commissioned by the Tanzanian Urban Planning Division of the Ministry of Lands, Natural Resources and Tourism. The results are given in Table 9, annex IX. It is likely that this area contains other pathogens creating a serious public health risk to swimmers, coastal fishermen using cast nets on the beach and their users.

The major coastal urban areas in the Lindi region are Kilwa Kivinje, Kilwa Masoko and Lindi. Lindi has no treatment facilities for urban waste, with raw sewage being discharged into the estuary. The effluent sites are all within the town limits and sediments were found to be anoxic 1 cm below the surface, posing a serious public health risk.

In the Mtwara region, Mtwara being the only major urban area, there are no major sources of urban pollution. Waste and sewage are collected in cesspits and intermittently pumped out to an unknown discharge site.

There are currently no facilities for treating urban waste on either Zanzibar or Pemba. Sewage is discharged directly into the sea. In Zanzibar, the raw sewage discharge points are directly in front of the town beaches which are used for recreational swimming. Hospital refuse and liquid wastes are also discharged directly in front of the Hospital. There is an increased level of productivity as a result. The embayment north of the dhow harbour (Malindi) produces a foul odour of faeces and hydrogen sulphide at low tides with sediments anoxic 0.5 cm below the surface.

## 2.3 Oil Pollution

The Port of Tanga is capable of receiving large ocean going vessels. On an average, 20 ships move in and out of the harbour a month. Oil and refined petroleum products are discharged

by tankers into a standpipe close to the dhow harbour and small oil spills have occurred in this process. In addition there are discharges from anchored vessels in the harbour.

In the Coast region the main source of oil pollution is from a generating station operated by TANESCO within the Mafia Coconut Company compound. Here spent oils are dumped outside the perimeter fence, which then permeate the ground and flow via a small watercourse to a dried stream bed. It is likely that during the rainy seasons, the accumulated oily deposits will be washed away into the sea, which is some 500 m away.

The Tanzanian and Italian Petroleum Refining Co. Ltd (Tipper) in the Dar es Salaam region is located at Kigamboni to the south of Dar es Salaam Harbour. It receives approximately 750,000 metric tonnes of crude oil per year, which are first discharged from tankers into an offshore coupling pipeline located to the west of Inner Makatumba Island. The crude oil is processed to produce gasoline, jet fuel, Kerosene, gasoil, 100 fuel oil, bitumen and a residue. The residue is gravity separated into hydrocarbon fractions and the waste water fraction is discharged into the harbour. Oil spills from the refinery have resulted in the chronic pollution of the harbour area and the coastline around the effluent outlet. Oil spills from tankers and the TIPER refinery have also caused a noticeable degradation of mangrove cover. The Marine Biology Department of the University of Dar es Salaam studied the tanker spill in 1981 and concluded that there was an immediate mortality of sipunculids, hydroids, isopods and fish species, and that the long term effect of the oil spill resulted in a 95% mortality of a mangrove area at the entrance to the harbour within 250 days of the event. In 1986 an oil spill accident from the refinery also caused severe damage to the flora and fauna of the area. Pollution protection measures have been proposed by the NEMC.

There were no major oil pollution problems in the Lindi region. There is, however, the slight problem, of indiscriminate dumping of waste oils from garages fronting the estuary and mangrove areas and the pumping of bilges into the estuary.

Mtwara harbour is a clean deep water facility with little traffic. The risk of oil spillage still exists within the course of tankers discharging oil into the standpipe provided. The valves and pipes both showed evidence of corrosion and a leakage could result in a substantial oil spill into the harbour area, which the authorities would not be able to cope with because of the lack of necessary equipment.

In Zanzibar, submarine discharge points for refined fuel products are located at Mtoni and south of Chake Chake in Pemba. Spillages have occurred during discharge operations at both sites. These spills, coat the beaches of Mtoni during the south monsoons and mangrove forests during the north monsoons. In Pemba, mangrove forests adjacent to the discharge points have become seriously coated with oil, with some mortality now apparent. Oil pollution is also attributed to the flushing of ship tanks. A tanker in Zanzibar has been observed flushing its tanks within the harbour area.

Tables 10 and 11, annex IX, the former gives a summary of the marine products for export from the year 1976 to 1986, and the latter gives a summary of the destructive impacts on the marine environment of the different regions.

### C. EXISTING GOVERNMENTAL FRAMEWORK, INSTITUTIONS AND BILATERAL AND MULTILATERAL AID PROGRAMMES

The existing legislative, institutional and governmental structures necessary to carry out the proposed Action Plan exist. However, amendments are required to the existing legislation, institutional facilities require upgrading, new curricula must be established for training institutions and personnel must be identified to fill the proposed Coastal Resources and

Management Sections under the umbrella of the National Environment management Council (NEMC), and the Zanzibar Ministry of Marine Tourism and Forestry.

The legislation currently applicable to the coastal zone and resources includes those covering Zanzibar and Pemba (annex VIII). The existing legislation concerning the marine environment is adequate, however, it must be reviewed, updated, strengthened and where necessary rescinded when no longer applicable. This process is already being carried out in Zanzibar in terms of a newly proposed Fisheries Policy and Legislation covering all aspects of inshore and offshore fishing, including the problems of conservation, marine parks, licensing and tourism.

Geopolitically the country is divided into regions and districts, with national planning and control maintained at various ministerial headquarters. The policies are then implemented by trained officers who have a sound knowledge of the population and geography of their areas, at regional and district levels. The problems of implementation have arisen through the chronic lack of resources, and inefficient communications infrastructure, duplication of efforts and the sheer scale of operations.

The United Republic of Tanzania is well endowed with institutions whose aims are to investigate the marine environment and to provide training facilities in fisheries and supporting subjects. The existing facilities however require upgrading to make them more efficient and effective.

The Mbegani Fisheries Development Center of the Tanzanian Ministry of Natural Resources and Tourism is the only institute in the Coast region offering training facilities in fisheries related subjects (nautical science, fisheries technology, fish processing and marketing and refrigeration). The institution which is supported by the Norwegian Agency for Development (NORAD), operates three training vessels and liaises with fishermen groups at the village level and the Ministry. The possibility of diversifying the present programme to include a unit on coastal resources and management and later a certificate course for coastal resource officers, was discussed and well received. Further action and discussions will have to be undertaken within the context of the Action Plan (Section E). The Boat Building Department of the Mbegani Center expressed interest in designing an inshore surveillance vessel which could be built at Bagamoyo by boat builders trained at the department.

Within the Dar es Salaam region there are a number of government institutions, they are: the University of Dar es Salaam complex with its Kunduchi Marine Biological Station and the Institute of Marine Sciences, the Government Chemical Laboratory and the Bureau of Standards Laboratory. The Marine Biology and Botany Department and the Institute of Resource Assessment in the University of Dar es Salaam are well equipped and staffed. Between them, they are capable of preparing the necessary curricula and practical demonstration programmes needed to train coastal resource managers and officers. The Institute of Marine Sciences of the University cover the fields of expertise in fisheries, mariculture, marine chemistry, physical oceanography, ecophysiology, marine resources, marine policy and phytology and is well placed to take on a consultative role in different programmes of the proposed Action Plan. The facilities are generally run down due to lack of investment in new equipment and buildings. However, it is possible for the institute to carry out basic research programmes. The University has expressed an interest in taking part in the implementation of the Action Plan. The Government laboratories are also well equipped and are capable of carrying out most analyses. However, the Kunduchi Station is ill equipped, with most facilities out of order and run down, and is in need of complete rehabilitation. In Zanzibar the Government Technical College (Karume Technical School) can be expected to expand its curricula by adding a unit on environmental management.

There are two international aid programmes currently being carried out in the Tanga region. They are the Pangani Fisheries Training Center and the Tanga Integrated rural Development Programme.

The Pangani Fisheries Training Center runs short courses for artisanal fishermen with the aim at improving the income of artisanal fishermen, increasing fish production within their area of operation and upgrading the skills and fishing techniques of the fishermen. The programme is supported by NORAD and the Tanzania Ministry of Natural Resources. NORAD has also expressed an interest in including a programme that would stress the importance of the marine environment and the interlinkages between coastal habitats and the need to curb destructive fishing techniques. The integrated rural development programme supported by the "Deutsche Gesellschaft fuer Technische Zusammenarbeit" (GTZ) aims at enhancing the ability of the rural population to utilize their development potential.

The GTZ programme presently includes two sub-programmes mainly, the Village Development Programme (VDP) and the Polytechnic Education Support Programme (PESP).

The VDP aims at supporting measures proposed as priority projects by village communities and which are to be implemented substantially by these communities/groups. In this connection GTZ has also expressed an interest in initiating a pilot salt production unit within the context of the Action Plan (Section E), training existing pan operators.

The PESP aims at introducing agriculture as a subject in the primary schools of the Tanga region. Under PESP curricula have been prepared, teaching material produced, teachers trained and a monitoring programme within the Tanga region implemented. The GTZ has developed the infrastructure necessary to disseminate information at the school, village and governmental levels and has expressed a keen interest in participating actively in the public awareness and schools programme to be developed in accordance with the Action Plan.

An aerial inventory of Tanzania forest areas including mangroves, has been funded by NORAD and will be carried out by the Tanzanian Division of Forestry of the Ministry of Natural Resources and Tourism.

## D. FINDINGS AND RECOMMENDATIONS

### 1. PRIORITIES FOR ACTION DEFINED BY REGIONAL AND DISTRICT OFFICERS

From discussions with regional and district officers the following priorities defined by them were to:

- amend existing legislation to combat explosive fishing;
- provide vessels for coastal surveillance and control operations;
- improve the availability of fishing gear at a nominal price;
- identify the potential for fisheries diversification;
- initiate extension programmes for artisanal fishermen;
- make an inventory of mangrove resources;
- prevent unregulated mangrove cutting and enforce existing legislation;
- reduce present levels of pollution;

- identify existing pollution sources and demand that industries be responsible for rendering harmless their effluent discharge;
- identify methods of pollution control;
- conduct baseline research and resource assessment in all coastal areas;
- identify and designate marine parks and reserves in line with Government policy for expanding the tourist sectors;
- amend legislation to include a module on marine parks and management;
- develop and implement public awareness programmes.

## 2. MAJOR PROBLEMS IDENTIFIED BY THE SURVEY

The survey identified priorities that need urgent attention in order that the critical marine habitats be maintained and the resource potential of the coastal area be upgraded. These priorities which need to be addressed in the context of the recommendations and Action Plan are the:

- general lack of awareness regarding all aspects of the marine environment by the population as a whole;
- persistent destruction of coral reef areas by the collection of live coral, commercial shell collection, explosive fishing techniques, the careless use of unsuitable anchors, sedimentations, urban and industrial pollution, beach seining and trap fishing;
- unregulated deforestation of mangrove areas;
- localized loading by pollution materials;
- beach and coastal erosion;
- overfishing of all inshore fishing grounds;
- total absence of stock assessments for finfish and shellfish species of commercial importance so as not to reduce the viable reproductive population of the species, resulting from overfishing; and the
- lack of awareness of and control of gazetted marine parks and reserves.

## 3. RECOMMENDATIONS

The following recommendations on the protection, management and development of the marine and coastal environment have been derived from priorities identified by the survey. On the basis of these recommendations an Action Plan has been drawn up. Within the Action Plan the recommendations will be elaborated, defining methods of implementation.

### 3.1 Public Awareness

There is generally a low level of public awareness regarding all aspects of the coastal and marine environment in the United Republic of Tanzania. It is important that the public is made

aware of the fragility and interlinkage between the coastal habitats and resources and is kept informed of the improvements achieved under the Action Plan. It is recommended, therefore, that:

- the national level of awareness regarding the marine environment should be raised in order that the public may understand the principles of the Action Plan and where possible support it and assist in its implementation;
- the degradation of the coastal environment should be controlled and arrested by the general disapproval of a well informed public against the use of destructive fishing practices.

### 3.2 Coastal Resources

The coastal marine resources of the United Republic of Tanzania are presently not quantified. It is therefore imperative that this be done in order to have accurate baseline data so as to understand what is to be managed and upgraded. It is recommended, therefore, that:

- quantitative baseline data be collected on the current status of coastal resources of commercial importance;
- the data be used to assess and, if necessary, to vary component programmes of the Action Plan.

#### 3.2.1 Fisheries

The results of the survey have shown that much of the observed degradation of the coastal environment, both intertidal and subtidal have been attributed to destructive fishing methods both passive and active. Passive destruction has been caused by beach seining, indiscriminate trap fishing, the use of artisanal stone anchors, reef walking and small mesh size seine netting. Active destruction has been caused by explosive fishing techniques, the use of metal bars to break the coral substrate in shell collecting, collection of corals for the use as building material and the occasional use of toxic substances to immobilize fish. It is recommended, therefore, that:

- steps be taken to control the active and passive destructive fishing methods so as to increase the resource potential and catches of both commercial and artisanal fisheries, whilst ensuring the protection of critical stocks;
- with a substantial data base it will be possible to control and re-direct fishing efforts to reduce the pressure on any given stock by imposing closed seasons and limiting permissible gear.

#### 3.2.2 Mangrove Resources

In the United Republic of Tanzania mangrove forests are all classified as forest reserves. The survey showed that mangrove areas have been indiscriminately felled to clear the land for saltworks and rice production and that there has been unregulated cutting for export, personal construction needs and firewood. It is recommended, therefore, that:

- an inventory be taken of the mangrove areas and a sound management policy designed to protect the mangrove ecosystems while allowing for the continued use of the resources;
- mangrove areas be developed and increased.

#### 3.2.3 Marine Reserves

The survey identified areas of unique habitats, biological importance, commercial fisheries importance, historical importance and recreational/tourism potential. In order to protect and

maintain these marine environments which are presently being destroyed, it is recommended, that:

- identified areas be gazetted as marine reserves and multiple use management areas.

### 3.3 Pollution

The major sources of pollution identified by the survey in Tanzania including Zanzibar and Pemba, were found to be limited to the urban areas namely, Tanga, Dar es Salaam, Zanzibar, Lindi and Mtwara, with the remaining coastline not having an apparent pollution problem. It is recommended, therefore, that:

- guidelines be prepared on effluent control, standards of water quality and discharge controls in harbour areas;
- the levels of pollution be reduced in seriously affected areas and that new developments should be prevented from polluting non affected areas;
- the water quality should be improved and thereby reducing the risk to public health.
- Tanzania enter into agreements with neighbouring states regarding joint actions to be taken in the case of an international pollution emergency.

### 3.4 Government Institutions

(i) Whilst the United Republic of Tanzania appears to have an adequate number of institutions in the fields of fisheries and related subjects some, however, require rehabilitation by way of investment for the repair and replacement of equipment and the improvements of physical facilities. It is recommended, therefore, that:

- finance be mobilized for the rehabilitation of the equipment and other physical facilities of these institutions; and

(ii) Problems of co-ordinating and implementing programmes and projects have previously arisen due to the overburdening of Government infrastructure. It is recommended, therefore, that:

- a Coastal Resources and Management Section be established under the aegis of the National Environment Management Council (NEMC) and the Zanzibar Ministry of Marine Tourism and Forestry, to implement the Action Plan.

## E. ACTION PLAN FOR THE PROTECTION, MANAGEMENT AND DEVELOPMENT OF THE MARINE AND COASTAL RESOURCES OF THE UNITED REPUBLIC OF TANZANIA

### 1. INTRODUCTION

This Action Plan for the Protection, Management and Development of the Marine and Coastal Resources of the United Republic of Tanzania is based on the current status of the coastal resources, the levels of degradation of specific habitats and the existing legislation, institutional and governmental framework.

The primary goals of the National Action Plan for the United Republic of Tanzania are based on the resolution adopted by the Conference of Plenipotentiaries on the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region in Nairobi from the 17th to the 21st of June 1985. The regional Action Plan adopted at the Conference aims at

preserving critical coastal marine habitats, to raise the level of awareness of the local population regarding all aspects of the marine environment, to eliminate explosive fishing techniques and provide alternatives for destructive traditional fishing methods, to declare marine reserves and multiple use zoned management areas, to control sources of pollution and to provide the personnel and institutional framework necessary to achieve these goals.

The long term benefits of the National Action Plan for United Republic of Tanzania will be to ensure the conservation of critical coastal and marine habitats, upgrade the resource potential resulting in improved yields of the artisanal and commercial fishery sectors and the identification of areas both natural and historical which will expand the tourism potential.

The National Action Plan for the United Republic of Tanzania should be implemented simultaneously on the mainland, Zanzibar and Pemba. The separate phases of the Action Plan should be organized jointly for the mainland and Zanzibar and implemented in parallel under the co-ordination of NEMC, the proposed National Co-ordinating Center.

## 2. IDENTIFIED PRIORITIES

The results of the survey have identified priorities needing urgent attention in order that the critical marine habitats be maintained and the resource potential of the coastal zone be upgraded. The identified priorities will be dealt with below:

### 2.1 National Public Awareness Programme

A generalized low level of public awareness regarding all aspects of the coastal marine environment has been identified. It is important that this be improved in order that the proposed Action Plan has a reasonable chance of success. Through a long term saturating information dissemination system, the public can be made aware of the fragility and interlinkage of coastal habitats and resources and kept informed of the improvements resulting from the activities of the Action Plan. The Public Awareness Programme will need to:

- Develop and produce a fully illustrated information package for the use and distribution in coastal villages. The package will contain information on:

- (i) coral reefs: showing that these are living units (not rocks) of great importance to the artisanal fishery;
- (ii) mangrove forests: stressing managed cutting to maintain coastal stability, preserve breeding sites and upgrade those critical marine habitats;
- (iii) seagrass beds: stressing the importance to the artisanal fishery and the potential for village groups to diversify into algal mariculture;
- (iv) pollution: localized effects of urban pollution stressing the danger to public health;
- (v) concept of linkage: all coastal activities and habitats are linked; and
- (vi) management policy: explain the goals and objectives of the Action Plan and what benefits they are likely to gain if they work with and accept the proposed management policies.

- Organize training and information dissemination workshops for village C.C.M. (Chama Cha Mapinduzi) leaders. The C.C.M. officials are empowered to oversee all activities within the village, organize meetings and political activities, and liaise with the district and regional governments. As such they are well placed to deliver information packages and advice to village groups, and to organize discussion seminars between the groups and district extension officers;



- Organize training and information dissemination workshops for district and regional natural resources personnel. The workshops will inform the public on all aspects of the coastal marine environment stressing the goals of the Action Plan. These workshops will introduce the Action Plan to existing field officers while gaining useful feedback regarding the problems of implementation in each district;
- Produce poster and display material for all tourist facilities. This will include an information pamphlet given to all visitors, which will describe the marine environment and the objectives of the Action Plan;
- Broadcast a regular radio programme on the problems of the coastal zone, applicable human interest stories and the progress attained by the Action Plan;
- Produce and broadcast a documentary for Zanzibar Television (there is no television broadcasting on the Tanzania mainland). This documentary should cover all the points noted for the information package and include visual descriptions of non destructive fishing methods. The documentary can be copied onto video cassettes and shown by mobile units to village groups;
- Introduce into school curricula (both primary and secondary) a unit on basic marine science, the principles of environmental management and practical demonstrations of non destructive fishing and anchoring methods to pupils in coastal areas; and
- Encourage the establishment of a National Non Governmental Organization which will assist in raising public awareness and independently deal with specific problems of interest related to it. The NGO can be given limited material support within the terms of the Action Plan.

## 2.2 Inventory of Coastal Resources

The coastal marine resources of the United Republic of Tanzania are presently not quantified. It is imperative that an inventory programme be initiated to provide a current quantified global resource assessment. The results will then be the resource baseline data from which the success of the Action Plan can be assessed. It is important to have accurate baseline data to understand what it is one is attempting to manage and upgrade. The inventory programme will:

- Carry out a quantitative inventory of all coral reef areas within the territorial waters of the United Republic of Tanzania. The inventory will include an assessment of the levels of degradation and identify coral reefs suitable for gazetting as marine protected areas based on their uniqueness, genetic diversity and current state. These coral reefs will then provide the genetic reserves for the re-colonization of damaged areas;
- Carry out a quantitative survey and inventory of current mangrove forest areas. Available data is now out of date, current baseline data is required to assess the standing crop, the degree of regeneration and to identify areas of unique biological importance. Identified areas will be zoned as closed forest areas, and no cutting will be permitted. The existing legislation should be amended to this end;
- Carry out an inventory of other critical coastal and marine habitats requiring special action. These will include sand dune areas, beaches, intertidal sand and mud flats, algal and seagrass beds, coastal shrubland, coastal grassland, nesting and breeding sites;
- Initiate a complete stock assessment for all commercially important finfish and shellfish species, and to maintain a catalogue of pelagic and reef associated fish and shellfish fauna in order that changes in the standing stock can be assessed relative to those environmental and human influences acting on them; and

- Survey and record the oceanographic conditions, both physical and chemical, influencing the coastal zone of the United Republic of Tanzania. The survey will identify current patterns, sources and transport of terrigenous substances and sediments, the levels of siltation, and the chemical characteristics of the water masses. This information will assist managers in defining reserve areas, to control sediment sources, to study the movement of larvae, and assess the regenerative potential of a given damaged area relative to distance and current patterns from a genetic source.

### 2.2.1 Fisheries

Much of the observed degradation of the coastal environment, both intertidal and subtidal, have been caused by destructive fishing methods, be they passive or active. Passive destruction is caused by beach seining, indiscriminate trap fishing, anchoring, using artisanal stone anchors, reef walking and seine netting using nets of small mesh sizes. Active destruction is caused by explosive fishing, shell collecting using metal bars to break the coral substrate, collection of corals for use as building materials and the occasional use of toxic substances to immobilize fish. In combination with the public awareness programme, the fisheries programme will:

- Provide field workshops and demonstrations for regional and district fisheries and natural resources officers. These workshops will aim to:

- (i) demonstrate the effect of destructive fishing practices and suggest alternative methods which can be presented to fishermen groups. Alternative fishing methods may include the placement of moorings on the fore-reef slope to make available currently underutilized reef associated fish stocks, while relieving the pressure on the damaged and overfished reef flat areas;
- (ii) encourage net fishing for pelagic species;
- (iii) identify new species such as Alcyonarians (soft corals) which may have geological or medical importance, and develop harvesting procedures;
- (iv) diversify the current fishery industry and encourage the development of small scale artisanal mariculture projects (Euchema, mangrove crabs, oysters, prawns);
- (v) demonstrate by direct observation the difference between coral reefs damaged by explosives fishing and undamaged reefs;
- (vi) introduce the goals of the Action Plan and specify the responsibilities of the regional and district officers;
- (vii) instruct village groups using prepared audio-visual packages; and
- (viii) introduce the concept of zoned management.

- Co-operate with commercial operators to establish a stock assessment programme for currently exploited stocks. Using simple length frequency measurements on representative sub-samples of the landed stock and currently available computer programme modules (FAO), an assessment of stocks can be carried out. The results will then be used to manage the fishery industry effectively to ensure sustainable yields. The programme can then be extended to include inshore stocks currently exploited by artisanal fishermen;

- Quantify the catch rates and efficiency of fishing gear currently being used and assess the damage caused by these to subtidal habitats. The results of this investigation will encourage the selection of non destructive fishing methods suited to the needs of the fishermen;

- Make available selected fishing gear at a nominal cost for a fixed period of time. The time factor will be decided by the National Co-ordinating Center in consultation with the Fisheries Division of the Ministries on the mainland and Zanzibar. This period should not be less than 5 years;

- Make an attempt to eradicate explosive fishing practices through a combined legal and public awareness programme;

- Carefully evaluate and, where required, amend existing legislation. The policy should be one of lenient enforcement initially, followed by penalties of increasing magnitude for repeated offenders;

- Identify and strictly control the availability of the sources of commercial explosives. A possible measure could be to designate a national body which would be responsible for all blasting operations and the stockpiling of explosive material;

- Quantify the use of artisanal explosives and implement strict control on key raw materials (i.e. glycerin);

- Control and manage the trade in marine curios (seashells, turtles shells) to ensure sustainable yields. The trade in turtle products should be stopped as is stipulated in the existing legislation;

- Identify areas specified for shell collection during the coastal resource inventory which should be rotated at fixed intervals depending on the life histories of the primary genera collected at each designated site;

- Control licences issued to shell exporters and shell collectors. The licences issued each year must specify which areas are open for collection and prohibit collection in unspecified areas. Offenders would be liable to lose their licences for a fixed initial period, repeated offenders would not be reissued with licences;

- Prohibit the collection of live corals for use as building materials and identify alternative aggregate sources;

- Prohibit seine nets of small mesh size currently used for beach seining. These nets are indiscriminately removing juvenile fish species (i.e. Carangidae) from nursery areas in seagrass beds and inshore coastal areas;

- Initiate discussions among the countries in the region so that they may come to an understanding regarding their various Fisheries policies, and how they can be applied to control the movement of artisanal fishermen across international borders. This point was highlighted by the arrest of 17 Zanzibar fishermen in Kenyan waters in November 1987;

- Encourage the establishment of an anchor factory producing a simple fisherman type anchor using readily available scrap metal. Once in operation, the small factory unit will initially produce enough anchors to replace all existing stone anchors. The first anchor would be provided free of charge to each fisherman, replacements would be purchased at a nominal cost. Once each fisherman has been issued with a replacement anchor an amendment to the existing legislation would be passed prohibiting the use of stone anchors; and

- Initiate, in association with the Mbegani Fisheries Development Center and the Pangani Fisheries Training Centre, a course on Coastal Resource Management, leading later to the development of a certificate level course.

### 2.2.2 Mangrove Resources

Mangrove forests are all classed as closed forest areas in the United Republic of Tanzania. However, the survey revealed that these mangrove forests are being indiscriminately felled to clear land for salt works and rice production. In addition, there is unregulated cutting for an export trade, for personal construction needs and firewood. The Mangrove Forest Management Programme will need to:

- Inventory all current mangrove forest stands, recording cover, species, diversity and regeneration as well as conflicting land uses;
- Zone existing mangrove areas for salt work developments and felling operations while maintaining the integrity of the ecosystem;
- Develop a programme whereby cutting is rotated at fixed intervals to allow for recovery and resettlement;
- Designate unique and biologically important areas as strict mangrove forest reserves; and
- Produce an information package to be used in the Public Awareness Programme to make the population aware of the biological importance of mangrove resources and explain the management programme.

### 2.2.3 Marine Reserves and Multiple Use Managed Areas

The coastal survey has identified areas requiring gazetting as marine reserves and multiple use managed areas. The selection of these have been based on the uniqueness of the habitats, biological importance, commercial fisheries importance, historical importance and recreational/tourism potential. The proposed areas identified are listed below (Figure 2 a, b, 17 a, b, c, annex X).

#### Tanzania Mainland Coast

- (i) Mbegani Marine Protected Area - to extend from Ras Mbegani to a point south of Kitapumbe Reefs (06° 34S; 39° 07E). The area will include the unique dune formations fronting Ras Mbegani, the mangrove forests and islands in Mbegani Bay and the coastal banks, islands and reefs. To seaward the protected area will extend to the 10 fathom depth contour thereby including the Kitapumbe Reefs and Mohingwi Reef (Figure 17 a, annex X).
- (ii) Ras Buyuni Marine Protected Area - to extend from Ras Kunzi to the north to Ras Pembannasi to the south and include all the reefs, bays, beaches and mangrove forests contained by the 100 fathom line to seaward and 1,000 meters inland (Figure 17 b, annex X).
- (iii) Extension to the Chole Bay - Tutia Reef Marine Reserve - to include all the reefs contained in the area bounded on the south by a line drawn from the southernmost tip of Tutia Reef to the westernmost tip of Buejuu Island and to the north by the southern coast of Mafia Island (Figure 17b, annex X)
- (iv) A multiple use zoned management area bounded on the north by a line drawn from Samanga to the northernmost tip of the reef at Okuza Island to the 100 fathom line, then southwards along the 100 fathom line to a point parallel to the southernmost tip of Songo Manara, then north along the coast to Samanga. The area will be zoned as follows (Figure 17 b, annex X):

- Industrial and residential: Kilwa Masoko - Songo Songo
  - Marine reserves: Okuza Isla., Myuni Isl., Fanjove Isl., Kilwa Harbour, Cape Kilwa, Albamarle spit, Rukya spit.
- (v) The Lindi Marine Reserve located north of Lindi Bay from Ras Banura in the south ( $09^{\circ} 41'S$ ;  $39^{\circ} 45'E$ ) to the north of Mchinga Bay. The seaward limit will be the 100 fathom line and landward all that area contained by a line 1,000 meters parallel to the coast. The reserve will contain both Banura and Mchinga Bays, their mangrove forests and all reef formations between them (Figure 17 c, annex X).
- (vi) The Mtwara/Ruvuma Marine Reserve - to extend from Ras Msanganku to the north, and the international border with Mozambique to the south and extending to seaward to the 100 fathom line. All that area contained by these limits and a line drawn 1,000 m inland parallel to the shore (high water line) including all the reefs and islands and the northern Ruvuma estuarine and mangrove complex (Figure 17 c, annex X).

#### Zanzibar - Pemba - Latham Island

- (i) The island situated 28.5 nm from Ras Mdege ( $06^{\circ} 50'S$ ;  $39^{\circ} 50'E$ ) should be classed as a strict reserve with no access to the island permitted. The reserve area should extend to the 100 fathom line in all directions (Figure 17 a, annex X). Latham Island Strict Marine Reserve is of international importance as a migratory seabird nesting site with the Greater Crested Tern (*Sterna bergii*), the Masked Booby (*Sula dactylatra*), the Brown Noddy (*Anous stolidus*), Gannets and Sooty Terns (*Sterna fuscata*) breeding regularly (Cooper et al. 1984). The island is also a turtle nesting site.
- (ii) Zanzibar Reef and Islands Marine Park and Multiple Use Management Area - to extend from the southernmost tip of Mwamba Chumbe south of Chumbe Island ( $06^{\circ} 18'30"S$ ;  $39^{\circ} 12'10"E$ ) with the southern limits to be a line drawn from that point to the midpoint between Mwamba Chumbe and Ukombe Island. From that point the eastern limit will be a line drawn north westwards ( $32^{\circ}$ ) to a point  $06^{\circ} 10'30"S$ ;  $39^{\circ} 08'20"E$ . From this point a limiting line ( $061^{\circ}$ ) is drawn to the easternmost point of the Chapani Island reef at the shipping channel at the 5 fathom contour line. The northern limits of the reserve area follows the 5 fathom contour to the northernmost tip of Changu Reef, then across the northernmost tip of Danzi Reef at the 10 fathom contour, the western boundary following the 10 fathom contour to the southernmost point of Bawi Reef; across to the north-western tip of Murogo reef at the 10 fathom line, southwards to include Nyange Reef and Pwakuu Reef and from the south-eastern most point of Pwakuu Reef ( $06^{\circ} 15'30"$ ;  $39^{\circ} 06'38"$ ) then joining the starting point by a line at  $120^{\circ}$ . Within this management area the Nyange and Murogo Reefs contained by the 10 fathom line should be declared a marine park and marked accordingly (Figure 2 b, annex X).
- (iii) Mnemba Island Marine Reserve - to include the Island of Mnemba on the north-east coast of Zanzibar and the Zanzibar coast fronting it to the west. The reserve area as shown in Figure 2 b, annex X, would include that area contained by a line to the north of Zanzibar at the point  $05^{\circ} 45'S$ ;  $39^{\circ} 21'30"E$  at  $090^{\circ}$  to the 100 fathom line, then south along the 100 fathom line to the intersection of a  $090^{\circ}$  line drawn from point  $05^{\circ} 50'S$ ;  $39^{\circ} 21'E$ . This reserve area will contain the island of Mnemba, its reef formation, a 6 nm section of the reef fringing the eastern coast of Zanzibar Island, the lagoon and back reef formations to a line drawn 500 m from the high water springs level.
- (iv) Mesali Island Reserve and Marine Park - Pemba - The island situated at  $05^{\circ} 15'S$ ;  $39^{\circ} 36'E$  would be included in the proposed park whose outer limits would be the 100 fathom line to seaward and the 10 fathom line to the north, south and east of the island

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- (ii) Zanzibar Reef and Islands Marine Park and Multiple Use Management Area - to extend from the southernmost tip of Mwamba Chumbe south of Chumbe Island ( $06^{\circ} 10'30"S$ ;  $39^{\circ} 12'10"E$ ) with the southern limits to be a line drawn from that point to the midpoint between Mwamba Chumbe and Ukombe Island. From that point the eastern limit will be a line drawn north westwards ( $32^{\circ}$ ) to a point  $06^{\circ} 10'30"S$ ;  $39^{\circ} 08'20"E$ . From this point a limiting line ( $061^{\circ}$ ) is drawn to the easternmost point of the Chapani Island reef at the shipping channel at the 5 fathom contour line. The northern limits of the reserve area follows the 5 fathom contour to the northernmost tip of Changu Reef, then across the northernmost tip of Danzi Reef at the 10 fathom contour, the western boundary following the 10 fathom contour to the southernmost point of Bawi Reef; across to the north-western tip of Murogo reef at the 10 fathom line, southwards to include Nyange Reef and Pwakuu Reef and from the south-eastern most point of Pwakuu Reef ( $06^{\circ} 15'30"$ ;  $39^{\circ} 06'38"$ ) then joining the starting point by a line at  $120^{\circ}$ . Within this management area the Nyange and Murogo Reefs contained by the 10 fathom line should be declared a marine park and marked accordingly (Figure 2 b, annex X).
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- (v) Mtangani Marine Reserve - The inlet at Mtangani and the fringing reef formation to seaward are proposed as a marine reserve. The reserves northern limit is on the coast of Pemba (05° 23'S, 39° 49'E) and a line from that point at 090° to the 100 fathom line. Southwards along the 100 fathom line to intersect with a line drawn at 090° from the point 05° 27'S; 39° 47'E and along the coast to join the first point. All that land 500 m from the high water springs line will also be included in the reserve area (Figure 2 a, annex X).

The proposed parks, reserves and management areas all represent unique or biologically diverse habitats identified during the course of the survey. The suggested limits to each reserve area may be extended or reduced pending the results of the proposed quantitative inventory of resources. But these areas may already be declared with the view of maintaining these critical habitats.

### 2.3. Pollution Control Programme

The survey has identified the major sources of pollution in Tanzania including Zanzibar and Pemba and has found that pollution is limited to urban areas namely Tanga, Dar es Salaam, Zanzibar, Lindi and Mtwara. The remaining coastline does not have an apparent pollution problem.

The transport of crude oil to the TIPER Refinery in Dar es Salaam and refined products to Zanzibar, Pemba, Tanga and Mtwara through difficult waters poses a serious potential threat to coastal ecosystems and there are no contingencies to deal with such an event. The Pollution Control Programme will need to:

- Inventory all sources of pollution which either directly or indirectly impinge on the coastal zone;
- Supply cleaning and dispersing facilities, training and spare parts to the harbours of Tanga, Pemba, Zanzibar, Lindi, Kilwa and Mtwara for use in the event of an oil spill;
- Introduce primary sewage treatment facilities in all major urban areas to render effluents harmless, reducing the current public health risk;
- Update all legislation dealing with the discharge of noxious substances and to make companies responsible for their effluents;
- Create a consultative unit at NEMC which will be responsible for the assessment of existing and future developments and which will advise existing companies and Regional Councils on possible treatment alternatives;
- Enter into discussions with neighbouring states to develop joint programmes to combat transnational effluents and pollutants and to adopt compatible contingency plans; and
- Produce an information package to be used in the Public Awareness Programme.

### 2.4 National Co-ordinating Centre

The National Environment Management Council (NEMC) having already undertaken a practical inventory of polluting industries and sources of pollution and being directly involved in the preparation and planning of the consultations leading to this report is proposed as the National Co-ordinating Unit in all matters concerned with the Action Plan. Its role will be to:

- (i) recruit, train and maintain the programmes staffing requirements;



- (ii) seek funding for the specific programmes outlined in the Action Plan and manage these funds accordingly;
- (iii) encourage existing national institutions to develop curricula to meet the increased staffing requirements of the developing programme;
- (iv) liaise with ministries to produce a co-ordinated effort to the ends defined in the Action Plan;
- (v) nominate and preside over an evaluating committee and to transmit the evaluations and recommendations to the field units;
- (vi) assess all new developments likely to have an impact on the coastal zone and demand an impact assessment statement prior to development if deemed necessary;
- (vii) produce and disseminate guidelines for all activities and developments affecting or utilizing the coastal zone and its resource base;
- (viii) commission new legislation to ensure the maintenance of critical habitats and ecosystems and any species considered to be or listed as endangered; and
- (ix) carry out any such duties as may be required of it to assist the successful implementation of the Action Plan.

#### 2.4.1 Personnel

Since existing natural resources, fisheries and forestry personnel of the Ministry of Natural Resources and Tourism on the Mainland and The Ministry of Marine, Tourism and Forestry in Zanzibar and Pemba are fully occupied with their present duties, it was recommended that a new division be established, namely the Division of Coastal Resources and Management. The division will be either under the control of the two respective ministries already noted or under the umbrella of the National Environment Management Council.

The staffing of the division would be a gradual process depending on the progress and requirements of the Action Plan. Selected personnel would be given the necessary training prior to employment through the successful completion of theoretical and practical material given at post graduate, graduate diploma and certificate levels by the University of Dar es Salaam, the Kunduchi Marine Biological Station, the Mbeganj Fisheries Development Center and the Pangani Fisheries Training Center. When fully staffed by the year 2000 the division should have 81 employees in the United Republic of Tanzania. The personnel structure is shown in Table 12, annex IX.

During the initial phases of the Action Plan staffing can consist of two coastal resources officers, two coastal resources extension officers, two surveillance and protection units and two maintenance units (14 people). During the planning phases all that is required is a coastal resources officer and one assistant.

#### Expatriate Staff and Consultants

Both Tanzania and Zanzibar have suitably qualified new graduates who could take over the position of coastal resources officers who would be working in association with two expatriate officers. The role of the expatriates will be to train their counterparts, participate in the planning phases, co-ordinate and oversee the implementation of the Action Plan.

The expatriates would engage short term consultants (1 to 3 months) who would initiate programmes and train local personnel. Each consultant would have yearly return consultancies to

assess progress and institute programme changes where necessary. The full time expatriate staff would no longer be required once the minimum agreed training and staffing requirements of the management plan are met.

## 2.5 Implementation

Problems of implementation have previously arisen through the chronic lack of resources, inefficient communication, surveillance, duplication of effort and infrastructure and the sheer scale of operation. It is recommended, therefore, that:

- an effective coastal surveillance unit be established to discourage the use of explosive and illegal fishing techniques;

- the role of the surveillance unit be expanded to one similar to that of the game wardens in terrestrial national parks.

- it is desirable that the Action Plan should be implemented within a way of a Pilot Management Zone. In this regard it is recommended that:

- the Pilot Management Zone should cover the coastal zone of the Tanga region and the islands of Zanzibar, Pemba and Latham.

### 2.5.1 Surveillance

The survey has shown that mobile surveillance teams could be an effective deterrent to fishermen using destructive techniques. The presence of fishery division personnel on board the survey vessel was seen to prevent the use of explosives in the areas visited. A surveillance vessel was one of the priorities given in all regions and districts including Zanzibar and Pemba. The Surveillance Management Programme will need to:

- Initiate the designing of a surveillance vessel of approximately 6 to 10 meters in length with a shallow draught, a planing hull and good seagoing qualities. Each region would then nominate a boat-building team and construct the vessel under supervision using supplied materials. Once completed the vessel would be supplied with twin outboard motors of 40 to 70 Hp (with spare parts) capable of running on both petrol and kerosene. By operating in this way, each region has an interest and an investment in the programme and should ensure that the vessels are properly maintained. Maintenance would be the responsibility of the boat-builder.

- Initiate the training of surveillance personnel through a rigorous training programme stressing enforcement policies, the basics of environmental management and their role in the context to the Action Plan. The duties of the surveillance teams would be to:

- (i) uphold existing legislation and regulations, combat explosives fishing, check licences, inspect catches and control fishing gear; and

- (ii) act as Marine Park Wardens regulating access to and the use of declared parks, reserves and exclusion zones.

### 2.5.2 Implementation of a Pilot Management Zone

To implement the different programmes of the Action Plan on a national scale would be totally untenable given the current low levels of public awareness and national preparedness to execute them. The proposal was therefore made to implement the Action Plan on a Pilot Management Zone to include the coastal zone of the Tanga region and the islands of Zanzibar, Pemba and Latham. Each phase will be assessed by a central committee nominated by the National

programme to achieve the expected goals. After an initial 'trial' period of the Pilot Management Zone each phase will be introduced on a national scale as shown in Table 13, annex IX.

The selection of the Pilot Area is based on:

- (i) the level of current destruction;
- (ii) the existence of undamaged marine environments in Zanzibar and Pemba;
- (iii) the uniqueness of contained marine environments;
- (iv) the artisanal fishing pressure;
- (v) the willingness of Tanga regional officials and ministry officials in Zanzibar to actively participate and encourage the development of the programmes;
- (vi) the conditions of the marine habitats in Zanzibar and Pemba which can be used as controls to assess the effectiveness of the separate programmes comprising the Action Plan; and
- (vii) the existence in the Tanga region of the Pangani Fisheries Training Center supported by NORAD, and the Tanga Integrated Rural Development Programme (TIRDEP) supported by GTZ having already developed an infrastructural base for training and education.

The implementation of the programmes in the Pilot Management Zone will be as follows:

- Following the planning of the programme and the recruitment of personnel, the phases of the Action Plan would be implemented sequentially beginning with the Public Awareness Programme and the training workshops for fisheries and surveillance officers. The inventory Programme will be implemented at the same time and data collected would be used to define specific actions and produce management directives;

- The construction of the proposed anchor factory can begin at an early stage and become operational upon completion. The programme of anchor replacements can be initiated as production begins to accumulate. By this time the fishing community would have received information regarding the planned prohibition of stone anchors;

- Marine parks and reserves in the Pilot Management Zone can be gazetted at an early stage. In Zanzibar the necessary legislation must first be enacted. This is currently being done through the proposed inclusions to the proposed Zanzibar Fisheries Legislation;

- The personnel requirements during the first 4 to 5 years will be the recruitment of two coastal resource management officers, two assistants, two boat-building teams and subsequently two maintenance teams. This core will work with an expatriate for an initial period. The expatriate will also be responsible for field co-ordination and implementation of the programme phases and liaising with the National Co-ordinating Center; and

- The policy of the programme regarding the expatriate staff and short terms consultants will be on an advisory capacity. Field decisions and the implementation of the Action Plan will be the responsibility of the Tanzanian staff.

#### REFERENCES

- Africa Pilot (1980). South and East Coasts of Africa from Cape Agulhas to Ras Binnah including the Islands of Zanzibar and Pemba. Volume 3 13th Edition. Hydrographer of the Navy.
- Atlas of Tanzania Second Edition (1976). Government of the United Republic of Tanzania, Survey and Mapping Division, Ministry of Lands, Housing and Urban Development, Dar es Salaam, Tanzania.
- Bryceson, I. (1978). Tanzanian Coral Reefs at Risk, New Scientist.
- Bryceson, I. (1982). Pollution of Dar es Salaam Waters by Industrial and Domestic Effluents. Workshops of the Current State of Development of Marine Sciences in Tanzania, April 1982.
- Cooper, J., Williams, A. J. and Britton, P.G. (1984). Distribution, Population Zones and Conservation of Breeding Seabirds in the Afrotropical Region. In: Croxall, J.P., Evans, P.G.H.,
- Christy, L.C. (1979). United Republic of Tanzania: Fisheries Legislation in Zanzibar. FAO - Technical Report Indian Ocean Programme 24.
- Crossland, C. (1902). Coral Reef of Pemba Island and the East African Mainland. Cambridge Phil. Proc. XII, pages 36 to 43.
- FAO/UNEP (1983). Legal Aspects of Protecting and Managing the Marine and Coastal Environment of the East African Region, UNEP Regional Seas Reports and Studies No. 38.
- FAO/UNEP (1984). Legal Aspects of Managing the Marine and Coastal Environment of the East African Region. National Reports UNEP, Regional Seas Reports and Studies No. 49, pages 133 - 163.
- Hamilton, H.G.H. and Brakel, W. (1984). Structure and Fauna of East African Reefs. Bulletin of Marine Sciences 34(2), pages 248 to 266.
- Harvey, J. (1977). Some Aspects of the Hydrography of the Waters off the Coast of Tanzania. A contribution to CINCWIO. University Science Journal (Dar es Salaam, University No. 3 (Vol. 1,2) pages 53 - 92.
- IMO (1982). Tanzania National Seminar on Marine Pollution Prevention, Control and Response.
- IMO/UNEP (1985). Oil spills and Shoreline Clean-up on the Coasts of the Eastern African Region. UNEP Regional Seas Reports and Studies No. 57.
- IUCN/UNEP (1984). Marine and Coastal Conservation in the East African Region. UNEP Regional Seas Reports and studies No. 39, pages 51 - 234.
- IUCN/UNEP (1985). Management and Conservation of Renewable Marine Resources in the Indian Ocean Region. Overview. UNEP Regional Seas Reports and Studies No. 60.
- IUCN/UNEP (1985). Management and Conservation of Renewable Marine Resources in the Eastern African Region. UNEP Regional Seas Reports and Studies No. 66.
- Lann, H. and Mbaggi, Y. (1986). The Rivers, Msimbazi, Dar es Salaam. Investigation of the Water Quality and Discharges of Waste Water into the River and its Tributaries (1984 - 1986). Ministry of Land, Water, Housing and Urban Development - Environmental Protection and Management Section.
- Ministry of Communications and Works, (1984). A National Marine Oil Spill Contingency Plan for Tanzania (Restricted).

- Ministry of Land, Natural Resources and tourism. (1984). Investigation of the Coliform Bacteria in Dar es Salaam Waters.
- Newell, B.S., (1957). A Preliminary Survey of the Hydrography of the British East African Coastal Waters. Fisheries Publications of the Colonial Office 9.
- Newell, B.S., (1959). The Hydrography of the British East African Coastal Waters, Part II. Fisheries Publications of the Colonial Office 9.
- Rahmatullah, Khan. (1982). Fisheries Legislation in Zanzibar (Third Report) FAO Regional Fisheries Law Advisory Programme (FL/IOB/82/7).
- Salm, R.V.; Clark, F.R. (1984). Marine and Coastal Protected Areas. A guide for Planners and Managers. IUCN Press, Geneva.
- Schreiber, W. (Eds) Status and Conservation of the Worlds Seabirds. ICBP Technical Publication No. 2 Cambridge.
- UN/UNESCO/UNEP (1982). Marine and Coastal Area Development in the East African Region. UNEP Regional Seas Reports and Studies No. 6.
- UNIDO/UNEP (1982). Industrial Sources of Marine and Coastal Pollution in the East African Region. UNEP Reports and Studies No. 7.
- UNEP (1982). Marine Pollution in the East African Region. UNEP Regional Seas Reports and Studies No. 8.
- UNEP (1982). Environmental Problems of the East African Region. UNEP Regional Seas Reports and Studies No. 12.
- UNEP (1984). Socio-Economic Activities that may have an Impact on the Marine and Coastal Environment of the East African Region. UNEP Regional Seas Reports and Studies No. 41.
- UNEP (1985). Action Plan for the Protection Management and Development of the Marine and Coastal Environment of the Eastern African Region. UNEP Regional Seas Reports and Studies, No. 61.

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UNITED NATIONS ENVIRONMENT PROGRAMME

*Coastal and marine  
environmental problems of  
the United Republic of Tanzania*

*UNEP Regional Seas Reports and Studies No.106*

*Annexes*

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UNEP 1989

## PREFACE

The Government of the United Republic of Tanzania approached UNEP in late 1987 with a request for assistance in assessing the coastal and marine environmental problems of the country and in drawing up a national action plan for the protection, management and development of its marine and coastal environment.

In response to this request, and in close co-operation with the Tanzanian National Environmental Management Council (NEMC), a mission was organized by UNEP. The terms of reference of the mission was to:

- review the status of the United Republic of Tanzania's capabilities in the field of marine sciences including the identification and description of national institutions engaged in marine science and pollution studies;
- survey coastal and marine living resources;
- identify species, habitats and ecosystems that may require protection in order to:
  - (i) maintain essential ecological processes and life supporting systems and the preservation of genetic diversity;
  - (ii) ensure the sustainable utilization of living resources;
- identify possible sites for the establishment or improved management of specially protected areas such as marine parks and reserves;
- identify major sources of marine and coastal pollution and assess the present levels of marine pollution in the coastal areas including identification of changes in the environment that may be ascribed to pollution; and
- make an inventory of major ongoing and planned development activities which have or may have an impact on the quality of the coastal and marine environment.

The surveys were undertaken in late 1987. They were carried out in consultation with local experts, to ensure that proper consideration was given to local, regional and national problems and priorities in the drafting of the National Action Plan.

The report consists of a summary describing specific coastal and marine environmental problems of the United Republic of Tanzania such as, coral reef destruction, mangrove cutting, fisheries over-exploitation and unnecessary intrusion in and disturbance of marine reserves. This summary is based on six sections on various regions of the United Republic of Tanzania, with their findings and recommendations; and of a proposed Action Plan for the protection, management and development of the marine and coastal environment of the United Republic of Tanzania, developed in the context of the regional Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region.

Dr. M. Pearson (Institute of Marine Science in Zanzibar) carried out the surveys and wrote the six sections of the report. Mr. P.K. Akiwumi prepared the consolidated report. The assistance of the national authorities and counterparts of the United Republic of Tanzania is gratefully acknowledged.

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## INTRODUCTION

The Tanga region (Figure 1, annex X) extends from the Kenya border to a point just north of Mligasi River. In addition to the Mligasi River, the coastal area receives the Msungasi, Pangani and Sigo Rivers, these originating from two watersheds; the Pangani and Wami draining a combined 101,643 km<sup>2</sup> (Figure 5, annex X). The Wami River though draining into the sea south of the regional demarcation influences the coastal ecosystems of the Tanga region due to a continuous northerly flowing current of 1/2 to 4 knots depending on seasonal factors and climatic conditions. The coastal zone is much indented, having a complex system of bays and islands to the north and a partial barrier of reefs and islands from 1-5 nm offshore extending just south of Pangani.

There are two urban centres, Tanga, the regional headquarters and Pangani, a small fishing and agricultural centre.

The survey of the Tanga region included a representative sample of all marine environments and the urban area including an assessment of industrial development on the coastal zone. The information presented below is a digest of observations and the result of discussions with regional officers.

## 1. MARINE ENVIRONMENTS

### 1.1 CORAL REEFS

Coral reefs and fringing reefs around offshore islands were observed and their conditions assessed. These included from north to south: Boma Reef, Mwamba Shundo, Mwamba Wamba, Fungu Nyama, Niule Reef, Yambe Island, Karange Island and Fungu Tongone.

#### (a) Boma Reef

A reef situated 0.45 nm off Boma Peninsula. A large drying section with a sand bank, and a channel between the reef and the mainland with a minimum depth of 7m is exposed at low water spring. The sand bank spreads towards the mainland coast, indicating that current flow is stronger to seaward, in a northwesterly direction. During the period of observation, the visibility was approximately 6m and the sea calm.

#### Status

During the survey, 19 coral genera were observed, the dominant species being the Acropora spp. and Galaxea spp. with the main frame building corals being Favia spp., Porites spp., Pavona spp., and Galaxea spp.. Observed coral cover was 15% with little evidence of juvenile specimens, when seen, these were predominantly Pocillopora spp.

#### Impacts

The area has been severely damaged by dynamite, this is evident by the presence of fractured massive frame building coral colonies, craters and rubble patterns. In addition, the damage has been exacerbated by anchoring techniques employed by artisanal fishermen. Fishermen using anchors carved from limestone (pleistocene coral reef) crush and drag coral colonies when anchoring over their fishing grounds. As the anchors drag over the coral substrate, they push coral rubble before them. This then falls down the fore reef slope, damaging deeper corals which would otherwise be immune to the immediate effects of explosive fishing. Further impacts may be

due to storm damage and reef walking by fishermen at low tide. The latter is a common practice on all Tanzanian reefs and tidal flats and constitutes an important element of the artisanal fishery, for molluscs and octopus. (Table 13, annex IX).

#### Potential for recovery

With efficient control measures, recovery is possible given the presence of good substrate for attachment and the existence of juvenile colonies.

#### (b) Mwamba Shundo

Mwamba Shundo is a coral reef lying 6 nm offshore within the 100 fathom line which lies 0.5 nm to seaward.

#### Status

The coral reef is 2.5 nm long and 0.4 to 1.2 nm wide. The area observed was 1.0 nm from the southern tip. The structure consists of a narrow fringe of coral, forming a reef flat that does not dry during spring tides but has a minimum depth of less than 1 m. Towards the west off-lying patch reefs 10 to 20 m in depth rise to a maximum depth of 1 m at low water springs. There is a slope of 35° to 45° to the west which starts at the 10 m depth contour.

#### Impacts

The reef shows evidence of dynamite damage but has also been subject to storm surge damage. It is possible that through the use of dynamite, the structure of the reef has been altered and that damage due to storm surge is increased due to the movement of fractured colonies that then impact attached living colonies. The back reef slope was covered by calcareous algal rubble. Close observation did not reveal any coral cover. It was surmised that these may in effect be separate calcareous algal units that tumble during heavy weather conditions and hence do not adhere to each other. This surface having no visible cementation was judged unsuitable for coral attachment. The reef crest had previously been colonized by massive colonies but has since been colonized by encrusting growth forms. The main frame building genera seen were Porites spp., Pavona spp., Favia spp. and Montastrea spp., but few living specimens remain. During the survey 19 genera were observed, of these the Acropora spp. and Galaxea spp. were dominant. Maximum cover was 20% in 3,000 m<sup>2</sup> observed.

#### Potential for recovery

This reef is located some distance from the inshore coastal fishing grounds but is subject to severe storm conditions during both the north and south monsoons. With the present use and pressures on the reef, the prospects for recovery are slight.

#### (c) Mwamba Wamba

Mwamba Wamba is one of the designated reefs that form part of the proposed Tanga Coral Gardens Marine Reserve. It is a large reef and only the southwestern section consists of a fore reef area. Reef crest and back reefs were observed. The fore reef consisted of a climax of Galaxea spp. stands interspersed with Pavona spp., Porites spp., Favia spp. and associated species. There is a sharp drop from the reef crest to a sandplain at 10 m, and several patch reefs of similar structure were seen to seaward of the principal reef formations. The back reef, also previously covered primarily by Galaxea spp., extends for approximately 0.1 nm.

### Status

Nine coral genera were observed on the fore reef area none of which occurred in large numbers to be considered dominant. On the reef flat and back reef area the same situation existed, but 17 genera were seen to be represented. Coral cover was less than 5% on the fore reef slope and between 5 to 10% on the reef flat and back reef areas.

### Impacts

The entire area surveyed has been severely damaged by explosive fishing and by artisanal anchors. Primary damage has been due to explosive fishing, consequently movement of columnar rubble from damaged Galaxea spp. colonies by stone anchors has caused damage to the entire fore reef slope. It is also possible that Acanthaster planci (Crown of Thorns Starfish) may have been present in large numbers, and this may have contributed to the observed mortality. During the survey seven specimens of Acanthaster were seen, a larger number than on any other coral reef surveyed in Tanzania. It has been reported that localized population explosions of Acanthaster have occurred in Zanzibar, the most recent being in 1979.

### Potential for recovery

It is the opinion of the consultant, based on the observations of the current conditions, fishing pressure and use of explosive fishing techniques, that the potential for recovery of this reef is poor.

### (d) Fungu Nyama

Like Mwamba Wamba this reef was also proposed to form part of the Tanga Coral Gardens Marine Reserve. Fungu Nyama is a large coral reef formation drying at low water springs with sand bank formations drying to 3 m.

Two areas were observed. Firstly, the fore reef which consisted of a sloping coral platform at 10 to 15 m in spur formations bounded by sand channels. No living coral was observed, and concomitantly no fish were seen. The coral surface seemed to have been scoured reducing the available habitats for fish species associated with reef formations. The surface was similar to that observed in Jamaica following the passage of Hurricane Allen (1981); the reef surface was devoid of settlement and rubble accumulations were seen in the sand channels.

Secondly, the back reef area over a distance of 0.7 nm parallel to the reef crest was observed. The structure typical of back reef areas was once luxuriant and had a high diversity of coral species.

### Status

Coral diversity was good with 21 genera represented, but as in the other reefs observed, the coral cover was low with a maximum of 15%. The density of living specimens in the area surveyed was also extremely low. Unlike other reefs observed, the molluscan species were well represented with Conus spp., Lambis spp., Strombus spp. and Cyprea spp. Two specimens of Acanthaster planci were seen, and these were feeding on Acropora spp. colonies. The dominant coral species on this reef were the Acroporiids and may also be the dominant species recolonizing the reef since juvenile specimens were observed. No major frame building coral was seen in their juvenile stages.

### Impacts

Extensive and continued use of explosive fishing techniques has reduced much of the substrate normally suitable for recolonization to unconsolidated rubble. This rubble is now

colonized extensively by soft coral species, inhibiting the possible settlement of the more energetically important scleractinian species. Artisanal fish traps were also seen to cause damage to the remaining coral colonies with traps being selectively dropped on or in the vicinity of living coral.

#### Potential for recovery

Since this reef is easily accessible to the artisanal fishermen who were observed to using dynamite, the potential for recovery is slight.

#### (e) Niule Reef

This reef is the third reef designated to form part of the Tanga Coral Gardens Marine Reserve and is the most accessible to Tanga. The area observed was at the northern pass close to Niule light. The reef is fronted by a large reef crest that dries to 1 m during low water springs. The area covered was 1,000 m<sup>2</sup>.

#### Status

The area is covered by dense concentrations of Ulva and Sargassum, both growing on broken coral substrate. In the deeper areas surveyed, patches of Thalassia were seen, but here as in the coral areas evidence of dynamite blasts were seen.

#### Impacts

Explosive fishing damage has been very extensive, and only two living coral colonies were seen in the area surveyed. These were a Pocillopora spp. and a colony of Stylophora pistillata, both on broken coral substrates. The reef flat areas have been observed to be under intense fishing pressure during low tides with 30 to 40 fishermen observed searching for octopus and mollusc species, both during the day and night.

#### Potential for recovery

With the lack of suitable substrate for settlement, continued pressure and explosive fishing techniques, resettlement and growth of scleractinian corals seem extremely unlikely. The possibility of resettlement being slight only if the area were isolated and a suitable genetic pool existed downstream of this reef. There was, however, no genetic pool identified during the survey.

#### (f) Yambe Island

The survey of the southern part of the inward reef adjacent to this island was observed by scuba diving. The area consisted of a series of patch reefs separated by sand, rubble or silt channels. The silt channels being predominantly to the south and the rubble towards the north. The patch reefs rose from a depth of approximately 10 m to within 2 m of the surface.

#### Status

The patch reefs observed were represented by 32 coral genera with the dominant species being variable on each patch reef. However, the main frame building corals were Galaxea spp., Porites spp. and Pavona spp.. Coral cover was variable with a minimum of 5% and a maximum of 60%, the latter being single species patches of Galaxea spp. or Pavona spp. undamaged by either explosive fishing or improper anchoring. Regeneration was seen in damaged areas when they were not dominated by Galaxea spp. or Acropora spp. rubble. They seem to provide an inadequate substrate for resettlement. Regeneration by Pocillopora spp., Acropora spp., Galaxea spp. and

other encrusting species was seen in areas previously colonized by Pavona spp., Porites spp., Favia spp. and Diplocestra spp. Regeneration was not, however, seen in areas recolonized by soft coral species, which have a faster growth rate and tend to reduce available substrate for settlement and overgrow juvenile colonies. In severely damaged areas soft coral cover was estimated at 60 to 80%.

#### Impacts

The patch reefs have been exposed to explosive fishing, with recent impacts observed. Sediment load was high and visibility poor. Coated sponges of the Siphonales spp. and corals of all species were unable to clear surface sediment. The latter were seen to be covered by a mucus sheath and showed evidence of bacterial infestation (Black Band Disease).

#### Potential for recovery

Given the diversity observed and the existence of undamaged patch reefs, damaged areas could be recolonized by the scleractinian species. But sediment loads are persistently high, and this in combination with overgrowth by soft coral colonies may reduce this potential. A further quantitative survey may classify the area to be suitable for isolation as a genetic reserve.

#### (g) Karange Island

The northern coast of Karange Island on the leeward side of the island was surveyed. The coastal strip was covered by dense mangrove forest of mixed species. The island consists of a series of uplifted pleistocene reef formations dissected at two places (north and south) by a pass which dries at low water. Three transects were run from the shore to a depth of 10 m, a distance of approximately 0.2 nm. In all cases, cover was similar following the same zonation patterns from shore to the maximum observed depth.

#### Status

Close to shore on a muddy substrate were dense stands of Thalassadendron interspersed with detached colonies of Goniopora spp., Seriatopora hystrix and Styllophora pistillata. The latter two were attached to hard substrate of some unidentified massive coral colonies. This area has begun to be colonized by soft coral forms.

To seaward of the seagrass and coral zone is an area previously colonized by a good cover of massive frame building corals long dead and subjected to normal bioerosional processes. The upper surfaces are now heavily colonized by soft corals both branching and encrusting. Little surface was available for the settlement of scleractinian species. The bioerosional processes have created micro-environments in crevasses and excavations, these areas are now colonized by new scleractinian growth of good diversity decreasing markedly to 5% or less, below 8 m. The dominant species over the entire area surveyed were Galaxea spp., Pavona spp. and Acropora spp..

#### Impacts

This reef is subject to heavy sedimentation which may account for decreased coral cover with increasing depth. It was seen that colonies with surface lesions were unable to clear sediments adequately, while uninjured colonies were well cleared. This observation tends to suggest that the corals are under continuous stress and that the system is inherently unstable. Sediment loads originate from the Pangani River and are transported north within the boundary of the off-lying reefs and islands. The sediment is then held and concentrated in the basin bounded on the east by Karange and Yambe Islands and on the west by the mainland of Tanzania.

Explosive fishing damage was seen to increase towards the northern part of the area observed. Damage attributed to explosive fishing was compounded by mangrove poles crushing and



abrading coral surfaces. The poles are cut illegally in the center of Karange Island and transported by canoe (Ngalawa) to the mainland. These canoes are overloaded and shed their load onto the reef in heavy weather.

#### Potential for recovery

A reduction in sediment load by improved agricultural techniques and reafforestation of the banks of the Pangani River should reduce stress factors and allow for the growth and resettlement of scleractinian species on the reef observed. The isolation of this area and control of logging operations on the island could stabilize this reef which could then serve as a genetic source for the resettlement of reef areas to the north (i.e. Yamba Island).

#### (h) Fungu Tongone

Fungu Tongone is an isolated sand bank fronted by an extensive fringing reef to seaward with a well developed back reef and off-lying patch reefs to leeward. The sand bank and the reef crest dry to 6 m and 1.5 m respectively during low water springs.

#### Status

The fore reef slope was observed to a depth of 10 m, no evidence of explosive fishing was seen, and coral cover was good at 45%. Normal reef zonation for a high energy reef was observed with little growth in shallow areas and a downward shift of all colonies with extensive growth and cover of Acroporiids spp. starting at 6 m. This area was fronted by massive frame building corals dominated by Porites spp., Pavona spp. and Diploastrea spp. Undamaged coral was seen to extend beyond the 10 m depth contour.

The back reef area was dominated extensively by Zostera and Thalassodendron spp. patches in the shallows. To seaward of the seagrass zone was a shallow slope covered by patch reefs of good diversity, 20 coral genera were observed, however, the cover was poor.

#### Impacts

The back reef area has been subjected to heavy explosive fishing, evident by distinct craters.

#### Potential for recovery

The reef is under continuous fishing pressure both with traditional and explosive techniques. Beach seining operations were observed to cause damage to bottom fauna and anchoring techniques, using traditional stone anchors have added to the damage caused by explosive fishing. The sediment load is also very high reducing light penetration on the back reef areas. Considering these factors, the potential for recovery of the back reef area is slight while the comparatively undamaged fore reef slope is subject to normal development patterns.

### 1.2 MANGROVES

The Tanga region has extensive mangrove cover in the Sigi River Delta, the bays and islands to the north of Tanga towards the Kenya border, Yambe and Karange Islands and the Pangani River Mouth.

In all areas visited, mangrove cutting was observed, most of the cutting is carried out without permits for use as building materials and firewood, some for export, but cutting of larger specimens is being carried out selectively by independent operators supplying the salt industry. There was no information available on the tonnage cut or the area cleared.

Mangrove areas in the vicinity of the Tanga urban limits are subjected to both cutting (which has led to coastal erosion of land fronting residential areas) and pollution from industrial and urban sources. The planned development of Tanga to the year 2005 does not take into account the importance of mangrove stands as biological units or as coastal stabilizers. Zones of industrial and urban development have been planned in areas fronted by mangrove forest, but no treatment facilities have been planned for the former, with effluents being discharged directly into watercourses leading to mangrove areas.

### 1.3 SEAGRASS BEDS

Extensive seagrass beds were found in all bays investigated and on the western side of all reefs and islands lying off the mainland coast. The dominant seagrass genera are Cymodocea, Thalassia and Thalassodendron and all are subjected to heavy artisanal fishing pressure by traditional techniques including bottom traps (Madema) and beach seines. The latter, as noted previously, causes considerable damage to bottom flora and fauna. Explosives fishing is also being carried out on seagrass areas, but here, unlike coral areas, the damage is restricted to compact craters with little apparent damage to adjacent areas. The lack of hard substrate seems to allow the shock waves from the explosion to pass unimpeded, while coral substrate form barriers to the waves and are broken.

The diversity and density of fish species normally found on seagrass areas were absent in all areas investigated, supporting the previous observation of excessive fishing pressures.

Apart from those genera of seagrass observed all coral areas and drying reef flats were covered by extensive stands of Sargassum, and Ulva. Samples of Euchema were also found suggesting the possibility of a natural stock of Euchema for mariculture development programmes in selected embayments.

### 1.4 FISHERIES

Artisanal fishing though an important activity of the coastal population of the Tanga region has contributed to the severe degradation of the marine environment with reduced catches already apparent (Table 1, annex IX).

Data from the Statistics Gathering Programme of the Fisheries Division of the Ministry of Natural Resources and Tourism show that there has been a decrease in landed catch with a slight increase in the number of fishermen and gear from 1985 to 1986. Table 1, annex IX, also shows the breakdown of gear and the number of fishermen for the year 1984 to 1985 with some values presented for 1986. Table 2, annex IX, gives a further account of the fisheries statistics from 1970 to 1986, showing the downward trend in catch per fisherman from 1981 to 1986.

From the data represented in table 2, annex IX, it can be seen that since 1981 there has been a decrease in the total catch per fisherman per year. When the composition of the total catch is analyzed, it shows that the major component of the landed catch has shifted from inshore demersal fish normally found on reefs and coastal areas to pelagic species, present and migrating in the offshore fishing grounds. The data corroborates with the observations, that the density and diversity of reef fish species have declined due to explosive fishing, improper anchoring techniques and careless fishing methods. The data also suggest that the resource base and productivity associated to coral reef areas has been reduced, possibly creating serious long term effects on the fisheries potential of the area.

### Recommendations

The recommendations for improving the artisanal fishery sector are an integral part of the Action Plan. Adoption of the Action Plan will in time result in increased productivity, a

rational extraction process designed to increase the potential while protecting the stock and diversification of the fishery industry to include mariculture development. The fundamental improvement to the fisheries industry will be the elimination of explosives fishing techniques, the banning of artisanal stone anchors while providing an alternative and a stock assessment programme to permit rational management and control of all fisheries in the region. These points are all discussed in detail in the Action Plan (Section E).

## 2. TANGA URBAN REGION

### 2.1. INDUSTRIAL SOURCES OF POLLUTION

An inventory of pollution sources in the Tanga urban region, has been carried out by the National Environment Management Council (NEMC). The results of the inventory were verified during the consultant's survey and are included below. The following industries all influence the levels of pollutants in the Tanga Bay and adjacent waters:

- Tanga Fertilizer Company Ltd. (TFC);
- Sabuni Industries;
- Amboni Ltd.;
- TIP Soap and Glycerine Ltd.;
- Tanzania Dairies;
- Bombo Hospital;
- Commercial Industries and Combine Ltd. (CIC); and the
- Tanga Central Sewage System.

#### (a) Tanga Fertilizer Company

The company began operations in 1972 at a site immediately to the south of Ras Kazone, a low density residential area. It produces sulphuric acid by an absorption method in which sulphur dioxide ( $\text{SO}_2$ ) and Sulphur trioxide ( $\text{SO}_3$ ) are converted to sulphuric acid using vanadium as a catalyst in the reaction. Under normal operating procedures, the conversion rate using a fresh catalyst is 98.5% with 1.5% emitted to the atmosphere as processed sulphur. At present, the catalyst has not been changed for 6 years, and the conversion rate has dropped to 89.90%, resulting in 10% of the processed sulphur being emitted to the atmosphere from a 100 m high stack and numerous vents.

The company also produces phosphoric acid from rock phosphate treated with sulphuric acid emitting toxic hydrogen fluoride gas. The gas is not released to the atmosphere directly but passes through a treatment plant containing a water scrubber designed to dissolve the gas. This wastes water is washed away with the plant's effluents to be discharged on the beach fronting the plant. Serious pollution problems were identified on the coastal area to the north and south of its outfalls.

#### Air emissions

The NEMC personnel determined that from July to December 1986, for every tonne of sulphuric acid produced 55 kg of  $\text{SO}_2$  and 2.1 kg of  $\text{SO}_3$  are emitted. These values are approximately double the current Swedish guidelines of 20 kg of  $\text{SO}_2$  of 0.6 kg of  $\text{SO}_3$  per tonne of acid produced.

### Emission to the sea

The effluent from the fertilizer complex is roughly 700 m<sup>3</sup>/h of waste water containing acid leakages, fluoride, phosphorous, nitrogen, small amounts of cadmium and gypsum in suspension. This effluent composition has been analyzed in Sweden and has shown the following results:

|               |                                  |
|---------------|----------------------------------|
| pH            | 4.1                              |
| Chloride, g/l | 15.8                             |
| Fluoride, g/l | 25.0                             |
| TOT-N, mg/l   | 68.0                             |
| TOT-P, mg/l   | 27.0                             |
| TSS, mg/l     | 380.0 (This being mainly gypsum) |
| Cadmium, mg/l | 0.016                            |

When taken in relation to the effluent volume of 700 m<sup>3</sup>/hour, the total discharge to the sea is:

|             |              |
|-------------|--------------|
| Fluoride    | 420 kg/day   |
| Phosphorous | 454 kg/day   |
| Nitrogen    | 1,142 kg/day |

During the consultant's visit it was noted that sulphur particles were common on the beach and extended at least 1 km north of the outfall towards a pier and loading facilities belonging to the company. The seawater outfall consisted of a re-inforced concrete pipe set in carbonate bedrock; the pipe has now collapsed and the bedrock eroded to create a large cavern extending towards the main access road. The extent of erosion creates a risk to the road and a nearby house.

A mangrove stand adjacent to the outfall seemed unaffected but no infauna was seen in the intertidal zone or subtidal zone for 1 km north of the effluent discharge. A massive kill of burrowing worms and swimming crabs was observed, but this may be the result of a large oil spill observed coating the area. The source was probably from a departing freighter since a large slick was seen to sea prior to visiting the site. The chronic pollution has resulted in anoxic sediments 2 mm below the surface, and no infauna was found in 15 sites investigated.

The coastal area adjacent to the effluent discharge has been altered. The mortality observed, however, is not accountable to the effluent analysis carried out by NEMC. The possibility therefore exists that the effluent may contain other toxic substances intermittently and that these may be causing serious ecological problems. The question remains and further research is required.

#### (b) Sabuni Industries

The company is operational producing soap and detergents, however, its output is reduced due to the lack of raw materials. Emissions include sulphur dioxide and waste water, the former emitted to the air and the latter discharged into the storm drain system.

#### (c) Amboni Ltd.

The company produces sisal from raw material grown on several estates. During processing, waste products consisting of 90% of the weight of sisal leaves, about 100 tonnes per day, are dumped directly into the Sigi River, 2 km from its mouth. The organic material in suspension at the time of discharge has built up banks of waste material in the river.

No effects have been observed on the mangrove forests adjacent to the Sigi River Mouth, but secondary effects may result from increased levels of productivity due to higher nutrient loads, increased turbidity and increased sedimentation. The solution to these potential problems would

be to install a settlement tank for the organic debris, decant the waste water into the river and dispose of the solids on land.

**(d) The Soap and Glycerine Ltd.**

This soap factory discharges the waste products of soap and spent lye directly into the storm drain system.

**(e) Tanzania Dairies**

This factory producing 40,000 l of milk from imported milk powder and butter oil started production in 1980. 100 kg of butter are produced daily from fresh milk.

Caustic soda, chlorine and a phosphate detergents are used for washing tanks and pipes. Daily effluent is 150 m<sup>3</sup>. A waste water treatment plant has been designed consisting of three waste stabilization ponds that will retain water prior to discharge for 105 days.

**(f) Bombo Hospital**

The Bombo Hospital situated south of Ras Kazone within the confines of Tanga Harbour empties its effluents and discharges into several septic tanks and soak pits which are at present overflowing. This discharge is washed into the harbour area during the wet seasons. No plans for improvement of facilities exist.

**(g) Commercial Industries and Combine Ltd.**

Commercial Industries and Combine Ltd. (CIC) is an integrated mill where carding, spinning, weaving, dying, finishing and garment making are carried out. The plant started operations in 1981 with a capacity of 8.5 million meters of cloth per year. At present, it runs at 55 to 60% capacity.

CIC consumes 15,000 to 16,000 m<sup>3</sup> of water per month discharging an equal amount of effluent into a storm water drain that falls into the sea south of Tanga. The company has released a list of chemicals used in their process including quantities used per month, these are:

|                    |          |
|--------------------|----------|
| - Starch           | 2,000 kg |
| - Sodium Hydroxide | 190 kg   |
| - Sodium Chloride  | 3,800 kg |
| - Sodium Carbonate | 3 kg     |
| - Acetic Acid      | 191 l    |
| - Ciba-Chrome Dyes | -        |
| - Helizeran Dyes   | -        |
| - Urea             | -        |

Effluent analysis carried out by NEMC showed a pH of 5.9, total alkalinity 70 mg CaCO<sub>3</sub> and an unquantified concentration of organic matter (permanganate) shown as being very high. NEMC and the consultant both recommend that a water treatment plant be incorporated into the future development plans of this industry.

## **2.2 MUNICIPAL WASTE WATER - URBAN WASTES**

Thirty-three percent of Tanga is currently served by a central sewage system, the remainder being installed with septic tanks. There are no treatment facilities whatsoever, and raw sewage from the central system and that emptied into the system by septic tank empties all discharge directly into the sea near the jetty belonging to the Fertilizer Company. The outfall is situated adjacent to prime residential areas.

The Development Plan for Tanga to the year 2005 makes provision for sewage treatment facilities, the type of treatment was not known. It is of interest to note, that land that has been zoned for a treatment plant has already been subdivided and allocated as residential plots.

The population of the Tanga region stands at approximately 300,000 with a 3% annual growth rate. The population of Tanga municipality is 140,000, but there is a movement of the population towards the coastal plain and the lowlands adjacent to it. Tanga expects to have 250,000 inhabitants by the year 2005. Considering the levels of pollution, both urban and industrial, it is imperative that an integrated treatment system be installed to provide at least primary treatment and stabilization prior to discharge. The present situation creates a real risk to inshore marine habitats and a serious public health risk. Investigations of the levels of pollutants and their possible influences on the marine environment will be discussed in section E as part of the Action Plan.

### 2.3 THE PORT OF TANGA

The port of Tanga is the northernmost harbour facility in Tanzania capable of receiving large ocean going vessels. There are an average of 20 ship movements per month, these discharging containerized goods and received sisal, coffee and cotton for transport to world markets. There is also a dhow harbour servicing the local trade along the coast and the islands of Zanzibar and Pemba.

Oil and refined petroleum products are discharged by tanker into a standpipe close to the dhow harbour. Small hydrocarbon spills have been reported from the discharge process and from the anchored vessels. There are no cleaning and dispersing facilities available. These would be used, if made available and a recommendation to that effect will be made.

The harbour requires pilotage which at present is provided by an expatriate Pilot/Harbour Master. He is also responsible for the maintenance of navigational markers and leading lights. Local vessels including the tankers require no pilotage after having entered the harbour three times. The harbour is difficult to enter, and the potential for grounding exists.

### 2.4 OTHER IMPACTS ON THE COASTAL ZONE

Salt production is a major industry associated with mangrove areas in the United Republic of Tanzania. For the most part, salt works utilize the solar evaporation technique; however, in the Tanga region salt is extracted by a combustion technique.

The combustion technique is ubiquitous to the Tanga region with small artisanal units spread over the entire coastal area. Each operator constructs pans from corrugated metal roofing sheets, 3 to 4 sheets per pan. These are then mounted on earthen supports, and wood is burned on a daily basis for 2 weeks, each month corresponding to the neap tides.

At two sites visited, 76 pans were in operation, each pan consumes 7 tonnes of firewood per week to produce 25 to 30 kgs of salt per week. On a yearly basis, the two areas visited consume in the order of 12,096 tonnes of wood to produce approximately 50,000 tonnes of salt. The profit margin, after expenses for fuel, wood, salaries and transport is approximately 500 TSh per week.

Firewood comes from two sources, inland sites such as Dima near Gombero where selective cutting of mature hardwood trees is being carried out and in the mangrove areas at the mouth of the Sigi River where the larger mangrove trees are also selectively being cut.

There is an associated coastal erosion problem created by the discharge of logs at the production site. The logs are rolled down the coastal slope denuding all surface vegetation over

wide areas. The rains then erode the slope transporting terrigenous sediments to the back mangrove areas.

It has been estimated that these operations have consumed the equivalent of 25 to 30 years of firewood otherwise destined for use as firewood in the Tanga region. A solution to this impact would be to:

- introduce demonstration solar production units using locally available materials all of which have been identified and create an information dissemination system for current operators;
- tighten up forestry logging regulations and institute controls;
- phase out the current combustion techniques as solar production units are instituted and operating successfully;
- zone back mangrove areas for salt production and pan construction; and
- provide an information booklet for producers including construction techniques, possible marketing alternatives, and encouraging co-operative ventures among existing operators.

### 3. PRIORITIES FOR MANAGEMENT AS DEFINED BY TANGA REGIONAL AND DISTRICT OFFICERS

At the request of the consultant, regional and district officers were requested to identify what in their opinion were the foremost problems needing attention within the context of a management plan for coastal resources. Priorities were identified as follows:

#### Fisheries Sector

##### (a) Explosive Fishing

- to implement an effective patrol system;
- to initiate fisheries extension programmes for fisheries officers and fisheries protection units;
- to initiate educational public awareness programmes on all matters relating to the marine environment; and
- to identify and control sources of dynamite.

##### (b) Legislation

- to amend existing legislation to make prosecution easier. In the Tanga region prosecutions have been unsuccessful, the last case took two years to come before the courts and a small fine was imposed.

##### (c) Water Pollution

- to reduce the levels of pollution; and
- to force existing industries to be responsible for their effluents.

**(d) Mangrove Cutting**

- to stop all unregulated mangrove cutting and enforce existing laws; and
- to develop an educational programme and general public awareness programme.

**Recommendations**

The problems of Tanga region have been discussed and their effects on the marine environment and coastal resources assessed. Based on this and the willingness of Tanga officials to act on recommendations, the region will be proposed to form part of a Pilot Management Zone in which the activities presented in the Action Plan will be implemented and amended as necessary (Section E).

**4. MARINE RESERVES AND PROTECTED AREAS**

Following the results of the survey, it is the opinion of the consultant that the proposed Tanga Coral Gardens Marine Reserve no longer warrants implementation. Furthermore, the survey failed to identify suitable areas for special protection.

An inventory of marine resources and habitats of the region contained in the Action Plan will identify areas suitable as genetic reserves and protected areas with the view that these may serve as genetic pools for the resettlement of damaged areas and improve the fisheries potential of artisanal fishing grounds. The necessary legislation to enact such sites when identified already exists.

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## ANNEX II

### REPORT ON THE COAST REGION

## INTRODUCTION

The Coast region (Figure 1, annex X) extends from the southern border of the Tanga region to the north to Samanga in the south where it borders with the Lindi region. Contained within the Coast region is the Dar es Salaam region encompassing Dar es Salaam urban area and coastwise to the midpoint between Dar es Salaam and Bagamoyo, and the midpoint between Ras Ndege and Ras Buyuni.

The Coast region receives the Wami, Ruvu and Rufiji rivers, each draining a separate watershed (Figure 14, annex X). The Ruvu, Wami and Rufiji basins together drain an area of approximately 250,290 km<sup>2</sup>, with the Rufiji basin contributing to 71% of this area.

The emergent pleistocene coast is varied with sand spits, mangroves, fringing and patch reefs, islands, banks and major deltaic features well represented.

There are three urban centers, Bagamoyo and Kisumu on the mainland of Tanzania and Kilindoni on Mafia Island.

The survey of the Coast region included a representative sample of all marine environments observed on the ground. The Rufiji Delta area was observed from the air on an overflight to Songo Songo Island and Kilwa Masoko to assess the potential impact of a planned gas field/industrial complex.

## 1. MARINE ENVIRONMENTS

Representative examples of all habitats found on the mainland coast and around the offshore islands were observed and their conditions assessed. The areas observed from north to south included Mbegani, the coastal area from Ras Ndege to Ras Buyuni, Sakuti Islands, Kwale, Koma, Mafia and Chole Bay.

### 1.1. CORAL REEFS

#### (a) Mbegani

##### Status

Mbegani Bay consists of an extensive mangrove system fronted by a stable sand dune spit unique to the Tanzania littoral. The bay is shallow with numerous small islands which are densely covered by mangroves. The shore is steep and covered by coconut palms. There are no coral reef formations in the bay, but to seaward of it is an extensive patch reef system.

##### Impacts

The area to the north of Mbegani towards Pangani is one of the prime prawn fishing grounds of Tanzania. Vessels from the Tanzania Fishing Company (TAFICO), the Bagamoyo Fishing Company (BAFICO) and the Zanzibar Fishing Company (ZAFICO) all fish this area where potential has not been adequately assessed. The breeding sites for this stock have not been identified, but it seems likely that Mbegani Bay and mangrove complex may have a role in stock cycling. Catch statistics are presented in table 3 & 4 annex IX. The extensive patch reef system is under intense artisanal fishing pressure and subject to explosive fishing resulting in damage such as that previously described in the Tanga region.

### Potential for recovery

Since no major reef formations were observed at this site, it is difficult to assess the degree of damage caused by fishing pressure, both artisanal and commercial and by explosive fishing techniques. The area does present a unique range of habitats and as such is a prime location for consideration as a marine reserve. The patch reefs and rock reefs seen have low density cover, the major habitat being seagrass beds and mangrove forests.

#### (b) Ras Ndege to Ras Buyuni

The coast from Ras Ndege to Ras Buyuni running in a north-south axis consists of a pleistocene coral platform backed by a coastal slope with numerous beaches fronted by patch reef formations. The current runs in a northerly direction at approximately 3 1/2 to 4 knots carrying a heavy sediment load.

#### Status

Artisanal fishing pressure was nominal with few fishing villages seen. Most fishing activity was from the shore by beach seining and hand lines.

Small farm holders on the coastal slope have deforested areas for agriculture. These areas have since eroded to the beach with an associated degree of beach erosion visible as well. The beach has been eroded to expose the pleistocene coral bedrock.

Ras Buyuni consists of a mangrove covered peninsula with an extensive fringing high energy reef formation fronting it. There is a small lagoon between the reef and the mangrove area. It was not possible to see this reef, but from depth soundings it was found to be steep to the 10 fathom line being a short distance 20 to 50 m from the reef crest.

Ras Buyuni with its reef and mangrove formations seem to influence the coastwise transport of suspended sediments originating from the Rufiji watershed. Dense sediment concentrations were seen at Ras Buyuni with complex circulation patterns and vortexes visible. This accumulation and concentration of sediments was ground proved from observations made on a satellite photograph (Figure 18, annex X).

It can be assumed that the reef and peninsula are creating localized circulation patterns that feed sediment to the mangrove and back reef areas thus stabilizing and extending them and that a complex ecosystem interlinkage exists here. Furthermore, the possibility exists that coastal stability northwards towards Ras Ndege is maintained by the Ras Buyuni complex.

#### Impacts

Water depths in the back reef areas were approximately 1m and the area is under intense fishing pressure by ambulant artisanal fishermen.

#### Recommendations

Ras Buyuni is an area that is already protected due to its considerable mangrove cover. The area requires further investigation and the forest reserve area should be extended to include the off-lying reefs, Buyuni Bay and the area towards Ras Pembannasi to the north. The limits are given in figure 18, annex X.

#### (c) Ras Buyuni to Koma Island

Southwards of Ras Buyuni, the coast arcs westwards to form Buyuni Bay, (Figure 18, annex X) then southwards to the Rufiji Delta and the southern limits of the Coast region at Samanga.

### Status

The coastwise course followed in the survey was within the sediment plume emanating from the northern deltaic regions of the Rufiji River. The coast is covered by intermittent mangrove stands interspersed by coconut plantations and reafforested casuarina stands.

To seaward are dense seagrass beds composed mainly of Thalassia, Thalassodendrum, and Zostera. Patch reefs are infrequent and not expected due to the high sediment and turbidity levels.

Several small islets were seen, these being North Fanjove, Sakuti and Kwale. North Fanjove and Kwale are pleistocene coral platforms covered by dense vegetation, on the latter are also dense mangrove forests to the north and south of the island. These two islands and the Sakuti banks have sand accumulations of terrigenous origin. Koma Island to the south of Kwale has a similar structure, but here the mangrove areas are reduced. No cutting was apparent.

### Impacts

Both Kwale and Koma have large fishing settlements with the former having a denser population and mixed agriculture of root crops and goat herding.

Artisanal fishermen have constructed fixed traps throughout the intertidal area from Ras Buyuni to Samanga. The density of fish traps is high with 3 to 4 traps erected from the high tide line to the low water spring level. An average of 21 fixed traps were counted in a 1 km area.

#### (d) Koma Island to Mafia Island - Kilindoni

### Status

Sediment loads from the Rufiji were no longer apparent 7 nm offshore. There were no coral reef features between Koma Island and the reefs off Kilindoni in Mafia. These reefs are predominantly shallow patch reefs of low diversity and cover. Towards shore, the bottom banks consists of shallow sandy areas covered in Thalassia and Zostera.

Kilindoni does not qualify as a harbour. Yet, all goods coming to Mafia are brought in by dhows, this includes petrol and diesel transported in drums. The town of Kilindoni stands away from the shoreline and apart from the spillage of diesel at a storage tank off the beach, there are no visible pollution problems. Urban wastes are contained in cesspits and pit latrines; there was no sewage outfall.

### Impacts

The reefs to the north of Kilindoni towards Ras Mkumbi in the north are subject to artisanal fishing pressure and explosive fishing has been reported. Coral cover is adequate at 25 to 30% with some juvenile Pocillopora spp. and Acropora spp. seen. Coral cover has been further damaged through the use of artisanal stone anchors.

#### (e) Chole Bay

The coral reef, mangrove and seagrass bed areas of Chole Bay (Fig 7, annex X), Juani Island southwards toward Tutia Reef are included in the declared Chole Bay Marine Reserve.

### Status

The reef structures of Chole Bay were investigated as were the mangrove stands bordering the entire coastal strip contained by the bay. The reefs are of good diversity with 32 genera

observed. The dominant species were the *Acroporiids*. Reef structure is unique and consists of isolated patches on pleistocene coral substrate rising to within 1 m of the surface at low water springs.

#### Impacts

There was no observed damage that could be attributed to explosive fishing, but the scarcity of finfish species supported the view that the area is being overfished using traditional artisanal techniques. District officials reported that explosive fishing was common to the area.

The reefs to the south, including Tutia Reef were not investigated due to prevailing weather conditions, but it has been recently reported (November 1987) that the reef at Tutia has been severely damaged to the west, with the eastern and southern more exposed fronts remaining relatively undamaged. This remains to be confirmed.

The shallow bank area between Mafia and the off-lying islands of Juani and Chole is a sunken platform now covered by isolated coral formations. Water flow due to tidal currents is very high ensuring good transport and turnover of nutrient material. Corals appeared to be in good condition, but finfish species were scarce confirming the observed heavy artisanal fishing pressure.

#### 1.2 MANGROVE AREAS

Mangrove cover was observed on the islands of Kwale and Koma, from Ras Buyuni to the Rufiji Delta, Mafia at Chole Bay, Mbegani and the Ruvu Delta.

On the islands including the mangrove areas of Mafia, no serious cutting was observed. Five species of mangrove were observed at Chole Bay and south of Ras Mkumbi following normal successional patterns from shore to the seaward edge.

At present, district officials on Mafia have no policy to follow regarding mangroves and would not be aware of cutting should this be carried out.

The major mangrove areas of the Rufiji Delta covering a reported 1,000 km<sup>2</sup> were observed during an overflight of the delta area. Cutting of mangrove forests was seen towards the interior where forest areas have been cleared to make room for rice production.

At present, it is illegal to clear further areas for this purpose without a licence, but existing areas in isolated locations seem to be expanding since enforcement of control regulations are difficult to exercise.

Salt production units were observed towards the south, all but one of these had been installed in back areas not requiring clearing, the remaining units had been sited in an area previously cleared of mangrove forest.

Reports from workers at the University of Dar es Salaam indicate that pesticide use in the delta rice production areas is high with unspecified volumes of DDT and organochlorides applied at frequent intervals. Further investigation are required to assess the long term effects of this practice and determine whether other insect control options exist which could be made available to the areas' rice producers.

The Rufiji Basin including the mangrove areas contained at the delta come under the jurisdiction of the Rufiji Basin Development Authority (RUBADA). The excellent work carried out by this parastatal should be in accordance with the general management plans for the region and to this end, close links should be maintained between RUBADA, the Tanzania Forestry Division of the Ministry of Natural Resources and NEMC.

## Recommendations

The mangrove cover of the Coast region has not been adequately inventoried. This needs to be carried out to assess the current economic potential of this area, to isolate mangrove stands recognized as beneficial to coastal stability and those recognized as important for the maintenance of commercial species in particular Penaeus indicus, Penaeus monodon, the main prawn species landed at the Bagamoyo and the Rufiji grounds.

### 1.3 FISHERIES

Artisanal fishing is an important activity of the coastal populations of the region, but the sector is experiencing a reduction in the number of registered artisanal fishermen and catch. The area also contains the two main prawn fishing grounds in the United Republic of Tanzania, these being, Bagamoyo and areas adjacent to the Rufiji Delta.

Data from the Statistics Gathering Programme of the Tanzania Fisheries Division of the Ministry of Natural Resources and Tourism indicate that there has been a shift away from gill-netting operations towards share-netting operations indicating greater effort applied to catching high value pelagic species. Table 3, annex IX, shows the breakdown of gear and the number of fishermen for the years 1984 and 1985.

A Kenyan based fishing company has been licensed to fish the Rufiji grounds and reportedly is doing so successfully. A problem exists here in that the ground has been let to a foreign operator prior to any stock assessment. The four vessels operated by the company are fishing an average of 21 days per month and according to fisheries division sources, may be landing up to 1 tonne of prawns per haul. These figures are acceptable if the Rufiji stock is considered virgin. Inconsistencies have arisen as to the methods employed by the company and should be duly investigated by the Tanzania Fishery Division. The agreement with the company also stipulated that the catch will be made available to the local coastal population. At present, this is not taking place. Current licensing procedures and fees payable by the licensee should be reviewed. The revenue in foreign exchange earned could then be applied to fisheries development projects and upgrading the artisanal fisheries.

## Recommendations

It is imperative that the Rufiji prawn stock be assessed, that spawning grounds and nursery areas be identified and isolated and where they are in close association with mangrove forests, that the adjoining mangrove area be included in the protected area. That the licensing procedures of foreign vessels be in accordance with accepted practices where the operator pay a fixed percentage of the value of the stock in the form of a licence.

A stock assessment can be carried out during commercial operations using simple length frequency relationships and currently available FAO prawn stock assessment computer programmes.

Existing legislation empowers the Tanzania Minister of Natural Resources and Tourism to declare closed areas and seasons if necessary.

### 1.4 OTHER FISHERIES

At present, there is an unregulated incidental turtle fishery being carried out in the Coast region and Mafia Island in particular. Capture of all marine turtle species is illegal, however, enforcement is difficult. Mafia District Officials suggest that the existing legislation provides inadequate guidance to fisheries officers and should be reviewed.

The lobster fishery is extensive and carried out by local artisanal fishermen and small scale commercial operators from Dar es Salaam. There are no regulations concerning this fishery, and no stock assessments have been carried out.

In Mafia, there are seven licensed shell collectors who may also hold licences for collection of edible Holothurian (Sea Cucumber) species. Both of these items are primarily for the export market and are unregulated. Severe damage to coral areas can be attributed to the former.

The extraction of coral species for trade and export was not seen on Mafia or in the Coast region, but the removal of massive frame building corals of the Porites spp. and Pavona spp. was seen. This coral is either burned to produce lime or is broken to be used as aggregate material in construction. It is the view of the consultant that this practice is unnecessary in view of the existence of a pleistocene coral bedrock from which aggregates can be quarried.

## 2. URBAN AREAS AND SOURCES OF POLLUTION

There are no large urban areas in the Coast region, the main coastal settlements are: Bagamoyo, Kisarawe and Kilindoni on Mafia.

Each of these towns is a district center primarily supplying local populations with goods and services. There are no major industrial developments but small scale industries, mainly metal work and soap production have been developed. The scale of operations and the location of these units have not created a pollution problem.

### Mafia Coconuts Ltd.

The integrated coconut plantation processing plant and dairy farm is the major employer on Mafia. The process uses all parts of both the coconut and the palm to produce fibre, oil, cattle feed, timber and charcoal. The by-products are spread away from watercourses and are mainly residues, from the fibre separation process.

A dairy has been installed producing butter and cheese from fresh milk. No data was given for effluent discharged from the dairy plant. These will mainly be washing compounds in small quantities discharged directly to a watercourse leading to the beach.

TANESCO operate a generating station from within the Mafia Coconuts compound. Spent oils are dumped outside a perimeter fence and these have permeated the ground and are flowing via a small watercourse to a dried stream bed at the bottom of a valley. It is expected that during the rains this accumulating oily deposit will be transported to the sea some 500m away.

## 3. PRIORITIES FOR MANAGEMENT AS DEFINED BY MAFIA REGIONAL AND DISTRICT OFFICERS

At the request of the consultant, regional and district officers were requested to identify what in their opinion were the foremost priorities requiring attention within the context of a management plan, for the coastal resources. The priorities were identified as follows:

- to extend the limits of the declared marine reserve at Chole Bay to include the island of Bwejuu, the reef formations to the south of Mafia and the southern coast of Mafia;
- to institute an educational programme for artisanal fishermen and make gear available at nominal cost;

- to strengthen legislation to combat explosive fishing. It is of interest to note that Mafia District has successfully prosecuted fishermen using explosive fishing techniques and presently hold three offenders. They have also confiscated dynamite, plastic explosive and blasting caps. A reduction in explosive fishing was reported following the arrests; and

- to make surveillance vessels available.

#### Recommendations

Marine Resources of the Coast region are varied and for the most part not under heavy pressure. The main impact being that of artisanal fishing and explosive fishing. The priorities defined by district officers are catered for in the Action Plan, which if adopted, will address these sequentially as each defined phase is implemented.

#### 4. MARINE RESERVES AND PROTECTED AREAS

The results of the survey have identified three areas which could be declared marine reserves and protected areas. These are the:

- proposed Mbegani Marine Protected Area;
- proposed extension of the Ras Buyuni closed mangrove forest area to include the offshore reefs and Ras Buyuni Bay; and
- proposed extension of the Chole Bay - Tutia Reef declared a marine reserve to include the reefs south of Mafia and Bwejuu Island.

The proposed areas would be zoned in accordance with the directives presented in the Action Plan. Other areas suitable for promulgation as reserves would be identified during the course of a quantitative resource and habitat inventory to be executed as part of the initial phases of the Action Plan and these should include identified prawn breeding and nursery areas at both the Rufiji and Bagamoyo grounds which would be zoned as closed areas in accordance to the Action Plan.

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### ANNEX III

#### REPORT ON THE DAR ES SALAAM REGION

## INTRODUCTION

Dar es Salaam (Figure 1, annex X) is bounded to the north by the regional demarkation line with the Coast region and to the south with the Coast region at the midpoint between Ras Ndege and Ras Buyuni.

Though the smallest of the coastal regions, it contains the largest urban and industrial complex in the United Republic of Tanzania. There is also a serious industrial and urban pollution problem, heavy artisanal fishing pressure by both traditional and explosive techniques, well established tourist facilities, gazetted marine reserves, a major harbour complex and a petroleum refinery.

The survey of the Dar es Salaam region included representative examples of island and bank ecosystems, mangrove stands, coastal features including the harbour area and the major effluent discharge points.

### 1. MARINE ENVIRONMENTS

#### 1.1 CORAL REEFS

##### (a) Fungu Yasin

A gazetted marine reserve consisting of a sand bank drying to 3 m at low water springs. To the north the bank slopes rapidly to 25 m with no coral or algal cover due to shifting sediments. To the east is a well developed fringing reef system extending 1.8 nm to the south. The reef crest is exposed at low tides and devoid of coral cover, the drying back reef is covered by Ulva, Sargassum and Sonneratea spp. Fishing pressure is heavy and explosive fishing has been observed. Coral cover is extremely poor at 25%, and reef associated finfish fauna is depleted.

##### (b) Mbudya Island

A gazetted marine reserve consisting of a pleistocene coral island covered in brush, palms and recently planted casuarina groves. Recreational facilities for visiting residents and tourists have been erected. These consist of beach shelters, a small bar, open kitchen facilities and pit latrines.

The island is fronted by a high energy fringing reef with back reef formations dominated by Acropora spp. The fishing pressure in the area is very heavy, and explosive fishing is common. This and indiscriminate anchoring have resulted in a serious degradation of coral cover. No coral recruitment was seen. Damaged areas have been recolonized by a dense cover of Alcyonarian coral species and luxuriant algal growth. Reef associated finfish stocks are rare, but seasonal fluctuations in density have been reported. This was not obvious during the survey. In addition to those impacts noted, coral cover has been further reduced by indiscriminate collecting by tourists. There is no information available to tourists identifying Mbudya as a marine reserve and no regulations regarding what activities they are permitted to enjoy whilst on the island.

#### Potential for recovery:

The island is a major attraction to tourists residing at the beach hotels on the mainland of Tanzania fronting it, however, the condition of the marine environment and the degradation of the terrestrial ecosystem through careless use has affected both the attraction and the coastal stability of the island. The regulations exist, within the Fisheries Act applicable to marine reserves, to control activities and prohibit all fishing activities on the island. If the

regulations were enforced, the coral fauna would recover by the colonization of juvenile scleractinian species. Coral cover was estimated at 20 to 25% with 26 genera represented.

(c) Bongoyo Island

Situated to the north of Ras Kankadya and elongated on a northwest, southeast axis, the island is fronted to the east (windward) by a dissected fringing reef system with sheltered reefs of variable structure to leeward.

The dominant corals are the Acropora spp., Platygyra spp., Galaxea clavus and massive Porites spp. Coral genera are well represented, but damage to the leeward less exposed sides of the island is extensive. Coral cover is estimated at 10 to 15%.

Bongoyo Island is a gazetted marine reserve, but no action has been taken to enforce this. A request has recently been submitted to NEMC to construct a day camp for tourists and visitors similar to that at Mbudya Island. A decision is pending and will be taken in view of the results of a quantitative survey to be carried out by a multi-disciplinary team assessing the present conditions of the reefs and islands in the Dar es Salaam region from Ras Kirimoni to Ras Ndege and assess the impact due to explosive fishing.

(d) Msasani Bay to Ras Kirimoni

The area from Msasani Bay in the south to Ras Kirimoni in the north is fronted by a beach broken occasionally by pleistocene coral outcrops. It is a major residential area with luxury houses and tourist beach hotels constructed over approximately 80% of the frontage. To seaward is an extensive seagrass bed dominated by Thalassodendron spp. interspersed by patch reefs of massive Porites spp. and other lesser species, primarily Pocillopora spp., Glaxea spp., Montipora spp. and Acropora spp.

The area contained by Msasani Bay to the south and north towards Ras Kirimoni including the islands of Bongoyo, Mbudya and Fungu Yasin is subjected to continuous explosive fishing. Up to three impacts per hour have been recorded, taking place during the morning. Fishermen in ngalawas (outrigger canoes) and small dhows drift slowly while a diver in the water locates a concentration of fish. Other divers then enter the water and form a loose ring some 20 to 30 m from the fish. An explosive charge is dropped on the fish which are then collected by the divers. The collected fish are then loaded on to a second vessel and presumably taken to a landing site for sale. Explosive fishing is being carried out openly during daylight hours in close proximity to residential areas. Action is seldom taken to prevent this activity.

A small watercourse enters the bay at Kunduchi, and a large accumulation of sand banks have appeared at the river's mouth. A recent survey commissioned by NEMC (but not yet released) suggests that the sand bank formations are the result of sand and aggregate extraction operations in areas adjacent to the river. Observations of beach dynamics, as suggested by current beach formations, and recent aerial photographs (June, 1987) suggest that current patterns in Msasani Bay and northwards to Ras Kirimoni have been influenced by the build-up of the banks at Kunduchi resulting in a serious beach erosion problem. The bank formations seem to suggest that coastwise currents are vortexing at the bank thus impeding the coastwise transport of beach material. Likewise, sediments moving northwards from Msasani Bay are trapped by the banks and hence do not feed the beaches north of Kunduchi.

(e) Ras Kankadya to Ras Ndege

The area from Ras Kankadya to Ras Ndege includes outer and inner Makatumbé and outer and inner Sinda Islands. The area represents a poorly developed fringing reef system fronting the coast from Dar es Salaam and the most serious levels of pollution both urban and industrial in the United Republic of Tanzania.

The marine environments were not observed during this survey, but the harbour area and effluent discharge points were seen. The islands and reefs south of Dar es Salaam will be assessed quantitatively from January to May, 1988. The results of this survey will be directly applicable to the formulation of an Action Plan and will identify programmes to be initiated in the Dar es Salaam region.

## 1.2 MANGROVE AREAS

Two mangrove areas were identified in the Dar es Salaam region. The first, a vestigial mangrove stand at Kunduchi has been severely cut back. Continued cutting for local use is further reducing what trees remain. The second, in the inner harbour of Dar es Salaam is in better condition with larger specimens and greater diversity (3 species counted), but these mangroves are subject to continuous chronic pollution by urban wastes flowing in from the Yembo River, chemical wastes from the Changombe area, oil spillages from the refinery at Kigamboni and oil and waste from ships in the harbour (Figure 9, annex X). The mangrove stands in the harbour are under continuous stress, and the forests are liable to collapse if the present load is maintained.

A mangrove stand which once occupied a prominent position at the southern entrance to Dar es Salaam Harbour was reportedly killed off by a large oil spill emanating from a tanker discharging crude oil at the single buoy mooring for the TIPER Refinery at Kigamboni. The beach behind the remaining stumps appears to be eroding, but this needs closer inspection and a profiling investigation of the current beach to assess change.

## 1.3 FISHERIES

The fisheries statistics for the Dar es Salaam region are incomplete, but the data suggest that there is a high density of registered fishermen in the region and that a large proportion of the landed catch consists of pelagic species. In 1984, pelagic species accounted for 22.19% of the landed catch, while in 1985 this increased to 26.35% which reflects the increase in both fishermen and gears. In both years, Lethrinus (Changu), a scavenging species, were caught in greatest numbers, 18.46 % of the total catch in 1984, and 35.60% in 1985.

The data for the Dar es Salaam region is presented in table 5, annex IX, but is incomplete and the differences suggest inconsistencies in the data gathering process. It is clear that an independent survey is required to accurately define the fishing effort in the Dar es Salaam region.

## 2. SOURCES OF POLLUTION, INDUSTRIAL AND URBAN

Dar es Salaam is characterized as having the highest levels of pollution in the United Republic of Tanzania. The effluents are from industrial discharges (with Dar es Salaam accommodating 80% of the national industrial base) and from urban wastes from both planned and unplanned residential developments. In all cases discharges are made directly to the sea or to water courses and drainage systems leading to it.

An inventory of polluting industries has been carried out by Tanzania Ministry of Lands, Tourism and Housing, Environment Section [which has since become the National Environment Management Council (NEMC)] and has been presented in UNEP Regional Seas Reports and Studies No. 8, 1982. NEMC is currently continuing this inventory and maintaining monitoring stations. Water analyses are carried out by the University of Dar es Salaam, the Government Chemical Laboratory or are analyzed abroad as part of an assistance programme in which SIDA provides NEMC with a senior environmental advisor and technical assistance as required.

Urban sewage is discharged directly without treatment through storm water drains into the harbour area at Keko, Kurasini, Mtoni, Shimo la Udango and via large pipes discharging to the mud flats fronting Ocean Road to the north of Banda Beach.

In both locations (Harbour and along Ocean Road to Oyster Bay (Figure 9, annex X) faecal wastes were seen to accumulate on the beaches. There is also an increased level of productivity associated with the persistent injections of organic waste, this has resulted in stimulated algal growth, primarily of Ulva, Thalassodendron and associated fauna. The increased productivity has likewise led to increased turbidity, siltation by detrital material of algal or planktonic origin and a foul smelling accumulation of rotting algal material and faeces on the beach and sand flats fronting the Selander Bridge.

Several beaches adjacent to the harbour, the main sewage outfall, and beaches a considerable distance from these (Oyster Bay) are popular swimming areas. The hazards of swimming at these beaches must be communicated to the public, and they must be made aware of the risk of contracting bacterial diseases such as typhoid, cholera, dysentery, giardiasis and viral diseases such as polio and infectious hepatitis. It should also be noted that the cysts of *Ascaris lumbricoides* can survive for several days in seawater.

The Tanzania Urban Planning Division of the Ministry of Lands, Natural Resources and Tourism commissioned a survey of the waters of Dar es Salaam to assess coliform bacteria content. The area investigated included the coastal area outside Dar es Salaam harbour, northwards to the Selander Bridge and the River Msimbazi and included sites in Msasani Bay to just south of Ras Kirimoni. The results of this survey carried out on the given dates is presented in table 6, annex IX.

The results seem to suggest that during high tides the dilution factor is enough to inactivate or reduce the density of the coliforms, *Salmonella* and *Staphylococci*. Their presence becomes apparent during low tides when they are recorded outside the Aga Khan Hospital, Banda Beach and Oyster Bay. On the 25 of October 1987 coliforms, *Staphylococci* and *Salmonella* were recorded at the Aga Khan Hospital and Banda Beach sites. The Aga Khan Hospital does not treat its effluents, and these are discharged on the beach fronting the hospital. It is likely that this area contains other pathogens creating a serious public health risk to swimmers, coastal fishermen using cast nets on the beach and their consumers.

It is recommended that swimming at Banda Beach and the Ocean Road Beach be prohibited and that the beach at Oyster Bay be posted with a warning. These are not solutions but measures taken to protect public health. Ultimately, all urban effluents must be treated and the discharge pipe located further offshore in a main northerly current stream where tidal cycling will not influence the dilution of the discharge.

**(a) Tanzanian and Italian Petroleum Refining Co. Ltd. (TIPER)**

This refinery located at Kigamboni to the south of Dar es Salaam Harbour receives approximately 750,000 metric tonnes of crude oil per year discharged from the tankers, into an offshore coupling pipeline located to the west of Inner Makatumba Island. The currents at the discharge facility are predominantly west to north.

The crude oil is stored on shore and processed to produce super gasoline (60,000 tonnes/year), normal gasoline (54,800 tonnes/year), jet fuel (24,600 tonnes/year), Kerosene (51,000 tonnes/year), gasoil (116,900 tonnes/year), IDO (62,600 tonnes/year), fuel oil (129,800 tonnes/year), bitumen (30,000 tonnes/year) and a residue (183,000 tonnes/year). The residue is gravity separated by an API unit into hydrocarbon fractions (stored for further separation and waste water fractions, the latter being discharged into the harbour). See figure 16 annex, X.

Oil spills from the refinery have resulted in chronic pollution of the harbour area and the coastline around the effluent outlet. Oil spills from tankers and the TIPER Refinery have resulted in a noticeable degradation of mangrove cover. A tanker spill (50 to 100 Tonnes) in January, 1981, was closely studied by the Marine Biology Department of the University of Dar es Salaam and showed that there was an immediate mortality of sipunculids, hydroids, isopods and fish species. The longer term effect, resulted in 95% mortality of a mangrove area at the entrance to the harbour within 250 days of the event. Only a few Avicennia spp. remained.

A second oil spill accident from the refinery occurred on 14 May 1986. During this event the harbour area was severely polluted, but no investigations were carried out to assess the effects of the remaining harbour biota.

Pollution protection measures have been proposed by the Environment Section of the Tanzania Ministry of Lands, Water, Housing and Urban Development, now the NEMC (1984). These included:

- (i) A regular water monitoring programme for measuring the volume of oil carried in effluent discharge. Previous records show that TIPER was dumping 1,000 mg of oil per litre of effluent. The temporary Tanzanian water standards for oil in effluents is set at 5 mg/l when the effluents are discharged directly into the receiving water.

The Central Government Chemical Laboratory was willing to use their infra-red spectrophotometer to this end. A new infra-red cell was purchased, but no water samples were received.

- (ii) It was suggested that a boom be installed at the sea fall to collect all discharged oils within the boom area. This oil would then be collected by the twin hulled weir skimmer belonging to the Harbour Authority.
- (iii) The refinery has the capacity to deal with the recovered oils and oil/water emulsions.

#### Recommendations

The TIPER Refinery causes unnecessary pollution of the harbour area and the coastal zone. The necessary legislation should be enforced and the recommendations of the NEMC adhered to.

#### 2.1 TANZANIA HARBOUR

The harbour is a natural deep water facility subject to incomplete flushing (Bryceson, 1982). It receives the effluents from moored vessels, the TIPER Refinery and from storm drains carrying urban and chemical wastes including insecticides, pesticides, paint wastes, mercury and organic wastes.

The control of shipborne spills and discharge are the responsibility of the Harbour Master and the Tanzania Harbours Authority whose responsibility it is to handle all aspects of oil pollution including its prevention and control. To satisfy the requirements of this role, the authority has the following oil spill response equipment:

- (i) a 500 Vikoma-Seapak inflatable boom with a fibreglass hull. This unit is not in working order;
- (ii) a twin hulled self-propelled weir skimmer with a 30 m<sup>3</sup> onboard storage capacity for recovered oil - not in working order; and
- (iii) a 15 m tender equipped for dispersant spraying in working condition and there is a stockpile of shell LTX dispersant.

A National Marine Oil spill Contingency Plan was proposed in December, 1984. However, it is not known if the plan has been adopted.

### 3. MARINE RESERVES AND PROTECTED AREAS

The Dar es Salaam region has four declared marine reserves which have been described in section 1, and includes the Islands of Mbudya, Bongoyo, Pangavini and the reef and sand bank formation at Yasin. Though gazetted, none of these reserves have been implemented, and the public is not aware of their status. Though gazetted in GN 137 of 1975, these islands have been subjected to continued fishing pressure and the removal of living specimens by visitors. The result has been a gradual deterioration of bottom fauna and associated finfish species to the present depleted levels.

It is recommended that these reserves be implemented and managed according to requirements of the Action Plan. Further deterioration can be avoided by the placement of fixed moorings for fishing and visiting vessels. No new reserves are planned for the Dar es Salaam region.

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**ANNEX IV**

**REPORT ON THE LINDI REGION**



## INTRODUCTION

The Lindi region (Figure 1, annex X) extends from the regional line separating it from the Coast region to the north at Samanga to the regional line separating it from Mtwara region at the mouth of the Mambi River to the south.

There are four watersheds draining into the coastal zone of the Lindi region: Mavudji, Mbemukuru and Lukuledi River Basins draining 53,370 km<sup>2</sup>. The largest of these, the Matandu, drains 18,565 km<sup>2</sup> at a point just north of Kilwa Kivinje followed by the Mbemburu draining 16,255 km<sup>2</sup> at a point south of Kisewere and the Lukuledi draining 12,950 km<sup>2</sup> into Lindi Bay (Figure 5, annex X).

The major coastal urban areas are Kilwa Kivinje, Kilwa Masoko and Lindi, the regional headquarters.

The survey of the Lindi region included the reefs and islands of Okuza, Nyuni, Songo Songo, the Kilwa area including the mangrove areas, a proposed industrial and residential development, the historical sites in Kilwa Kisiwani and the Lindi area. These sites are assessed based on direct observations and discussions held with officials at Kilwa and Lindi. The environmental implications of the proposed natural gas developments at Songo Songo and Kilwa Masoko were assessed in the presence of the Tanzania Petroleum Development Corporation (TPDC) officer and members of NEMC in the course of a site investigation organized by NEMC and funded by TPDC.

## 1. MARINE ENVIRONMENTS

### 1.1. CORAL REEFS

#### (a) Okuza Island

A sand island (Figure 7, annex X) covered by casuarina trees on a pleistocene coral platform surrounded by a well-developed fringing reef to seaward and extensive patch reef formations on all remaining sides. Coral cover was reduced to leeward of the island presumably due to sediment mobility. The island is used by transient fishermen who have erected a temporary camp using existing vegetation. Intermittent cutting to erect the camp has partially denuded the island which has destabilized and eroded substantially. The changes in profile due to erosion are evident from the fallen trees and exposed root systems of the remaining vegetation.

The back reef area is dominated by Acoporiids and Pocilloporiids, Pavona spp. and Montipora spp. colonies are also common. Cover was estimated at a maximum of 70% but this was reduced to less than 5% in areas above 10 m that had been subjected to explosive fishing and shell collecting. Dynamiting has been carried out on both shallow (less than 10 m) coral areas and on sand areas adjacent to patch reefs. Impacts on coral areas caused direct destruction of colonizing species while blasts on the sand areas lifted considerable volumes of sediment which then settled heavily on the adjacent corals. Mortality due to smothering by sediments was observed.

Damage due to shell collecting was also seen. This being easily diagnosed by the circular patterns of small debris created as the collector searches for cryptic mollusc species.

Artisanal anchors have further damaged coral areas in the back reef area, but this was not as serious as in other sites visited since the island serves as a refuge, and the vessels are anchored in specific protected areas to leeward of the island during both monsoons.

The island may have been an important turtle nesting site and they may still be landing, but the presence of fishermen eliminates all possibility of nesting. Three Chelonia myades (Green Turtle) shells were offered for sale.

#### Potential for recovery

Given a reduction in fishing pressure, the elimination of explosive fishing methods, fixed mooring for fishermen and prohibited settlement and disturbance of the island, there is no reason why damaged areas would not recover. A factor limiting possible reef regeneration is the settlement of damaged areas by soft coral species.

#### (b) Myuni Island

A pleistocene coral island (Figure 7, annex X) covered in palm trees and bushes and surrounded by a well-formed fringing reef to seaward and back reef area of patch coral formations. The island is densely settled by temporary fishing camps.

#### Status

The back reef areas were observed and found to be in excellent condition with good cover, 45 to 50% below 10m but severely damaged by explosives, anchors and shell collectors above 10m. The area from a 2 m depth to low water spring levels was devoid of coral, but the damaged coral substrate had been replaced by an algal mat.

The area contained by the 10 m and 2 m depth contours had poor cover and diversity, 1 to 2% for the former and Acropora spp. dominance for the latter. There was no evidence of coral recruitment in the area contained by the 10 m depth contour, but a substantial new settlement of soft coral species was seen, cover of these could reach 60%.

Turtles are attempting to nest on the island, but these are slaughtered by the resident fishermen. A freshly killed adult Hawksbill Turtle (Eretmochelys imbricata) was seen and reportedly had been killed ascending the beach the previous night.

#### Impacts

Shell and coral collectors from Mtwara are constantly on the island, they supply boats every two weeks. Each group of collectors may stay on the island for up to six weeks.

Explosive fishing was observed on Myuni Reef, and those fishermen observed were seen to be using what appeared to be an artisanal explosive device, the 'bomb', which was contained in a coconut. The vessels seen to be using explosives were large open boats with a central holding tank and powered by outboards. There were no visible registration numbers, and no traditional fishing gear was seen.

Fishermen once in receipt of a valid licence may fish any marine waters of the union. This mobility puts added pressure on distant fishing grounds and requires that a certain degree of control be applied. Fishing vessels observed (Ngalawas) outrigger canoes and outboard powered open boats, were from Dar es Salaam, Zanzibar and Mafia in the north, Kilwa, Lindi and Mtwara to the south.

#### Potential for recovery

The damage seen to the shallow coral areas will recover up to the 2 m depth contour line. Growth of scleractinian between low water springs and the 2 m depth contour are unlikely to recover due to substrate unavailability.

Nyuni forms part of a proposed zoned management area. Based on the results of the survey, a recommendation will be made that the area contained within a line drawn from Samanga and Okuza in the north to the southernmost point of Songo Manara Island in the south to the 100 fathom depth contour to the east and all adjacent coastal areas be considered for multiple use zoned management under the recommendations presented in the Action Plan.

(c) Songo Songo Island

Status

A pleistocene coral island (Figure 7, 14, annex, X) now the centre of a planned natural gas recovery and ammonia cracking plant complex to be constructed at Songo Songo (primary separation) and Kilwa Masoko (Ammonia Plant). The island is not freely accessible but has an excellent runway capable of accepting light commercial aircraft. Access from the sea is discouraged.

Impacts

The exploration phase has left three capped producer wells offshore and two capped producer wells onshore. There is a small village for Tanzania Petroleum Development Corporation (TPDC) employees and a local village on opposite sides of the island. (Figure 16, annex X). Two piers have been constructed. The first, a wooden structure (Point A, Figure 14, annex X) is used for discharge of petroleum products for use on the island, the second (Point B, Figure 14, annex X) a large concrete structure formerly used to discharge heavy equipment and load drilling pipe sections. The construction of the cement pier has already begun to cause erosional problems. The construction of the pier, in line with two pleistocene coral islets, has effectively created a barrier which has altered current flows and coastwise sediment transport. The beach area fronting the TPDC village is eroding despite a small retention wall of cement bags erected on the beach at the high water line. The village was constructed in 1976, the cement pier was completed in 1981, erosion of the beach fronting the village began in 1981. The only factor which had changed over that period was the pier. The planned developments are discussed in section 2.

(d) Kilwa Kisiwani, Kilwa Mssoko

Both of these settlements are at the mouth of the extensive mangrove and harbour area of Kilwa Harbour. Kilwa Masoko is the Kilwa District Headquarters, Kilwa Kisiwani on the opposite side of the harbour is an island of great historical and anthropological value.

Status

The harbour is fringed by a well-developed mangrove forest cover, which up to 1980 was cut for export to Iran. Since the start of the Gulf War this market was terminated, present cutting for domestic use is unregulated and estimated at 10 to 20 mangrove poles per person per year. There has been no recent inventory of mangrove resources.

The inner 'harbour' area is possibly an important breeding site of commercially important finfish species, Carangidae, Tunnidae and Sardinella. There are no important coral reef formations in the inner harbour area, which is dominated by seagrass, Thalassia, Thalassodendron in shallow areas (less than 10 m). Extensive coral reef formations were seen fronting Kilwa Kisiwani Island to seaward and on the southern entrance to the harbour. The reef banks steeply from 35 to 50 fathoms. Likewise, there were important fringing reef formations fronting the mainland coast to seaward of Kilwa Masoko leading to a coral and sand island complex 7 nm to the east and north.

No pollution problems were observed, urban wastes being contained in septic tanks and pit latrines. There are no industrial developments on the Kilwa Kisiwani or Kilwa Masoko.

### Impacts

District officers report that the use of explosive fishing is common, but no evidence of this was seen. The removal of frame building Porites spp. and Pavona spp. for use as aggregate material and lime production was seen. Fossil coral is commonly available and should be used in preference to living coral whose use should be discouraged.

A well preserved complex of ruins dating to the 11<sup>th</sup> century are found on Kilwa Kisiwani. The site is unique, representing a range of architectural styles, tracing the historical and anthropological development of the region. Given the right conditions, this site could well be developed as a major tourist attraction. With this goal in mind, it is suggested that it be zoned appropriately within the framework of the multiple use management area. The proposed zones within the management area are shown in figure 12, annex X, and described in the Action Plan (Section E).

## 2. SONGO SONGO - KILWA MASOKO - NATURAL GAS/AMMONIA/UREA INDUSTRIAL COMPLEX

Explorations for hydrocarbon deposits in Tanzania have identified a major natural gas field under the island and in the coastal waters adjacent to Songo Songo. Initial exploration has estimated that the recoverable gas reserves is in the order of 762 billion standard cubic feet and could last 25 years under the present extraction and processing plans.

At present, there are five producer wells, two on the island of Songo Songo and three offshore. These have been capped pending implementation of the management plan.

The plan calls for feeder pipelines from the five producer wells to be taken to a dehydration and separation plant to be constructed on Songo Songo. The raw gas will be treated with triethylglytrol which will separate water (0.5 barrel/million SCF) and hydrocarbons (0.5 barrel/million SCF) from the raw gas which will then be piped to the ammonia/urea cracking plant to be constructed at a site adjacent to Kilwa Masoko (Figure 13, annex X). The water will be discharged directly to the ocean via a piped outfall and the hydrocarbons shipped to the TIPER Refinery in Dar es Salaam for processing. A 50 km pipeline having a 22 km submerged section will be constructed from Songo Songo to the Kilwa Masoko complex. Delivery rate will be 65 million SCF/day or 56,797 m<sup>3</sup>/hour.

The Kilwa Masoko ammonia/urea plant (KILAMCO) will be constructed as per (Figure 13, annex X). The plan calls for the construction of harbour facilities with a pier to run from the shore over pleistocene coral substrate to a deep berth at 20 fathoms. The area chosen for this is currently devoid of mangrove cover, but they are present, both to the east and west of the planned site. It was noted that the existing mangrove cover (of mixed species) was an important coastal stabilizing factor, and their removal should be avoided during the construction phases.

The planned ammonia/urea complex will have a capacity of 515,000 tonnes NH<sub>3</sub>/year from which 535,000 tonnes of urea will be produced. The complex will use 29,000 m<sup>3</sup> of seawater/tonne of product as cooling water. The urea plant will utilize an estimated 48 m<sup>3</sup> of seawater and 55 m<sup>3</sup> of freshwater per tonne of product, the ammonia plant an estimated 126 m<sup>3</sup> of seawater and 80 m<sup>3</sup> of freshwater per tonne of product.

The plant proposes to use the Haldor Topsoe Ammonia process and the Snaprogetti urea process which reportedly will add 500 kg of ammonia and 1,000 kg of urea to discharge waters per day. The proposed discharge site will be via a 200 to 300 m pipeline directly to the sea adjacent to the jetty.

A residential area and hotel complex are also planned. The former located to the north of the plant and the latter on a plot adjacent to the plant (Figure 14, annex X).

## Recommendations

Prior to construction of the complexes on both Songo Songo and Kilwa Masoko, it will be strongly recommended that a full baseline study be carried out and that guidelines in accordance with the areas management priorities be produced. The study should be long term entailing an initial investigation to include:

- (i) a determination of physical and chemical oceanographic factors, in particular investigating current patterns and velocities, turnover rates, salinity, temperature, pH, sediment load, productivity;
- (ii) a full inventory of coral reef and mangrove resources;
- (iii) the identification of representative habitats and faunal associations for use as benchmarks. These will serve as indicators of environmental change for a long term monitoring programme; and
- (iv) a full cost/benefit analysis of the planned developments.

## 3. LINDI

Lindi, the regional headquarters and main urban area of the Lindi region is situated at the mouth of Mto Lukuledi in a well-developed estuarine system bordered by mixed mangrove forests. Lindi Bay fronting the urban area is a wide geographical feature with shoaling banks of alluvial origin close to shore and fringing coral reef formations on both the northern and southern shores (Figure 11, annex X).

### Status

Coral reef areas were investigated at a location west of Ras Rungi (Figure 11, annex X). The reef consists of a well-formed fringing reef subject to heavy artisanal fishing pressures. There is a shallow bank leading to the reef crest from the 8 m depth contour to a drying crest. This area had been severely damaged by explosive fishing and artisanal anchoring techniques, the degree of damage attributable to each being approximately equal. Coral cover was less than 5% with Montipora spp., Porites spp., and Galaxea spp. being dominant. To seaward of this damaged zone was a fore reef slope of about 40° densely covered by a diverse coral fauna to a depth of 25 m. 38 genera were observed with no clear zonation or dominance. Porites spp., Favia spp., Porites spp., Pavona spp., Montipora spp., Oulophyllia spp., Plerogyra spp., Phisogyra spp., Millepora spp., Acropora spp. and other genera were all well represented. Cover in this area was estimated at 75 to 80% with no evidence of dynamiting. Reef fish were abundant and herbivorous species normally found in shallow reef areas were present on the fore reef slope. It is possible that, due to fishing pressure and habitat degradation on the shallow reef, the reef fauna has shifted downward to stable reef zones away from direct pressure.

It is recommended that fixed moorings be placed in suitable areas on the deep reef to provide access to the finfish stocks while allowing the shallow reef flat to regenerate.

Shallow areas had been colonized by soft coral species and Sargassum. The cover of these was estimated at 35 to 40%. The dense cover precludes settlement by scleractinian species, however, the presence of a diverse genetic source on the fore reef slope makes rehabilitation of the reef flat distinctly possible. Juvenile Acropora spp., Pocillopora spp. and Gardinoseris spp. were observed.

### Impacts

In addition to explosive fishing and anchoring practices, coral reefs in the Lindi area are also subject to damage from shell collectors of which there are several dealing with one licensed exporter, exporting to Hong Kong, Japan, India, West Germany, China, Canada, Singapore, France and the United Arab Emirates. In addition to shells mostly Murex, Turban and Cypraeid, export markets have been found for Holothurian species, shark fins and jaws. Corals are also collected for use as aggregates and building materials. This practice is unregulated.

The mangrove areas in the Lindi region have not been recently inventoried. The cutting of mangrove areas has been extensive to clear areas for salt production using solar evaporation basins. A conflict between the Division of Forestry of the Tanzania Ministry of Natural Resources and Tourism and the Industry Ministry has become apparent. The Forestry Division considers all mangrove areas to be closed forests and extends considerable effort in controlling cutting operations in accessible areas where surveillance is possible. The Ministry of Industry promotes regional development and so encourages new projects. A licence to operate a salt work can be issued by the Ministry of Industry without consulting the Forestry Division as to site selection. The operator in possession of a valid licence is then free to develop the property specified in his licence.

It is clear that the NEMC, a supra ministerial body which can liaise with the ministries, should be in a position to assess different project proposals having an influence on the coastal zone, assess site selection and request impact statements where situations are unclear or unknown. It will be suggested that NEMC assume this role and that in consultation with the ministries concerned evaluate all proposed developments.

District officials expressed concern over a considerable beach erosion problem. On investigation, it was found that the two areas in question, the beach fronting Lindi town and an area backed by a sandstone cliff, were subject to normal beach dynamics. The beach fronting the town has built up over the past 10 years to within one metre of the top of a retaining wall, reportedly four metres of accumulation. Sand accumulation can be expected in this area which is influenced both by riverine sediments and shifting sand banks of alluvial origin. The beach has small dune formations covered by stabilizing vegetation. It was suggested to district officers that the beach was stable and that investment in a further sea-wall was not required, but that beach profiles should be studied. The second site is undergoing continuous erosion but contours suggest that this has been the case prior to any settlement of the area. The cliff is of compacted alluvial sediments of terrigenous origins which was exposed by receding sea levels. This erosional process may have generated much of the current beach and bank accumulations. Construction of a sea-wall to prevent this process will prove difficult with the collapse of the construction likely, in a short period. It was suggested that a better alternative would be to prevent construction of new residential areas in that land fronted by unstable cliff formations.

Sand extraction is not allowed in the beach area, but small scale extraction was seen to be taking place. A larger site (3 extraction faces) was found on the northern shore of Lindi Bay. Excavation was being carried out in an alluvial cliff formation backing a low density mangrove stand. The sand at the site was capped by approximately 2 m of red clay/loam topsoil, a 3 to 4 m band of recoverable sand was below. Excavation of the sand caused the collapse of the heavier topsoil which was then shunted to the beach area. Two of the excavation faces were approximately five to eight metres from the high water spring line, the third was at the high water spring level. It was suggested that excavations should be abandoned as it poses a greater threat to coast stability than the two upper sites which are fronted by a substantial protective platform. There should also be a sediment trap constructed, consisting of a simple ditch approximately 1.5 m deep with drainage on the top. Rainwater and sediment will collect in the ditch, the sediment will settle out and water with only fine suspended particulate material, will drain out the top of the ditch. A second drainage system can be constructed to decant water once rain ceases, this being necessary to avoid a mosquito problem. The sediment once dry can be removed.

#### 4. URBAN AND INDUSTRIAL POLLUTION

There are no major operating industrial developments in Lindi. Cashewnut processing factories have been erected, but these are no longer functioning. A small industrial complex is now operating, but there are no effluents being discharged at the moment.

There is a slight problem, easily rectified, which is caused by the indiscriminate dumping of waste oils at a garage fronting the estuary and backing onto a mangrove stand. The oil was seen to be coating the root systems of trees adjacent to the garage. The oil is washed away from the dumping site to the mangrove stand during high water springs.

Lindi has no treatment facilities for urban wastes. Raw sewage is carried by a drainage system to open streams that then empty into the estuary. The effluent sites are all within the town limits and as such pose a serious public health risk. The beach area fronting the town had a thick cover of Ulva in the intertidal area. The sediments were anoxic 1 cm below the surface, burrowing organisms were rare. The area is used for fishing, cleaning landed catches and cooking utensils.

##### LINDI HARBOUR

The harbour contained to the south by a drying sand bank has recently undergone a rehabilitation programme. The alongside berth can accept one shallow draught vessel. There are no cleaning facilities in the event of an accidental oil spill. Harbour regulations for Lindi must prohibit the pumping of bilges into the estuary, and a storage facility must be provided.

#### 5. FISHERIES

The Lindi region having no inshore bank areas and a narrow fringing reef system has correspondingly fewer number of registered artisanal fishermen. The Statistics Programme of the Tanzania Ministry of Natural Resources and Tourism collects data on a regular basis, however the data for the Lindi region must be taken with scepticism. The District Natural Resources Officer reported that the data gathering system is unreliable.

The statistics presented in table 6, annex IX, do raise questions about their validity since there was a reduction in the number of vessels by 47% yet an increased number of gear and catch. The only vessel type showing an increase is the dhow of which there are 53 in 1985 as opposed to 46 in 1984. This slight increase cannot account for the increased number of nets. Furthermore, the general complaint of fishermen is the difficulty in obtaining this type of gear hence justifying their use of explosives. The data from the Lindi region requires verification by an independent frame survey.

#### 6. PRIORITIES FOR MANAGEMENT AS DEFINED BY LINDI REGIONAL AND DISTRICT OFFICERS

At the request of the consultant, regional and district officers were requested to identify what in their opinion were the foremost problems needing attention within the context of a management plan for coastal resources.

Priorities were identified as follows:

- to establish a surveillance unit to combat explosive fishing;

- to inventory the mangrove resources of the region and to curb the illegal cutting by unlicensed operators;
- to declare a protected area from Ras Banura to Mchinga Bay;
- to institute an extension programme for artisanal fishermen; and
- to make fishing gear available at nominal cost to artisanal fishermen.

The priorities identified by regional officers are all addressed in the context of the proposed Action Plan.

## 7. MARINE RESERVES AND PROTECTED AREAS

Two areas have been identified as suitable for marine reserves. The first is that area described from Okuza Island to Songo Manara (Figure 12 annex X) which would be treated as a multiple use zone managed reserve, and the second, the area contained by Mching Bay to the north and Ras Banura to the south which would be classified as a strict marine reserve. (Figure 11, annex X). The proposed site is a complex of embayments, islands, fringing reefs and mangrove forest that reportedly, is an identified spawning and nursery area for pelagic and reef finfish and also an identified turtle nesting area.

At present, the second site is subject to intense artisanal fishing pressure by both traditional and explosive techniques. Carcasses of Green (Chelonia myades) and Hawksbill (Eretmochelys imbricata) Turtles are common at all established fishing camps.

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**ANNEX V**

**REPORT ON THE MTWARA REGION**

## INTRODUCTION

The Mtwara region (Figure 1, annex X) borders the regional demarkation line with Lindi region to the north at the mouth of Mambi River and borders Mozambique at the Ruvuma River to the south.

Mtwara is the only major coastal urban area and contains the southernmost deep water harbour in Tanzania and the regional headquarters.

Due to current political tensions in the area, it was not possible to carry out a coastwise survey of the Mtwara region. The harbour area and Mikindani Bay were observed from shore in the presence of Mtwara Regional Natural Resources Officer.

## 1. MARINE ENVIRONMENT

### 1.1. COASTAL FEATURES

The coast is characterized by a deep embayment at Mikindani Bay, a bank area fronted by fringing reefs and islands extending from Ras Msamgambku to the north, and Ras Ruvura to the south. The Ruvuma River which marks the border with Mozambique has formed an extensive deltaic plain which is well covered with mangroves.

The major impact to coastal resources was reported to be explosive fishing. This was confirmed by site observations reported by qualified divers who reported a general decrease in coral cover and reef fish populations in shallow coral reef areas (less than 10 m).

The general reason given for the increase in explosive fishing is the shortage of gear availability, in particular that of fishing nets produced by the Dar es Salaam Fish Net Factory. It was reported that artisanal fishing groups have been complaining to fisheries officers that there is a noticeable decrease in available fish stocks when using traditional fishing methods.

The sources of explosives according to regional officers are the Dar es Salaam Cement Factory at Kunduchi, and the Finnwater Project who use explosives for seismic surveys. There have been reports of a robbery of several hundred kilos of dynamite from the stores of the Finnwater project.

There is no reported explosive fishing activity in the reef and bank area south of Mtwara, from Ras Msamgambku to the Ruvuma River. This area consisting of extensive fringing reef systems, offshore islands (with coast watching stations), mangrove forests and banks is reputedly a potential prawn fishing area. The area is under strict control by the military. Regional officers suggest that the area south of Ras Msamgambku could be gazetted a marine reserve under a multiple use management plan (Figure 15, annex X). This must, however, be verified by an on site inspection.

The mangrove areas observed are subject to unregulated cutting by the local population using the poles as building materials. Several salt works were seen in back mangrove areas, but no mangrove clearing was observed. There has been no recent inventory of mangrove resources. The only available figure is 7,998 ha. in 1957.

As in the Lindi region there is a well established shell, Holothurian and marine curio collection system organized by licensed exporters. The extent of this trade has not been quantified.

### 1.2. FISHERIES

Data collected through the Statistics Gathering Programme of the Tanzania Ministry of Natural Resources and Tourism are given in table 7, annex IX.

As in the Lindi region it is doubtful that the data can be treated with confidence. Between 1984 and 1986, there has been a reduction in boats with a reduction in total landed catch, yet there has been an increase in the number of fishermen and in all gear except for gill nets whose numbers have decreased from 1,292 to 428.

## 2. Mtwara Urban Area

The population of the Mtwara region as of 1984 was 869,095 with 54,000 residing in urban Mtwara and 162,562 in adjacent rural areas. The annual population growth is 3.0%.

There are no major sources of pollution in Mtwara, urban wastes and sewage are collected in cesspits which are intermittently pumped out but the discharge sites were not identified.

There are no operational industrial developments in the Mtwara region. The cashewnut processing factories have been closed for several years. A small industrial estate is currently under construction but little interest has been expressed regarding occupancy. The handling of effluents and discharges were unknown.

The Mtwara Harbour, a deep water facility with little traffic was found to be clean and no evidence was seen of past oil spillage. A potential for spillage of processed petroleum products does exist in that they are discharged from a tanker to a standpipe 3 m from the dockside and piped to storage tanks a short distance from the shore. The valves and pipes both show evidence of corrosion and any breakage will result in a substantial oil spill into the harbour area. At present, the harbour authorities possess no cleaning or dispersing equipment, but if made available would be prepared to use it.

## 3. PRIORITIES FOR MANAGEMENT PRIORITIES AS DEFINED BY Mtwara REGIONAL AND DISTRICT OFFICERS

At the request of the consultant, regional and district officers identify what in their opinion were the foremost priorities requiring attention within the context of a management plan, for the coastal resources.

The priorities were identified as follows:

- (i) education: fishermen extension services and a limited public awareness programme;
- (ii) fishing gear: make fishing gear available to artisanal fishermen;
- (iii) surveillance: provide vessels for coastal surveillance and control operations; and
- (iv) marine Reserves: investigate the possible gazetting of a marine reserve area to include all the coastal areas to the 100 fathom line south of Ras Msamanku. (Figure 15, annex<sup>o</sup>X).

### Recommendations

Since the coastal zone of the Mtwara region was not properly assessed due to existing tension and controls, it is not possible to recommend actions specific to the needs of the region within the context of the Action Plan. But those aspects dealing with public awareness programmes, the control of explosive fishing and inventory programmes are all applicable to the region.

**ANNEX VI**

**REPORT ON ZANZIBAR**

## INTRODUCTION

Zanzibar comprising the islands of Zanzibar (Unguja), Pemba and other minor islands, united with Tanzania in 1964, but still retains its own Parliament and Government. The population of Zanzibar and Pemba is approximately 589,000, divided relatively equally. The annual population growth is 3% in rural areas and approximately 5% in urban areas. Geologically, the islands are very different.

Zanzibar (Figure 2, annex X) consists primarily of an exposed pleistocene platform backed by an extensive bank formation to the mainland of Tanzania. Several islands of pleistocene coral origin can be found to the west, these being Kepandiko, Chapani, Chango, Bawi, Chumbe, Kwale and Pungume. To the north is the island of Tumbatu, which may once have been attached to the main island and is now separated by a channel 1.5 to 3 nm wide with a maximum depth of 8 fathoms and a minimum depth of 1 fathom.

The east coast is generally straight on a northwest/southeast axis. To the north is a small pleistocene coral island (Mnemba) surrounded by extensive coral formations and deep water to seaward. There is a large embayment of shoaling water at Chwaka. The bay is covered primarily by Thalassodendron and is surrounded by mangrove forest on its southern fringes.

A fringing reef fronting the east coast is continuous from Ras Mungwe to the north and Ras Kizimkazi to the south. This is a high energy reef, backed by a small back reef/lagoon system that may dry at low water springs. Fishing villages (Figure 6, annex X) can be found the length of the east coast, but the communication infrastructure is not well developed.

There are no rivers in Zanzibar. The main urban area is Zanzibar Town with lesser rural agglomerations, Mkokotoni to the north, Chwaka on the east and Makunduchi to the south.

Pemba Island (Figure 2, annex X) lies between the latitudes 04° 50'S and 05° 30'S, bisected by the longitude 39° 45'E. It is a true oceanic island surrounded on all sides by deep water reaching a maximum depth of 546 fathoms (1,092 m).

The east coast of the island consists of a narrow fringing reef with the 100 fathom line lying 1 to 2 nm offshore. Between Ras Kiuyu to the north and Ras Upembe to the south, the coast consists of a low lying pleistocene reef structure, with three breaks, fronted by low mangrove covered islands.

The south coast from Ras Upembe to Matumbe Makupa is a drying bank area with a series of dissected pleistocene coral islets. The islets may have eroded to their present position explaining the structure of the bank which is likewise a pleistocene coral platform.

The west coast of the island from Matumbe Makupa to Ras Kigomasha in the north, is a unique indented coast fronted by low lying pleistocene coral islands (Mesali, Fundu and Njao). To the west of these islands are embayments, fringed by mangrove forest with poor reef development, mainly small patch reefs, but extensive seagrass beds. The coral reef areas to seaward consist of narrow ribbons of fringing reefs from Mesali Island to Ras Kigomasha. The 100 fathom line lies close to shore with the distances varying from less than 0.5 to 1 nm.

Pemba has three main urban areas, all situated on the west coast, almost equidistant from each other. From north to south they are: Wete, Chake Chake and Mkoani. There is a single tarmac road linking these urban areas with tracks through the bush.

Latham Island (Fungu Kizimkazi), located at 06° 54'S and 39° 56'E is a low coral island lying 23 1/2 miles east of Ras Kimbiji. The maximum height is 3 m. To the south, there are numerous eroded and collapsing blocks of sandstone which seem to be the primary bedrock material, no pleistocene coral was seen. Northwards of the sandstone block area is a flattened plateau

approximately 1 m from the high water spring line. This area has been flattened by the constant treading of seabirds and has been built up by guano accumulation. At the time visited, Gannets, Brown Booby and Sooty Terns were breeding.

To the north of the plateau is a beach sloping sharply from the high water spring line to a platform interspersed with uplifted slabs of beachrock and coral boulders. This suggests that the island was subject to violent storm conditions.

To seaward of the island is an extensive bank of coral and sand, sloping gradually to the 100 fathom line. The extent of coral growth has not been recorded. The bank on the same northwest/southeast axis as Zanzibar is approximately 11 nm long and 5.5 nm wide. Currents are very strong reaching 4 to 6 knots in a northwesterly direction.

Representative examples of all marine and coastal environments were surveyed on Zanzibar and Pemba including an assessment of urban and industrial development. The information presented below is a digest of observations and discussions held with Zanzibar Government officials. The survey included Latham Island to the south of Zanzibar.

## 1. MARINE ENVIRONMENTS

### 1.1. ZANZIBAR

The reefs and islands fronting Zanzibar town and extending to the southwest of the island are arranged in a loose formation which can be represented by three rings.

- (i) The ring formed by the islands of Chapani, Kepandiko and Chango to the north and the reefs of Fungu Chawamba, Pange and Kisiki arching to the southwest;
- (ii) The ring consisting of Danzi Reef to the north, Bawi Island, the reefs known as Murogo and Nyange and the reef and island formations of Chumbe and Kwale to the southwest; and
- (iii) The ring to seaward of Zanzibar Town formed by Fawatu Reef to the north and towards the south, Fungu Mapape, Mwamba Mapape, Pwakuu Reef and the Tambare and Boribu Reefs (Figure 2, annex X).

These reefs and islands have all been extensively surveyed and the data for these are available. Only those habitats of interest to this survey will be discussed.

#### (a) Chapani - Kepandiko - Chango Islands

These islands to the north of Zanzibar Town (2 to 2.8 nm) are surrounded by extensive bank areas with poorly developed patch reef cover, consisting of 26 genera with Acropora spp., Pocillopora spp., Goniopora spp., Galaxea spp. and Seriatopora spp. being dominant. The coral distribution can be compared to a standard back reef development.

The bank areas are also covered by luxuriant growths of Thalassia, Thalassodendron and Zostera. These seagrass areas far outweigh the corals in total cover, with corals showing a maximum of 20% cover.

The water around these islands are characterized by high turbidity levels with visibility seldom exceeding 4 m. The turbidity can be attributed to planktonic and suspended organic material due to increased levels of productivity fueled by raw sewage effluents from Zanzibar Town. The current patterns are predominantly northwards, but the islands forming a barrier to the north create a circular counterclockwise localized flow pattern.

Poor water quality, increased productivity and heavy artisanal fishing pressure have resulted in a continuous mortality of the coral fauna. This seems to suggest that the coral fauna are surviving marginally in stress conditions.

Changu Island, formerly a quarantine post and a prison, has recently been developed as a tourist facility consisting of a guesthouse, a restaurant and bar. The island receives frequent visitors, and a marked degradation in coral fauna has been observed.

(b) Pange Reef

Pange Reef which dries to 2 m, is an extensive bank formation covered by shallow patch reefs in poor condition. Twenty-four genera have been observed with the dominant species being Galaxea spp., Porites spp. and Acropora spp. Coral cover is variable with undamaged areas having a 60 to 70% cover while other areas, subjected to Acanthaster planci (Crown of Thorns) pressure approximately 10 years ago, have not recovered and show 5 to 10% cover. Damage to coral in the shallow (less than 10 m) areas has been exacerbated by artisanal fishing pressure (use of traps) and the use of the artisanal stone anchor.

To the west of Pange, there is a deep reef development to 30 m which is undamaged. Thirty-nine genera were observed with the dominant corals being the Montepora spp., Porites spp., Galaxea spp. and Favites spp. and cover 70 to 90%. Sediment load is high with the non colonized surfaces coated in fine particulate material. Living corals do not show sediment accumulation and seem to be adapted to low light levels.

Finfish species are abundant on the deep reef and large schools of adult yellowfin tuna are common at this site.

(c) Bawi Island

Bawi Island is a pleistocene coral island covered in dense shrub vegetation with a well developed beach on its southwestern tip. It is fronted by a well developed coral reef formation to the north and southeast. The northwest and southwestern sides are composed primarily of loosely aggregated patch reef developments on a shallow sand bank extending northwest for 2 nm. Seagrass cover is poor with low density stands of Zostera and Thalassodendron.

The reef to the north and southeast is steep reaching a depth of 30 m. Thirty-six genera are represented with coral cover variable between 30 to 90%. The dominant species is Galaxea, while the main frame building corals are the massive Porites spp. Other corals showing dominance are the Acropora spp., Plerogyra spp., Pocillopora spp., Fungia spp. and Montipora spp.

This island having been a naval base until quite recently was a closed area and as such the reef has not been severely disturbed by artisanal fishing pressure. The collection of shells, corals and marine curios is limited due to strong currents reaching 4 knots and surprising turbulent flows below 10 m. Hawksbill Turtles (Eretmochelys imbricata) and Green Turtles (Chelonia myades) are commonly seen on the reef. It is not known if they nest on the island.

(d) Murogo Reef

Murogo Reef is a circular reef surrounding a drying sand bank to the south of Bawi Island. The coral formations are continuous over the circumference of the reef and consist of a fringe of diverse corals extending from 1 m to 10 m and varying in width from 2 to 30 m. There are well developed patch reefs to seaward rising 10 to 15 m to within 1 m of the surface.

Forty-eight genera were observed with coral cover variable from 60 to 100%. There is no apparent damage to the coral surfaces, though a 20 to 40% mortality of shallow specimens mainly Acropora spp., Millepora spp. and Plerogyra spp. was observed. The cause is attributed to

increased water temperatures during the months of February and March, 1987, when the water temperature rose by 1.5 to 2°C. Mortality was preceded by mucus accumulations, sloughing of the tissue surfaces and a population explosion of zooxanthellae. The area was surveyed again in October, 1987, and the coral mortality was arrested. Colonies killed during this event have begun to be settled by Alcyonarian species.

(e) Nyange Reef

This reef is similar in all aspects to the Murogo Reef but approximately twice as large. Coral cover and dominance is virtually the same, but on Nyange Reef the coral cover is more extensive and the fore reef slope is well developed to 15m.

Recommendations

The Murogo and Nyange Reefs constitute the most diverse intact coral reefs seen on the coast of the United Republic of Tanzania and as such, it is proposed that they be zoned as a marine park and genetic reserve area within the limits of the proposed Zanzibar Reefs and Islands Marine Reserve.

(f) Chumbe Island

A pleistocene coral island with an extensive coral reef and seagrass bank towards the southeast. The area observed to the north and east of the island, consisted of extensive Thalassodendron and Zostera beds to the north, with pleistocene coral promontaries rising to within 3 m of the surface. These were covered with recent coral growths of 26 genera. No dominance was seen. To the east is a dense seagrass bed interspersed with loosely aggregated coral colonies mainly of the genus Goniopora spp., Seriatopora hystrix and Pocillopora spp.

Artisanal fishing pressure is very high, and damage due to shell collecting, the indiscriminate use of fish traps and stone anchors was identified.

(g) Kwale Island

A wooded island 9 m high surrounded by a bank and reef formation that extends northwards to Ras Fumba.

The island has a well established fishing camp, and damage due to it is visible on the reef to the west of the island. Damage to coral areas have reduced the cover to less than 15% and is due to the use of stone anchors and shell collecting. The area has been severely overfished with low observed finfish densities. Seagrass beds predominantly of Thalassodendron are the main bank features.

(h) Pwakuu Reef

A large coral reef bank to seaward of Nyange Reef and separated from it by a 7 fathom channel. The coral development on Pwakuu Reef has been influenced by a continuous northerly flowing current which has restricted settlement to the sides of pleistocene coral mounds. The coral growth is stunted, and likewise growth forms are seen to be influenced by the flow with encrusting forms of Porites spp. and Montepora spp. The conditions have also scoured all sediment from the pleistocene substrate and these have been colonized by encrusting red calcareous algae.

The shallow reef has been damaged by shell collecting and anchoring, and drying reef flats have been denuded by reef walkers.



(i) Mangapwani

A hotel development has been planned for Mangapwani to be constructed on two beaches separated by an exposed pleistocene cliff formation. The beaches are fronted by a narrow ribbon of coral, which have been found to be in poor condition. The survey conducted at this site showed that the coral fauna was under stress, and this was attributed to temperature and salinity fluctuations. It was found that volumes of fresh water are seeping under the beach through the permeable carbonate bedrock and are reducing the temperature and salinity of the water fronting the beaches. There was a marked temperature reduction 50cm below the surface which was coupled to a distinct density band.

Recommendations

The coral development fronting the beaches has a considerable stabilizing effect and is probably responsible for the accumulation of beach material. In view of this, it is recommended that a complete impact assessment be commissioned prior to development of the site.

(j) Nungwe

The reef to the northeast of Ras Nungwe (the northernmost point of Zanzibar) was surveyed. The fringing reef falls off sharply to seaward from a drying reef crest consisting of broken and accumulated coral debris, evidence of extreme wave energies impinging on this coast.

Coral cover was poor, 15 to 30%, and those colonies present were encrusting a scoured pleistocene coral substrate. Sand accumulations were rare, but the fore reef had been extensively colonized by soft coral species. The back reef area devoid of living coral is covered by Zostera. There is heavy pressure on the area by local villagers who litterally swarm onto the back reef in search of octopus and mollusc species.

(k) East Coast Fringing Reef

Access to the seaward reef is difficult, and to date, only the back reef areas have been observed. These areas have been destroyed south of Chwaka Bay with those areas observed at Bwejuu being devoid of living coral. Likewise, seagrass bed cover is poor. As a result, the finfish fauna normally associated with back reef systems were not present.

The back reef areas to the north at a point opposite Mnemba Island are good representative examples of back reef coral ecosystems. Isolated patches of Acropora spp. dominate with foliose Pavona spp. and Gardinoseris spp. common. The reef area observed is subject to increasing fishing pressure as back reef areas to the south become depleted. Coupled to this is an increase in the use of beach seines which will accelerate the degradation of this fragile ecosystem.

(l) Chwaka Bay

The only major embayment on the east coast of Zanzibar is an important seagrass bed dominated by Thalassodendron. The bay is fringed to the south by extensive mangrove cover of mixed species. During low water springs the entire bay dries. Coastal fishery exploitation is currently being carried out.

1.2. PEMBA

The marine environments on the west coast of Pemba were surveyed. These included the fringing reef running southwards from Ras Kigomasha fronting Njao Island including the Njao Gap, fronting Fundu Island including the Fundu Gap, the Uvinje Gap and Mesali Island.

The waters contained by the outer islands including Port Kiuyu to the north and Mkoani Bay to the south were all surveyed. The reef fronting Mtangani Gap on the east coast was observed as were the mangrove areas to the east of Mtanga Island.

The fringing reef from Ras Kigomasha to just south of the Uvinje Gap are all characterized by very narrow reef flats with depths of 1 to 7 m; leading to a very steep fore reef slope lying on the 100 fathom line.

At all eight sites surveyed, there had been severe damage by artisanal fishermen using stone anchors. Diversity and cover was extremely low (17 genera, 5% cover), the dominant species being Galaxea spp. and Pocillopora spp. This degree of destruction is to be expected since all the artisanal inshore fisheries are restricted to this narrow band of coral, with beach seining operations being the predominant technique used in the embayments between the offlying islands and the main island.

To seaward of the reef flat is a steep fore reef slope with excellent cover more than 60% in all cases. There was no obvious dominance or zonation but 46 genera were counted.

(a) Mesali Island

To the south of Uvinje Gap there is a unique reef flat area to the west that descends to the fore reef slope in a stepwise manner. Coral cover was 40 to 60% with 40 genera observed, the dominant species being Porites spp., Montipora spp., Montastrea spp., Diploastrea spp., Acropora spp. and Galaxea spp. Fishing pressure has upset the finfish fauna and resulted in an excess of herbivorous species. The Pomacentrus and Chaetodon spp. have grazed on coral surfaces leaving lesions which are causing bacterial infections and mortality of Montastrea spp. and Favia spp., 70% of these genera had been affected. The fore reef slope from 15m has a luxuriant coral cover similar to that seen in all other fore reef areas.

Recommendations

In view of the uniqueness of the habitats and the remaining coral cover, it is recommended that Mesali Island and the coral reef areas surrounding it be designated a strict marine protected area.

(b) Protected Inshore Area from Njao Gap to Port Cockburn

The inshore waters are shallow bank areas some of which dry at low water springs. There is a deep water channel with a maximum depth of 7 fathoms from Uvinje Gap to the harbour at Wete.

Coral cover is restricted to very isolated patch reefs, but the entire area is covered extensively by algal and seagrass species. As such and bearing in mind the productivity levels which are high, the area would be highly suitable for diverse mariculture developments, in particular that of Euchema and the Oyster Crassostrea.

(c) Mtangani

The fringing reef fronting Mtangani was observed and found to be in poor condition. Coral cover is variable and never exceeded 15%. Diversity is poor with only 16 genera represented. Shallow back reef areas consisting of Galaxea spp. and Acropora spp. had been damaged by storm surge and stone anchors. No resettlement was seen.

Of greater interest is the mangrove area contained within the inlet separating Mtanga Island from Pemba. The channel between the two islands is deep (7 fathoms) and may be a breeding site for finfish species. The mangroves mainly Avicennia have not been recently cut and are the habitat of a highly varied bird fauna (Hornbills and tropical birds were seen).

## **Recommendation**

It is recommended that Mtangani be surveyed and declared a coastal protected area and that the limits of the area extend to the 100 fathom line to seaward.

### **(d) Mangroves**

The coastal zone of Pemba is well covered by dense mangrove forests of mixed species. These are currently not under heavy cutting pressure and are subject to a rational management programme by the Zanzibar Ministry of Marine, Tourism and Forestry.

Cutting mangroves is permitted under licence and only in one of three specified areas, which are rotated at 5 yearly intervals. Cutting is selective and only for personal use.

### **1.3. LATHAM ISLAND**

Latham Island is unique to the coast of Tanzania both as an offshore geologic feature and as a seabird rookery. It is unclear who has jurisdiction over Latham Island with both the mainland of Tanzania and Zanzibar claiming rights. A thorough search of historical records will be necessary to determine legal rights.

The biological importance of Latham Island has been well recorded (Cooper, et. al., 1984) and was confirmed during this survey.

It is of interest to note that artisanal fishing pressure has increased and that there have been reports of explosive fishing. Evidence of this was seen on the beach where seven reef fish were observed on the high tide line. These fish had disrupted blood vessels around the eyes and gills. In addition, a recent turtle nest had been disturbed and the eggs removed.

## **Recommendations**

In view of the uniqueness of Latham Island, it is recommended that it be declared a strict reserve area and that all access to the reefs and the island be prohibited and that scientific research be licensed on a limited annual quota. The reserve area should extend to the 100 fathom line.

### **1.4. FISHERIES**

Fish protein accounts for approximately 90% of the annual intake of animal proteins by the Zanzibar populations. With this in mind, the Zanzibar Government's policy is to increase the supplies of fish by encouraging increased productivity in the artisanal fishing sector. This policy has been implemented by making gear and engines available to fishermen and by developing a distribution infrastructure to make the catch available to the rural populations. The government also seeks to stabilize prices at a low levels and to this end freezes and stores fish (mainly sardines and mackarel) caught by the state fishing company (ZAFICO). ZAFICO operates a small fleet of commercial vessels but the catch attributed to the commercial vessels is small (169 tonnes during the first quarter of 1987).

The available statistics from data (Table 8, annex IX) collected at designated landing sites (Figure 6, annex X) by the Zanzibar Ministry of Marine, Tourism and Forestry do not give details of catch by species, hence it is difficult to assess the importance of the various species. The principal groups contributing to the present catches are the demersal fish (breams, parrotfish, emperors, snappers, mullets, groupers, sharks, rays etc.) which are caught with hand lines, traps

and nets, the small pelagic fish (sardines, anchovies and mackarels) which are caught with purse seines, scoup nets and beach seines and the large pelagics (tuna, kingfish, rainbow runner, sailfish, marlin, etc.) which are caught by lines, drift gill nets and purse seines (FAO, 1987).

From the data, it can be seen that the artisanal fishing pressure is substantial and the general trend from 1980 to 1985 is an increase in both vessels and gear. It is interesting to note that there is a decrease in the number of beach seines on both Zanzibar and Pemba which is in line with government policy prohibiting their use. Yet, discussions with fisheries officers seem to suggest that this technique is once again being used.

Zanzibar has a rational development plan for the fisheries sector, and consultations with the FAO South West Indian Ocean Project are continuous to that end.

### 1.5 OTHER FISHERIES - SHELL COLLECTING

Shell collecting is currently being carried out on all Zanzibar and Pemba coral reefs. The methods used are extremely destructive and should be discouraged.

The government's policy should be to encourage rational utilization of this resource while maintaining the existing stock. To achieve this, a population survey of the major harvested molluscan species should be carried out. Designated collection areas should then be identified and these rotated at set intervals or at shorter intervals if the stock is in danger of being overfished.

#### (a) Sea Cucumbers

There is an active sea cucumber extraction fishery by a licensed exporter employing field collectors. As with the seashells, no assessment of the stock has been carried out, and it is suggested that this be carried out to assess the resource potential and institute management policies.

#### Recommendations

Little can be said to fault the long term view of the Zanzibar Government with regard to their Fisheries Policy. A note of caution should be necessary in the issuance of licences to foreign fishing vessels and these if licensed should also be responsible for stock assessments in accordance to the requirements of the government.

The Zanzibar government should actively prohibit the use of beach seines and artisanal stone anchors. The latter being replaced by manufactured fisherman type anchors as proposed in the Action Plan.

It should be a government policy to require stock assessments of all currently exploited species as a pre-requisite for management.

## 2. TOURISM

It is the policy of the Zanzibar government to expand tourism in the islands and to achieve this goal they are actively marketing the islands. Several investors have expressed an interest to develop sites at Mangapwani, Nungwe (Kendwa) and Matemwe on the east coast. A beach cottage hotel is currently being completed at Chuini.

It is recommended that prior to development, a complete assessment be carried out to determine the possible effects on the coastal marine habitats and preventative safeguards issued.

### 3. SOURCES OF POLLUTION - URBAN AND INDUSTRIAL

NEMC has conducted a recent survey of polluting industries in Zanzibar. These include the State Leather and Shoe Factory, Cotex Textile Mill, Afrochem Ltd, Aluminium Utensils Factory, Soap Factory, Oil Refinery (hydrogenated oils), Coconut Oil Factory and the Mahonda Sugar and Perfume Corporation. The NEMC team did not investigate the raw sewage discharges from Zanzibar Town.

#### (a) State Leather and Shoe Factory

The factory was constructed in 1968 with Chinese aid, but production stopped in 1984 due to mechanical problems. Process chemicals in the tannery operations include chromic acid, and discharges are fed into a stream 100 m from the sea. A factory rehabilitation programme is currently being considered by Czechoslovakia.

It is recommended that a waste stabilization system be constructed prior to restarting the production line.

#### (b) Cotex Textile Mill

The factory, located some 2 km from the sea, discharges its wastes into the same stream as the Shoe Factory. The factory is equipped for spinning, warp neating and dying with yarn. It has a capacity to produce 6,000 m of cloth per day but is currently not operating.

When operating at capacity, the factory consumes 300 m<sup>3</sup> of water per day and discharges wastes of equivalent volumes containing hydrogen peroxide, soda-ash, caustic soda and various dyes. There are no treatment facilities.

#### (c) Afrochem. Ltd.

This factory producing polyurethane foam mattresses and detergent powders started operations in 1982. The processes used do not produce any waste water.

#### (d) SIDO Estate

A small industrial estate consisting of 13 factories started operating from 1976 to 1981. But only 4 factories were currently in operation. The estate area is provided with well designed waste stabilization ponds consisting of two primary 100 m<sup>2</sup> ponds and two secondary 2,000 m<sup>2</sup> ponds. The waste from all the factories is treated in these ponds.

#### (e) Aluminium Utensils Factory

The production process uses two acid treatment baths, the first containing concentrated phosphoric acid (400 kg) and the second with concentrated sulphuric acid (200 kg). Both acids are changed regularly every 1 or 2 weeks depending on the volumes processed. The acid flows to the waste stabilization ponds.

#### (f) The Soap Factory

The capacity of the plant is 34 tonnes of laundry and toilet soap per month from 540 tonnes of animal fat and 100 tonnes of caustic soda. The wastes are disposed of to ponds. The factory is currently not operational.

#### (g) Coconut Oil Factory

All wastes are flushed to the waste stabilization ponds. The factory produces oil from copra produced locally.

**(h) Mahonda Sugar and Perfume Corporation**

The factory started operations in 1973 with Chinese aid. It is designed to produce sugar, liquor and perfume. The capacity being 6,000 tonnes of sugar and 540 m<sup>3</sup> of liquor annually. Current production stands at 1,000 tonnes of sugar annually.

Waste water is discharged to a drain flowing into a small river, 2 to 3 fish kills have been reported in recent years. The causes of these are unknown and there has been no analysis of the effluents.

Two pesticides stores have been identified on the sugar cane plantations. These contain a mixture of different pesticides some in leaking containers. 2.5 tonnes of sodium trichloracetate were found in one store. In addition, there are expired pesticides from China (5,000 boxes each containing 10 glass bottles), the labels are all in Chinese, therefore no identification was possible.

**(i) Zanzibar Wharfage Co.**

The company is responsible for all movements in Zanzibar harbour and also maintains a workshop and fuel depot adjacent to the harbour. Diesel oil contained in one of these tanks was seen to be discharged into the harbour prior to cleaning. The volume discharged is unknown, but it created a slick several kilometers in area, encompassing the harbour area and recreational beaches to the south of the harbour. No cleaning or dispersing of the slick was considered.

It is recommended that the fuel contained in the storage tanks be removed, containerized and transported to the refinery in Dar es Salaam for re-processing or disposal should the storage tanks require cleaning or servicing in the future.

**(j) Fuel Discharge Points**

Submarine discharge points for refined fuel products are located at Mtoni in Zanzibar and south of Chake Chake in Pemba. Spillages have occurred during discharge operations at both sites. In Zanzibar the spill coats the beaches at Mtoni during the south monsoon and a small mangrove forest to the south of the discharge point during the north monsoon. In Pemba the mangrove forests adjacent to the discharge point have become seriously coated, and some mortality is now apparent. A tanker in Zanzibar was observed flushing its tanks within the harbour area.

**Recommendations**

There are no cleaning or dispersing facilities and no facilities for the storage of ship discharges in the harbour. It is recommended, therefore, that:

- cleaning and dispersing facilities be purchased and that an oil spill contingency plan be devised to handle all manner of hydrocarbon pollutions;
- all discharges within the harbour should be prohibited and offenders heavily fined and made to bear the costs of the cleaning operations;
- the Zanzibar Government should enter into discussions with the Mainland Government to produce an integrated co-operative control programme; and
- that similar discussions be held with relevant Kenyan authorities to the same end.

### 3.1 URBAN POLLUTION

There are currently no facilities to treat urban and domestic wastes on either Zanzibar or Pemba. In all urban areas domestic wastes are discharged directly into the sea.

Raw sewage discharge points in Zanzibar are at sites fronting the town normally used for recreational bathing. Hospital refuse and liquid wastes are discharged into the sea directly in front of the hospital and are transported northwards to public bathing areas 150 m away. All the beaches around Zanzibar town are contaminated by fresh faeces. There are increased levels of productivity as evident by luxuriant growths of filamentous green algae and *Ulva*. The embayment to the north of the dhow harbour (Malindi) which dries at low tides produces a foul odour of faeces and hydrogen sulphide. The sediments are anoxic 0.5 cm. below the surface.

#### Recommendations

In view of the public health risk posed by the current disposal practices, it is recommended that:

- a long term policy be adopted where every effort is made to divert all present discharge points to a treatment facility prior to being discharged to the sea; and
- a pipeline with a submarine discharge be constructed westwards from Ras Shangani to the midpoint between Ras Shangani and Pange Reef. At this location there is a southerly bottom flowing current at 15 m. which will dilute and disperse the treated effluent away from Zanzibar Town.

### 4. OTHER IMPACTS - SALT PRODUCTION

Salt works using the combustion technique identified in the Tanga region were observed in the mangrove areas north of Bumbwini (Figure 8, annex X). The scale of operations is small with only one pan producing continuously and others operating if the market price for salt is high. It was found that the technique is new to Zanzibar and was introduced by the Tanga region.

The operators are keen to participate in a pilot solar evaporation demonstration project. The Ministry of Marine, Tourism and Forestry is willing to provide the necessary funds for this programme.

### 5. PRIORITIES FOR MANAGEMENT AS DEFINED BY ZANZIBAR (UNGUJA) AND PEMBA GOVERNMENT OFFICERS

At the request of the consultant, Officers of the Zanzibar Ministry of Marine, Tourism and Forestry and ZAFICO were encouraged to identify what in their opinion were the foremost problems needing attention within the context of a management plan for coastal resources. These were identified as follows:

- to conduct baseline research and resource assessment programmes in all coastal areas of Zanzibar, Pemba and Latham Island;
- to identify and designate marine parks and reserve areas in line with the government policy of expanding the tourism sector;
- to develop and implement a public awareness programme at the village level;

- to erect a surveillance system and guidelines to enable officers to check gear, vessels and licences;
- to commission a consultative report on sources of pollution and possible control measures;
- to investigate possible areas for diversification of the fisheries such as mariculture schemes and the identification of new stocks;
- to improve the productivity of the artisanal fisheries sector; and
- to include an addition to the proposed fisheries legislation for Zanzibar concerning marine parks and managed areas.

In addition, the ministry representatives in Pemba would like to see a complete inventory of mangrove resources and guidelines issued for rational management.

#### Recommendations

The Zanzibar Government is well placed to act on the guidelines and policies of a National Action Plan for the Management of Marine Resources but is quite clear that all activities taking place in Zanzibar waters would be under the exclusive control of the government or appointed officials.

Within the context of the proposed Pilot Management Zone, Zanzibar is eager to co-operate fully and enter into discussions with Tanga regional officers and the central government to develop and implement the programme at an early date.

It is expected that the programmes in the Pilot Area would be implemented in parallel, with funding allocated accordingly.

## 6. MARINE RESERVE AND PROTECTED AREAS

At present, Zanzibar has no marine parks, reserve areas or managed areas, but it is government policy that these be identified and gazetted in 1988.

As a result of this mission several suitable areas have been identified and these are described fully in section E.

The identified areas are as follows:

- |   |                                  |
|---|----------------------------------|
| 1. Latham Island protected area   | - gazetted as a strict marine    |
| 2. Zanzibar Reef and Islands Multiple Use<br>Management Area - Murogo Park proposed | - gazetted as a management area  |
| 3. Mwemba Island Marine Reserve area  | - gazetted as a strict protected |
| 4. Mesali Island Marine Reserve - Pemba   | - gazetted as a strict reserve   |
| 5. Mtangani Marine Reserve  | - gazetted as a strict reserve.  |

#### Recommendations

It is important that these reserve areas be gazetted at an early stage and given the surveillance necessary to safeguard identified coral areas. These reefs represent the only identified intact shallow coral reef formations in the United Republic of Tanzania and as such are critical and unique habitats.



## ANNEX VII

### MARINE RESERVES

## INTRODUCTION

### 1. Fungu Yasin Marine Reserve

All that area consisting of land and ocean waters centered at latitude  $06^{\circ} 36' 00''$  south and longitude  $39^{\circ} 14' 30''$  east and extending to a depth of 5 fathoms below the mean low tide mark from the center point.

### 2. Mbudya Island Marine Reserve

All that area consisting of land and coastal waters centered at latitude  $06^{\circ} 39' 30''$  south and longitude  $39^{\circ} 15' 00''$  east and to 5 fathoms.

### 3. Bongoyo Island Marine Reserve

All that land and coastal waters centered at latitude  $06^{\circ} 43' 12''$  south and longitude  $38^{\circ} 16' 00''$  east extending to a depth of 5 fathoms.

### 4. Panavini Island Marine Reserve

All that area consisting of land and coastal waters centered at latitude  $06^{\circ} 40' 42''$  south and longitude  $38^{\circ} 14' 12''$  east extending to a depth of 5 fathoms.

### 5. Chole Bay Marine Reserve

(a) All that area of land and ocean waters bounded by a line commencing at the southernmost tip of Miewi Island which bears north  $08^{\circ} 00' 00''$  west and which extends to the mainland of Mafia Island, thence along the mean high tide line to the nearest point on the outer fringing reef to the 5 fathom contour, and thence in a southerly direction generally parallel to the western shore of Miewi Island at the 5 fathom contour to the point of origin at the southernmost tip of Miewi Island.

(b) All that area of land and ocean waters bounded by a line commencing at the northernmost tip of Chole Island extending towards the southernmost tip of Miewi Island to its point of intersection with a line commencing at the northernmost tip of Juani Island which bears north  $50^{\circ} 00' 00''$  west, thence along this line to the northernmost tip of Juani Island and thence in a southerly direction along the mean high tide line of land on Juani Island to the point of origin on Chole Island.

### 6. Tutia Island Marine Reserve

All that area of land and ocean waters centered at latitude  $08^{\circ} 07' 30''$  south and longitude  $39^{\circ} 39' 30''$  east and to the 5 fathom contour.

### 7. Maziwi Island Marine Reserve

All that land and ocean waters centered to the north and south by  $05^{\circ} 29' 48''$  south and  $05^{\circ} 31' 00''$  east and extending to a depth of 5 fathoms below the mean low tide.

**ANNEX VIII**  
**ENVIRONMENTAL LEGISLATION**

## INTRODUCTION

UNEP Regional Seas Reports and Studies No. 49, 1984, has reviewed the current status of legislation as applicable to the marine environment. This work though a thorough analysis needs to be re-iterated in the context of a Action Plan with existing inconsistencies addressed.

## INTERNATIONAL AGREEMENTS

Although many international agreements exist for the environment, Tanzania is a party to some, but has not ratified many of them.

### Ratified Agreements

**Treaty Banning Nuclear Weapons Tests in the Atmosphere, Space and Under Water, Moscow, 1963**

Tanzania ratified this treaty in 1964, but has yet to enact legislation covering this treaty.

**African Convention on the Conservation of Nature and Natural Resources, Algiers, 1968**

Tanzania accepted this agreement in 1974, after it had come into force in 1969. The Convention's objective is the adoption of measures necessary to ensure conservation, utilization and development of soil, water, flora and faunal resources in accordance with scientific principles and with regard to the best interest of the people (Article II).

No specific legislation exists to cover this Convention, but existing legislation, The Wildlife Conservation Act (GN No. 12 of 1974), The Water Utilization Act (GN No. 2 of 1974), The Land Ordinance (Cap 18), The Town and Country Ordinance (Cap 378) and The Range Management Act (GN No. 51, of 1964) all serve to support Article II of this Convention.

Tanzania is not a party to the 1979 Convention on the Conservation of Migratory Species of Wild Animals that migrate across National Boundaries but has agreements with neighbouring countries which have wildlife conservation legislation.

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

Tanzania became a party to this Convention in 1980, the Convention came into force in 1975. No legislation has been produced to deal specifically with this Convention, but the Minister of Natural Resources supported by the Wildlife Conservation Act can declare any area to be a game controlled area.

### SIGNED AGREEMENTS

**The United Nations Convention on the Law of the Sea (UNCLOS), Kingston, 1982**

Tanzania signed this Convention in 1982 and is in the process of ratifying it, but as yet, no legislation exists to cover and support the implementation of this Convention.

Tanzania has since declared territorial waters extending 50 miles, and will soon extend its jurisdiction to a 200 mile Exclusive Economic Zone (EEZ). Zanzibar has requested the Union that it be granted jurisdiction and control of the EEZ from the agreed Kenya Border southwards to the midline between Latham Island and Mafia. Final approval of this request is pending.

**International Convention for the Prevention of Pollution from Ships, London, 1973 (MARPOL)**

Tanzania has signed this Convention but as of yet has not ratified it. The Convention defines marine pollution as 'Harmful Substances', as defined by GESAMP and 'Discharge' was made to include any escape, disposal, spilling, leaking, pumping, emitting or emptying of harmful substances arising from ceased explorations and the release of harmful substances resulting from scientific research into pollution abatement.

If Tanzania accedes to this Convention, it will be faced with a heavy financial burden to satisfy (Annex XI) the Regulations for the Prevention of Pollution by Oil and (Annex II) the Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk, both of which are compulsory. These annexes include the provision of reception facilities at oil loading terminals, repair ports and in ports where vessels have residues to discharge.

**International Convention for the Safety of Life at Sea, London, 1974**

Through the Merchant Shipping Act (1967), the Minister of Communications can declare regulations for the prevention of collisions (Part V) and load line regulations in keeping with the provisions of the Convention.

**Convention on the High Seas, Geneva, 1958, and the Convention on the Continental Shelf, Geneva, 1958**

Tanzania has not ratified either of these Conventions. The Convention on the High Seas provides for freedom of the seas, but is strict about pollution of the high seas. Tanzania proposed a clause in the convention regarding flags of convenience, stating that there must be a definitive link between vessel and flag.

The Convention on the Continental Shelf, deals with the exploration and exploitation of natural resources on the continental shelf while limiting resources and not interfering with oceanographic and scientific research. The points of interest in this Convention have since been covered by the Law of the Sea Convention of 1982.

**Convention on the Prevention of Marine Pollution by Dumping of Wastes or other Matters, London, 1972**

This Convention recognizes the rights of a state to exploit its natural resources while prohibiting damage to the environment of other states. The Convention lists prohibited items (mercury and mercury compounds) and other substances such as lead, arsenic etc. which are allowed to be dumped with specific controls.

Tanzania has no legislation regarding dumping and views this as a problem of industrialized states.

**Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil thereof, Washington, London, Moscow, 1971**

This Treaty and the Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques (1977) have both been accepted by Tanzania but as yet not ratified.

## NATIONAL LEGISLATION - TANZANIA MAINLAND

Most aspects of environmental management and control are covered by existing legislation, but in many cases this legislation needs amending and updating. It would also be useful to compile all existing legislation pertaining to the environment into a single reference handbook for use by implementing agencies and enforcement bodies.

It must, however, be noted that the following outlined national legislation is based on information available and is by no means exhaustive of the existing national legislation relevant to the protection, management and development of the marine and coastal environment of the United Republic of Tanzania.

### NATURAL RESOURCES

#### THE FISHERIES ACT 1970 - GN 6 OF 1970

The Fisheries Act under the control of the Minister of Natural Resources and the Director of Fisheries provides for the development, protection, conservation of marine products, namely finfish, shellfish, marine algae and invertebrates including turtles and dugongs.

The Act is implemented by the Fisheries Division which is responsible for issuing licences to vessels, fishermen, exporters, dealers and with ministerial approval, the granting of licences to foreign operators. The Act also deals with the use of explosives, poisons and water pollution. The Fisheries Regulation, (GN 109, of 1986) where fishing with explosives, electrical devices and poisons is prohibited. Salient points of the Act are included below as reference material.

#### THE FISHERIES ACT, 1970 GN 6 OF 1970, THE FISHERIES (GENERAL) REGULATIONS, 1973

##### PART ii - Registration of Fishing Vessels

- (a) Every vessel to which these regulations apply shall be registered in accordance with the Act and be subject to the provisions of the Act.
- (b) This Regulation applies to every vessel other than dugout canoes used for fishing purposes.

##### PART ii - Section 20

- (a) The Director of Fisheries, notwithstanding anything contained in the regulations, may grant to any person, without a fee, a licence to be called a special licence which shall entitle the holder to engage in fishing and to do such other things as may be specified therein for any of the following purposes:
  - scientific research;
  - complementary purposes;
  - educational services; and
  - the supply of food in cases of emergency where no other adequate food supplies are available.
- (b) A special licence may authorize fishing in any water for any species of fish provided that a special licence issued for complementary purposes shall not authorize the fishing of any fish declared protected under any Regulations made under the Act of Fishing in any marine reserve.

**PART iv - General Provisions Relating to Prohibitions, Restrictions and Exemptions**

**Section 23 - Restrictions on Import, Export and Introduction of New Species**

- (a) No person shall, without obtaining a written permit or other authorization of the Director of Fisheries, and except with the conditions specified:
- import any live fish into Tanganyika other than fish indigenous to Tanganyika;
  - introduce into the waters of Tanganyika Blue Gill Sunfish (*Heliopora macrochira*), Carp of all species of *Cyprinus* including Goldfish or any species of fish not indigenous to Tanganyika or the eggs thereof;
  - transfer any species of fish not indigenous to Tanganyika or eggs thereof from one water to another; or
  - export any live fish from Tanganyika.

**Section 25 - Prohibition of the use of Explosives etc, and damaging of Dams**

- (a) No person shall use or be in possession of any explosives, electrical device or any poisonous or noxious substance with intent thereby to capture, kill or injure fish in any waters, or to render any such fish easier to capture.
- (b) No person shall cut through, break down or destroy any dam in any water with intent to capture, kill or injure fish.

**Section 26 - Prohibition of Disturbance of Spawn**

- (a) No person shall willfully disturb any spawn or spawning fish or any bed, bank or shallow in which there is any spawn or spawning fish.
- (b) Provided that nothing in this Regulation shall affect any legal right to take any material or water from any waters.

**Section 27 - Prohibition of Throwing Overboard of Certain Substances**

- (a) No person shall throw overboard ballast, coal ashes, stones or other prejudicial or deleterious substances in any lake, river, harbour or roadstead, or any other water where fishing is carried on.

**Section 28 - Prohibition of Effluents and other Deleterious Substances**

- (a) No person shall cause or knowingly permit to flow or pass into, or put or knowingly permit to be put in any waters, lime, chemical substances or drugs, poisonous matter, dead or decaying fish or remnants thereof, mill rubbish or saw dust, or any other deleterious substance or thing to such an extent as to be injurious to fish or to the spawning grounds, spawn or food of fish.
- (b) The minister may by order declare any substance to be deleterious for the purpose of this Regulation.

**Section 29 - Exemptions from certain Prohibitions**

- (a) Notwithstanding anything contained in these Regulations, a person shall not be guilty of an offence against any of the provisions of Regulation 25, 26, 27 or 28 by reason only of any act done in exercise of any legal right, or in continuance of any process

or method which he has been lawfully employing from before the commencement of these Regulations, if he proves to the satisfaction of the court that he had used all available and practicable means to render any substance, matter or thing used by him harmless to fish or to the spawning grounds, spawn or food of fish.

Section 39 - Nets or Weirs not to Obstruct the Passage of Fish

- (a) No person shall erect, construct, use or maintain in the territorial waters any net or weir or other fishing gear which unduly obstructs the passage of fish. An authorized officer may order the removal or cause to be removed any such net, weir or other fishing gear.

Section 40- Prohibition of Use of Certain Sizes of Seine and other Types of Nets, Rockets, Explosives, Harpoons, Spear Guns

- (a) Notwithstanding anything contained in these Regulations, no person shall use for fishing:
- monofilament nets in all fresh water fisheries;
  - rockets, explosive materials or explosive projectiles, except for fishing whales; and
  - harpoon guns, spear guns.

**THE FISHERIES ACT - HARPOON FISHING (MAFIA ISLAND) REGULATIONS 1973**

These Regulations came into operation on the 14th of July, 1973 and expired on the 31st of December, 1974.

Every person who is the holder of a valid fishing licence issued to him pursuant to the Fisheries (General) Regulations (1973) and who is, in the opinion of the authorized officer, a "bona fide" tourist may at any time while these Regulations are in force and subject to the Provisions of the Fisheries Act (1970) and of Regulations made thereunder, engage in fishing by using harpoon or spear guns without air bottles within the area described in the schedule:

- AREA 1: Commencing at point "A" which is 7° 55' 05" south and 39° 51' 03" east of Greenwich, thence following the shore to point "B" which is 7° 10' 54" south and 39° 50' 00" east of Greenwich approximately 2.1 km in a straight line north-east of point "A".
- AREA 2: On Juani Island, commencing at point "C" which is 7° 45' 57" south and 39° 29' 51" east of Greenwich, thence following the shore to point "D" which is 7° 36' 58" south and 39° 29' 51" East of Greenwich approximately 1.6 km in a straight line of point "C".

**THE FISHERIES ACT, 1970 - THE FISHERIES (MARINE RESERVES) REGULATIONS, 1975, GN OF 137, 1975**

- (a) The areas described in this schedule of these regulations are declared marine reserves.
- (b) No person unless authorized by the director shall fish in a marine reserve.
- (c) No person shall enter or reside in a marine reserve without the prior consent in writing of the director. This Regulation shall not apply in relation to:



- a public officer on duty within the marine reserve or a member of his family or domestic employee;
  - a person who resides at any place within the boundaries of a marine reserve;
  - any person engaged in work being lawfully carried out within the boundaries of a marine reserve; and
  - any person who is a "bona fide" tourist or visitor.
- (d) No person shall collect any fish or other marine organism within a marine reserve.
- (e) No person shall cut, carve, injure, mutilate, remove, displace or break off any undergrowth or formation or other flora within a marine reserve.
- (f) No person shall dig any hole within a marine reserve or in any other way impair any natural habitat or underwater scene within a marine reserve.
- (g) No person shall swim, wade, dive or use any diving equipment within a marine reserve, except for any purpose connected with scientific study or if otherwise specifically authorized by the director.
- (h) No person shall destroy, mark, deface, displace, remove or tamper with any sign, float or placard within the boundaries of a marine reserve.
- (i) No person shall within the boundaries of a marine reserve carry on, or permit, or cause to be carried on any operation involving dredging, excavating, drilling or filling of any kind, or use a permit, or cause to be used any equipment, machinery or equipment normally used for dredging, drilling or excavating or deposit construct or install any such machinery or equipment.
- (j) No person shall within a marine reserve operate, anchor, cast or drag any vessel, water craft, mooring device in such manner as would likely strike, injure or otherwise cause damage to any marine life or underwater feature.
- (k) No person shall within a marine reserve use or have in his possession any type of fishing equipment save with the permission in writing of a fisheries officer in charge of such a reserve.
- (l) Any person who contravenes any provision of these Regulations shall be guilty of an offence and shall be liable a conviction to a fine not exceeding twenty thousand shillings or imprisonment for a terms not exceeding five years.

**AN ACT TO MAKE PROVISION WITH RESPECT TO EXPLORING FOR AND PRODUCING PETROLEUM (GN 27, OF 1980)**

**Section 1** - This Act shall apply to Zanzibar as well as mainland Tanzania.

**Section 2** - This Act shall apply to and in respect of the seabed and subsoil of the continental shelf.

**Section 34 - Investigation of Locations**

- (a) Where a location has been declared under section 33, the minister may, by written notice served on the registered holder of an exploration licence, direct that the holder carry out, within a period specified in the notice of not less than two years,

such appropriate investigations and studies as the minister thinks proper to assess the feasibility of the construction, establishment and operation of an industry for the recovery of petroleum from the location.

- (b) The investigations and studies referred to in subsection (a) may include if appropriate;
- (i) technical and economic feasibility studies relating to the recovery, processing and transport of petroleum from the location;
  - (ii) studies of proposed sites for facilities that would be required by the industry referred to in subsection (a);
  - (iii) studies of port and berthing facilities and roads, pipelines and other transportation facilities; and
  - (iv) investigations into:
    - suitable water facilities and reticulation systems for industrial and town purposes;
    - the location and design of a suitable airstrip and associated landing and terminal facilities if so required by that industry; and
    - the generation and transmission of electricity so required by that industry.
  - (v) investigations of any other works, services or facilities that may be so required for that industry in relation to the location;
  - (vi) investigation into the development, if so required, of a suitable town for the industry;
  - (vii) studies on future labour requirements for the industry; and
  - (viii) physical impact studies into the possible effects of the industry on the environment.
- (c) The registered holder of an exploration licence shall furnish to the minister, within the period specified in the notice under subsection (a) such reports, analysis and data resulting from the investigation and studies carried out under this section as the minister, by written notice on the holder, may require.

#### THE WATER UTILIZATION (CONTROL AND REGULATION) ACT 1974

The Act confers powers to the Central Water and Basin Water Boards to grant water rights in the country. Also under the terms of the Act, any person who pollutes the water of any river, stream, or watercourse, or in any body of surface water to such an extent as to be likely to cause injury directly or indirectly to public health, livestock, fish, crops, etc., will be guilty of an offence.

#### THE WATER UTILIZATION (CONTROL AND REGULATION) (AMENDMENT) ACT OF 1981

Confers on the Central Water Board the power to control and regulate water pollution and to carry out and promote research and investigations into the causes of and the control and regulation of water pollution. It can also recommend to the government plans, for the control of effluents by all water users and advise users and government on control and prevention of water pollution.

Users must submit to testing procedures laid down by the board and maximum permissible standards for effluents have been laid down. For domestic water the standards are comparable to those specified by WHO (1963).

AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF THE NATIONAL ENVIRONMENT MANAGEMENT COUNCIL, (GN 19 OF 1983)

The National Environment Management Council was enacted on September 10, 1983, by the Parliament of the United Republic of Tanzania.

#### **PART II - Functions of the Council**

The main function shall be to advise the government on all matters relating to the environment and in particular the council shall:

- formulate policy on environmental management and recommend its implementations by government;
- co-ordinate the activities of all bodies concerned with environmental matters and serve as a channel of communication between those bodies and government;
- evaluate existing and proposed policies and the activities of the government directed to control pollution and the enhancement of the environment and to the accomplishment of other objectives which affect the quality of the environment and on the basis of that, formulate policies and programmes which will achieve more effective management and enhancement of environmental quality;
- recommend measures to ensure that government policies including those for development and conservation of natural resources take adequate account of environmental effects;
- stimulate public and private participation in programmes and activities for the rational and beneficial use of natural resources;
- seek advancement of scientific knowledge of changes in the environment and encourage the development of technology to prevent or minimize adverse effects that endanger man's health and well-being;
- specify standards, norms and criteria for the protection of beneficial uses and the maintenance of the quality of the environment;
- establish and operate a system of documentation and dissemination of information relating to the environment;
- formulate proposals for legislation in the area of environmental issues and recommend their implementation by the government; and
- undertake or promote general environmental educational programmes for the purpose of creating a national public opinion regarding the environment and the role of the public in its protection and improvement.

#### **PART III - Power of the Minister to Impose Duty**

- (a) If the minister considers it necessary in the public interest, he may, after consultation with the minister for the time responsible for finance, by order published in "The Gazette", impose a duty payable to the council by any person or body of persons benefiting of the activities of the council or whose activities affect the activities of the council, and every such person or body of persons

specified in the order shall have all necessary measures to pay to the council such amount of duty and in such manner as may be specified in the order.

- (b) Every amount of duty required to be paid under subsection (a) shall be paid by the specified person or body of persons and the amount so payable shall be a debt due to the council and may be recovered by the person or body of persons as a civil debt by a suit at the instance of the Director General or any person authorized by him on that behalf.

The legislation described in the above section comprises a compendium of information available on existing regulations dealing with the environment and natural resources. Not included in this section is a regulation from the Forestry Act stipulating that areas of mangrove in coastal areas are all to be considered as reserve areas.

## NATIONAL LEGISLATION - ZANZIBAR

Zanzibar is part of the United Republic of Tanzania, a federal state comprising the former People's Republic of Zanzibar and the Republic of Tanganyika. The interim constitution of Tanzania 1965 (CAP 596), as amended in 1975 and 1977, notes that the United Republic of Tanzania is a Parliamentary Republic based on the fundamental principles of socialism and self-reliance. There is a single political party, the Chama Cha Mapinduzi (CCM), a President and Vice President one of which must come from Zanzibar. The National Assembly which includes members from Zanzibar legislates for the mainland on all matters and for the United Republic on the following:

- Constitution and Government of the United Republic;
- External Affairs;
- Defence;
- Police;
- Emergency Powers;
- Citizenship;
- Immigration;
- External Trade and Borrowing;
- Public Service of the United Republic;
- Income and Corporation Tax, Customs and Excise;
- Harbours, Civil Aviation, Post and Telegraph;
- Currency;
- Industrial Licensing and Statistics;
- Higher Education;
- Hydrocarbons;
- National Examination Council; and
- Matters listed in the East African Treaty for Co-operation.

All other matters affecting Zanzibar are within the exclusive jurisdiction of the Zanzibar Executive and Revolutionary Council. These will include control of all activities within its territorial waters which at present remain undefined since the declaration of a 50-mile territorial limit by the Union. The existence of this separate legislation concerning the development and current use of territorial waters is important in the formulation of a National Action Plan for the management of the coastal zone of the United Republic of Tanzania.

## FISHERIES LEGISLATION

At present, Zanzibar Fisheries are legislated by the Fisheries Protection Decree, 1948, (CAP 125), as amended by the Fish Protection Amendment Decree, 1964 (P.D. No. 18).

The decree empowers the minister to make rules for the more effectual control, protection and improvement of fish, and the government and management of any declared area in which fishing may be carried on. It also includes the following powers of the minister and fisheries officers:

- to impose and prescribe the condition for the regulation of fishing;
- to register all boats, nets, stakes employed in fishing;
- to register all transactions relating to the sale and the dealing in nets;
- to determine the times and seasons at which the taking of any species of fish shall commence and cease;
- to issue licences and certificates of registration to persons authorized to take any species of fish;
- to prescribe the fees payable in respect of any licence or registration issued;
- to provide for and regulate the description and form of nets to be used in fishing and to prohibit any special description of nets or meshes or any tackle, instrument or appliance whatsoever tending to impede the lawful taking of fish or being in any manner detrimental to the preservation or increase of fish; and
- to prohibit or regulate the sale of any fish.

There are also rules that regulate the importation of live fish and a prohibition on the use of beach seines (Fish Protection, Importation Restriction Rules, 1951 (N95), and the Fish Protection (Seine Net Fishing) Prohibition Rules, 1914.

Zanzibar has also formulated and enacted the Wild Animals Protection Decree (CAP 128), which applies to any animal listed on the schedule and which includes the Hawksbill Turtle (Eretmochelys imbricata), the Wild Birds Protection decree (CAP 129), which protects listed birds throughout Zanzibar and provides for sanctuaries. Sanctuaries have been declared on the shore at Chwaka and Zanzibar Town (Wild Birds Protection sanctuaries Order (G.N. #53, of 1944). Other legislation currently in force affecting the coastal zone and marine resources includes:

THE WOODCUTTING (AMENDMENT) DECREE, 1968, PRESIDENTIAL DECREE #4, OF 1968

This Decree provides restrictions on woodcutting on government land and includes the cutting of mangroves. It specifies that cutting on government land can only be carried out on receipt of a proper licence and the payment of a specified fee.

THE FOREST RESERVES PRINCIPAL LEGISLATION (CAP 120), AND THE WOODCUTTING (PROTECTION AND CONTROL OF THE CHWAKA MANGROVE FORESTS) RULES (GN. 99 OF 1946) (CAP 1210)

Provides in the former for the minister to declare any area of government land a forest reserve with a notice of intent being published in the gazette giving the limits of the land. Under this Legislation, Zanzibar has declared eight forest reserves, these being:

|                                     |                |
|-------------------------------------|----------------|
| - Kichwele Forest Reserve           | GN 28 of 1955  |
| - Pangani Forest Reserve            | GN 29 of 1955  |
| - Pangani Kwa Wokomi Forest Reserve | GN 30 of 1955  |
| - Walezo Ckumbani Forest Reserve    | GN 31 of 1955  |
| - Dunga Forest Reserve              | GN 34 of 1959  |
| - Ngezi Forest Reserve              | GN 66 of 1959  |
| - Unguja Uhuu Forest Reserve        | GN 102 of 1959 |
| - Jozani Forest Reserve             | GN 63 of 1960  |

The rules concerning the mangrove forests of Chwaka Bay specify that no person can cut poles (mangrove poles) from the reserve area except by permit, while exempting these having traditional rights. The Legislation also names areas promulgated as Mangrove Forest Reserves, these being:

- (a) All these areas of mangrove forests in Chwaka Bay known as: Mapopwa area and the Mto wa Serikali area (GN 71 of 1949).
- (b) All that area of mangrove forest in Chwaka Bay Kinani extending to Chuzi Island (G.N. 59, 1955).
- (c) All these areas of mangrove forests in Kisakasaka Bay and Kiwani Bay (GN 59 of 1955).
- (d) On Pemba, all that area known as Mwituu Kikuu and that area known as the Ngezi Forest (GN 71 of 1947).

#### THE PUBLIC LAND DECREE (CAP 93) - REMOVAL OF NATURAL PRODUCTS RULES (1984) UNDER SECTION 610

Specifies natural products as being stones, sand, gravel, lime and any other natural produce of the same groups. This Decree may be applicable directly to a coastal management programme since it rules that no person may excavate, remove, transport or sell any natural produce from public land without permit, while specifying hours during which a person may excavate or transport. It also give powers to the minister to declare such areas of land or sea shores surrounding the islands of Zanzibar and Pemba to be protected areas, where a prohibited area means any area declared by the minister to be closed for any activities of an excavation or removal of natural produce.

Zanzibar has recently commissioned FAO through a series of consultancies from 1980 to 1987, to analyze the existing institutional and legal framework of the Zanzibar Fisheries and to propose general fisheries regulations in order to give effect to proposed legislation. The results of these consultancies are given in FAO Document FL/IOB/82/7 and are currently being considered by the Zanzibar Government prior to adoption.

The proposed Fisheries (General) Law will provide for the management and development of fisheries in the marine waters under the jurisdiction of Zanzibar and for matters connected therewith and incidental thereto. To this end, the law will be administered by the minister who may delegate his powers to the Director of Fisheries who will then confer with an advisory board.

- (a) The Law makes provisions for the establishment of a Fisheries Development Fund. The formulation and review of management plans which may include the following management measures:
  - (i) closed seasons of designated areas, species of fish or methods of fishing;
  - (ii) prohibited fishing areas for all species of fish or methods of fishing;
  - (iii) limitations on methods and gear, including mesh sizes; and
  - (iv) limitations on the amount, size, age and other characteristics and species or compositions of species of fish that may be caught, landed or traded.
- (b) The Law makes provision for the protection and development of both artisanal and commercial fishing sectors.
- (c) The proposed Law covers all aspects of licensing including foreign vessels, with stringent controls applied to the latter. It was noted though, that the proposed legislation provides for permits issued for beach seining in specified areas,

Part VI, Section 12 of the proposed Fisheries (General) Law. This section should be carefully considered prior to enactment as Law, considering the detrimental effect of this fishing method on bottom fauna.

- (d) The Law specifies conservation measures and prohibited fishing techniques where all explosives, poisons or other noxious substances for the purpose of killing, stunning or disabling fish so as to render such fish more easily caught or where the possession of these materials to be used in fishing are considered illegal. This part of the Law also prohibits the use of spear guns, except under licence the catching of undersized fish or the use of specified prohibited gear as may be prescribed at the time.
- (e) The proposed legislation goes a long way towards satisfying the requirements of Zanzibar Fisheries Policy, but following a recent meeting between the FAO consultant, this consultant and Zanzibar officials, it was decided that the conservation section be expanded to include the declaration of marine parks and reserves, the formation of a Fisheries Protection Unit and the requirement of licensed commercial vessels to provide data on the length and frequency of those species caught in order that the stock assessment be carried out to enable sound management policies to be developed.

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## ANNEX IX

### TABLES



Table 1. Fisheries Statistics of the Tanga Region

|                                | 1984      | 1985      | 1986      |
|--------------------------------|-----------|-----------|-----------|
| Total no. of fishermen         | 4,191     | 2,926     | 3,311     |
| Total no. of vessels           | 959       | 718       | 841       |
| Total weight catch in m.tonnes | 6,219.3   | 4,547.3   | 4,504.4   |
| Total value in '000' TSh.      | 164,346.5 | 145,117.6 | 171,090.3 |
| Gill nets                      | 451       | 515       | -         |
| Shark nets                     | 563       | 467       | -         |
| Seine nets                     | 35        | 33        | -         |
| Cast nets                      | 287       | 157       | -         |
| Hand lines                     | 1,215     | 1,148     | -         |
| Long lines                     | 38        | 38        | -         |
| Traps                          | 2,310     | 1,995     | -         |
| Fixed traps                    | 95        | 124       | -         |

Table 2. Fisheries Statistics of the Tanga Region from 1970 to 1986

| Year | No. of gear | No. of boats | Catch m. tonnes | Value TSh. | No. of fishermen | Catch per fisherman |
|------|-------------|--------------|-----------------|------------|------------------|---------------------|
| 1970 | 2,263       | 634          | 798.9           | 7,211.7    | 1,874            | 0.39                |
| 1971 | 4,780       | 885          | 4,885.5         | 6,396.9    | 2,599            | 1.90                |
| 1972 | 4,730       | 985          | 6,471.5         | 9,526.2    | 2,642            | 2.45                |
| 1973 | 2,246       | 787          | 4,221.0         | 9,440.2    | 2,213            | 1.90                |
| 1974 | 3,848       | 828          | 5,416.7         | 16,036.8   | 2,338            | 2.30                |
| 1975 | 4,368       | 846          | 5,377.9         | 15,761.9   | 2,642            | 2.00                |
| 1976 | 6,955       | 1,011        | 7,392.0         | 23,849.3   | 3,129            | 2.36                |
| 1977 | 4,692       | 882          | 6,186.1         | 28,780.7   | 3,111            | 2.20                |
| 1978 | 4,441       | 785          | 6,715.8         | 37,332.4   | 2,871            | 2.34                |
| 1979 | 4,442       | 786          | 6,144.2         | 38,152.3   | 2,901            | 2.22                |
| 1980 | 3,525       | 793          | 7,058.6         | 37,604.7   | 2,879            | 2.45                |
| 1981 | 3,461       | 624          | 7,392.0         | 23,849.3   | 2,302            | 3.20                |
| 1982 | 4,121       | 880          | 6,944.8         | 111,988.   | 2,727            | 2.50                |
| 1983 | 4,825       | 904          | 6,074.8         | 157,318.0  | 3,314            | 1.80                |
| 1984 | 4,994       | 959          | 6,219.3         | 164,346.5  | 4,191            | 1.48                |
| 1985 | 4,335       | 718          | 4,547.3         | 145,117.6  | 2,926            | 1.55                |
| 1986 | 5,492       | 841          | 4,504.4         | 171,090.3  | 3,311            | 1.36                |

Table 3. Fisheries Statistics of the Coast Region

|                                 | 1984      | 1985      |
|---------------------------------|-----------|-----------|
| Total no. of fishermen          | 3,848     | 2,644     |
| Total no. of fishing vessels    | 585       | 673       |
| Total weight catch in m. tonnes | 11,463.4  | 10,739.6  |
| Total value in '000' TSh.       | 211,558.2 | 194,753.4 |
| <u>Fishing vessels</u>          |           |           |
| Mashua                          | 160       | 140       |
| Ngalawa                         | 365       | 390       |
| Mitumbwi                        | 49        | 45        |
| Boats                           | -         | 23        |
| <u>Fishing gear</u>             |           |           |
| Gill nets                       | 3,885     | 991       |
| Shark nets                      | 991       | 1,197     |
| Beach seines                    | 114       | 35        |
| Cast nets                       | 87        | 47        |
| Hooks                           | 1,102     | 879       |
| Basket traps                    | 1,586     | 984       |
| Fixed traps                     | 350       | 12        |
| <u>Engines</u>                  |           |           |
| Outboard                        | 10        | 17        |
| Inboard                         | 5         | 6         |

Table 4. Commercial Fishery Statistics for the Marine Waters of the Tanzania Mainland

| Company Name              | TAFICO     | DAR FISH   | TOTAL      |
|---------------------------|------------|------------|------------|
| No. of fishing vessels    | 16         | 2          | 18         |
| Operational vessels       | 8          | 2          | 10         |
| Weight catch in m. tonnes | 542.1      | 419.9      | 962        |
| Catch value in '000' TSh. | 13,147,600 | 11,733,200 | 24,870,800 |
| Weight of prawns          | 114.6      | -          | 114.6      |
| Value of prawns           | 8,227,800  | -          | 8,227,800  |
| Total                     |            |            |            |
| Weight m. tonnes          | 660.7      | 419.9      | 1,080.6    |
| Value TSh.                | 21,375,400 | 11,733,200 | 33,098,600 |

Table 5. Fisheries Statistics of the Dar es Salaam Region

|                             | 1983     | 1984      | 1985      |
|-----------------------------|----------|-----------|-----------|
| Total no. fishermen         |          | na        | 2,072,568 |
| Total no. fishing vessels   | 191      | 393       | 601       |
| Total weight catch m.tonnes | 5,306.5  | 4,814.7   | 6,833.8   |
| Total value in '000'TSh.    | 61,928.8 | 136,448.2 | 299,325.0 |
| <u>Fishing vessels</u>      |          |           |           |
| Ngalawa                     | na       | na        | 248       |
| Mitumbwi                    | na       | na        | 77        |
| Dhow                        | na       | na        | 130       |
| Planked Boats               | na       | na        | 107       |
| Mashua                      | na       | na        | 39        |
| <u>Fishing gear</u>         |          |           |           |
| Gill nets                   | na       | 139       | 428       |
| Shark nets                  | na       | 155       | 664       |
| Seine nets                  | na       | 1         | 936       |
| Hand lines                  | na       | 401       | 5,395     |
| Traps                       | na       |           | 3171,930  |
| Cast nets                   | na       | na        | 518       |
| Fixed traps                 | na       | na        | 8         |
| <u>Engines</u>              |          |           |           |
| Outboard                    | na       | 87        | 81        |
| Inboard                     | na       | 0         | 26        |

na: not available

Table 6. Fisheries Statistics of the Lindi Region

|                              | 1983     | 1984      | 1985      |
|------------------------------|----------|-----------|-----------|
| Total no. of fishermen       | 1,232    | 1,938     | 1,403     |
| Total no. fishing vessels    | 305      | 921       | 438       |
| Total weight catch m. tonnes | 6,129.7  | 9,802.1   | 11,589.4  |
| Total value in '000' TSh.    | 55,438.8 | 275,097.6 | 610,011.1 |
| <u>Fishing vessels</u>       |          |           |           |
| Mashua                       | na       | 38        | 30        |
| Ngalawa                      | na       | 429       | 147       |
| Dhow                         | na       | 46        | 53        |
| Mitumbwi                     | na       | 392       | 194       |
| Boti                         | na       | 16        | 14        |
| <u>Fishing gears</u>         |          |           |           |
| Gill nets                    | na       | 1,188     | 1,480     |
| Shark nets                   | na       | 239       | 392       |
| Seine nets                   | na       | 100       | 228       |
| Cast nets                    | na       | 30        | -         |
| Hand lines                   | na       | 3,237     | 4,207     |
| Long lines                   | na       | 70        | 49        |
| Traps                        | na       | 842       | 304       |
| Other gear                   | na       | 153       | 116       |
| <u>Engines</u>               |          |           |           |
| Outboard                     | na       | 12        | 20        |
| Inboard                      | na       | 6         | 6         |

na: not available

Table 7. Fisheries Statistics of the Mtwara Region

|                              | 1983      | 1984       | 1985       |
|------------------------------|-----------|------------|------------|
| Total no. of fishermen       | 2,820     | 1,734      | 2,568      |
| Total no. of fishing vessels | 377       | 680        | 601        |
| Total weight catch m. tonnes | 3,970.20  | 7,510.0    | 6,833.90   |
| Total value in '000' TSh.    | 50,170.90 | 329,004.30 | 299,325.00 |
| <u>Fishing vessels</u>       |           |            |            |
| Ngalawa                      |           | na         | 1248       |
| Mitumbwi                     |           | na         | 50777      |
| Dhow                         | na        | 149        | 130        |
| Mashua                       | na        | 23         | 39         |
| Boti                         | na        | na         | 107        |
| <u>Fishing gear</u>          |           |            |            |
| Gill nets                    |           | na         | 1,292428   |
| Shark nets                   | na        | 394        | 664        |
| Seine nets                   | na        | 121        | 936        |
| Hand lines                   | na        | 802        | 5,395      |
| Cast nets                    | na        | 4          | 518        |
| Traps                        | na        | 1,363      | 1,930      |
| Fixed traps                  | na        | 37         | 8          |
| <u>Engines</u>               |           |            |            |
| Outboards                    |           | na         | 481        |
| Inboards                     |           | na         | 026        |

na: not available

Table 8. Unguja and Pemba Islands  
The Number and Type of Fishing Units

|                        | 1980  | 1985  | 1980  | 1985  | 1980  | 1985  |
|------------------------|-------|-------|-------|-------|-------|-------|
| <b>Fishing vessels</b> |       |       |       |       |       |       |
| Mashua                 | 192   | 362   | 37    | 85    | 229   | 447   |
| Ngalawa                | 1,052 | 1,149 | 661   | 758   | 1,713 | 1,907 |
| Mitumbwi               | 273   | 247   | 1,290 | 1,026 | 1,563 | 1,273 |
| Dhow                   | 336   | 379   | 49    | 121   | 385   | 500   |
| Total                  | 1,853 | 2,137 | 2,037 | 1,982 | 3,890 | 4,127 |
| <b>Fishing Gear</b>    |       |       |       |       |       |       |
| Handlines              | 4,023 | 4,939 | 3,954 | 4,552 | 7,977 | 9,490 |
| Troll lines            | 774   | 1,129 | 877   | 612   | 1,651 | 1,741 |
| Basket Traps           | 4,399 | 4,814 | 3,995 | 4,394 | 8,394 | 9,208 |
| Weir traps             | 152   | 312   | 94    | 65    | 246   | 377   |
| Gill nets              | 4,877 | 2,884 | 2,606 | 2,738 | 7,483 | 5,622 |
| Seine nets             | 1,086 | 691   | 1,552 | 27    | 2,608 | 718   |
| Beach seines           | 104   | 0     | 122   | 3     | 226   | 3     |
| Cast nets              | 118   | 50    | 616   | 177   | 734   | 227   |
| Scoop nets             | 122   | 187   | 0     | 15    | 122   | 202   |
| Spear guns             | 208   | 262   | 72    | 106   | 280   | 368   |
| <b>Engines</b>         |       |       |       |       |       |       |
| Outboards              | 147   | 146   | 15    | 6     | 162   | 152   |
| Inboard                | na    | 20    | na    | 0     | na    | 20    |
| Total                  | na    | 166   | na    | 6     | na    | 172   |

na: not available

SOURCES: Ngoile M.A.K. (1981), A Survey of fishing units in Zanzibar and Pemba. Tanzania Notes and Recods (No.88 and 89, 89 to 96p.)  
Carrara G. (1986) Artisanal Fishery catch assessment survey Plan Zanzibar FAO/raf/79/065 (unpublished Mineograph).

Table 9. Coliform Bacteria Content in Dar es Salaam Waters

| STATION                           | H <sub>2</sub> O Temp. 27-31°C<br>4/7/84 Low Tide<br>Ebbing Flow |                         | H <sub>2</sub> O Temp. 24-27°C<br>10/7/84 High Tide |                         | H <sub>2</sub> O Temp. 26-31°C<br>25/10/84 Low Tide<br>Flooding |                         |
|-----------------------------------|--|-------------------------|---|-------------------------|---|-------------------------|
|                                   | E-Coli<br>Samonella  | E-Coli<br>Staphylococci | E-Coli<br>Samonella                                 | E-Coli<br>Staphylococci | E-Coli<br>Samonella   | E-Coli<br>Staphylococci |
| Bahari Beach                      | -  | -                       | -   | -                       | 0   | 0                       |
| Masasani Beach                    | -  | -                       | -   | -                       | 0   | 0                       |
| Yacht Club                        | -  | -                       | -   | -                       | 0   | 0                       |
| Oyster Bay                        | -  | -                       | -   | -                       | +   | -                       |
| Ocean road<br>Aga Khan Hospital   | +  | -                       | -   | -                       | +   | +                       |
| Banda Beach                       | -  | -                       | -   | -                       | +   | +                       |
| Kigamboni Beaches                 | -  | -                       | -   | -                       | 0   | 0                       |
| Msimbazi River<br>Selander Bridge | 0  | 0                       | 0   | 0                       | +   | -                       |
| Morogoro Road                     | 0  | 0                       | 0   | 0                       | +   | -                       |
| Kigogo Road                       | 0  | 0                       | 0   | 0                       | +   | -                       |
| Port ACC ESS RD                   | 0  | 0                       | 0   | 0                       | +   | -                       |
| Upstream                          | 0  | 0                       | 0   | 0                       | +   | -                       |

0: no investigation

-: not present

+: present

Table 10. Summary Table: Marine Products for Export 1976 - 1986

|               | 1976         |                    | 1977           |                     | 1978         |                     |
|---------------|--------------|--------------------|----------------|---------------------|--------------|---------------------|
|               | Tonnes       | TSh.FOB Val.       | Tonnes         | TSh.FOB Val.        | Tonnes       | TSh. Val.           |
| Seashells     | 446.6        | 2,658,911          | 427.3          | 8,878,138           | 306.4        | 2,276,753           |
| Beche-de-Mer  | -            | -                  | -              | -                   | -            | -                   |
| TurtlesHELLS  | 1.8          | 212,843            | 26.6           | 237,562             | 1.2          | 170,224             |
| Crustaceans   | 283.6        | 5,351,980          | 186.7          | 5,332,398           | 83.9         | 2,839,774           |
| Sharkfins     | -            | -                  | -              | -                   | -            | -                   |
| Molluscs      | -            | -                  | -              | -                   | -            | -                   |
| <b>Totals</b> | <b>732.0</b> | <b>8,223,734.0</b> | <b>640.6</b>   | <b>6,457,980.0</b>  | <b>391.5</b> | <b>5,286,721.0</b>  |
|               | 1979         |                    | 1980           |                     | 1981         |                     |
|               | Tonnes       | TSh.FOB Val.       | Tonnes         | TSh.FOB Val.        | Tonnes       | TSh. Val            |
| Seashells     | 281.3        | 1,248,150          | 1,241.0        | 1,565,898           | 457.5        | 4,705,130           |
| Beche-de-Mer  | -            | -                  | -              | -                   | 1.8          | 29,665.3            |
| TurtlesHELLS  | 2.9          | 54,008.3           | 1.1            | 158,223             | 0.6          | 95,596              |
| Crustaceans   | 169.1        | 3,972,730          | 149.9          | 2,330,720           | 194.3        | 3,632,836           |
| Sharkfins     | 0.6          | 61,736             | 1.7            | 57,431              | -            | -                   |
| Molluscs      | -            | -                  | -              | -                   | -            | -                   |
| <b>Totals</b> | <b>453.9</b> | <b>5,336,624.3</b> | <b>1,393.7</b> | <b>4,112,272.0</b>  | <b>654.2</b> | <b>8,463,227.3</b>  |
|               | 1982         |                    | 1983           |                     | 1984         |                     |
|               | Tonnes       | TSh.FOB Val.       | Tonnes         | TSh.FOB Val.        | Tonnes       | TSh. Val            |
| Seashells     | 216.8        | 142,962.3          | 68.6           | 1,135,624           | 129.1        | 1,911,992           |
| Beche-de-Mer  | 4.4          | 91,223.5           | 21.0           | 438,722.1           | 36.9         | 1,084,755.1         |
| TurtlesHELLS  | -            | -                  | -              | -                   | 0.37         | 207,741             |
| Crustaceans   | 84.4         | 2,128,819          | 22.6           | 8,772,489           | 132.3        | 14,393,680          |
| Sharkfins     | -            | -                  | -              | -                   | 0.1          | 47,823              |
| Molluscs      | -            | -                  | -              | -                   | -            | -                   |
| <b>Totals</b> | <b>307.6</b> | <b>2,363,004.8</b> | <b>112.2</b>   | <b>10,346,835.0</b> | <b>298.8</b> | <b>17,645,991.0</b> |



Table 10 Cont'd

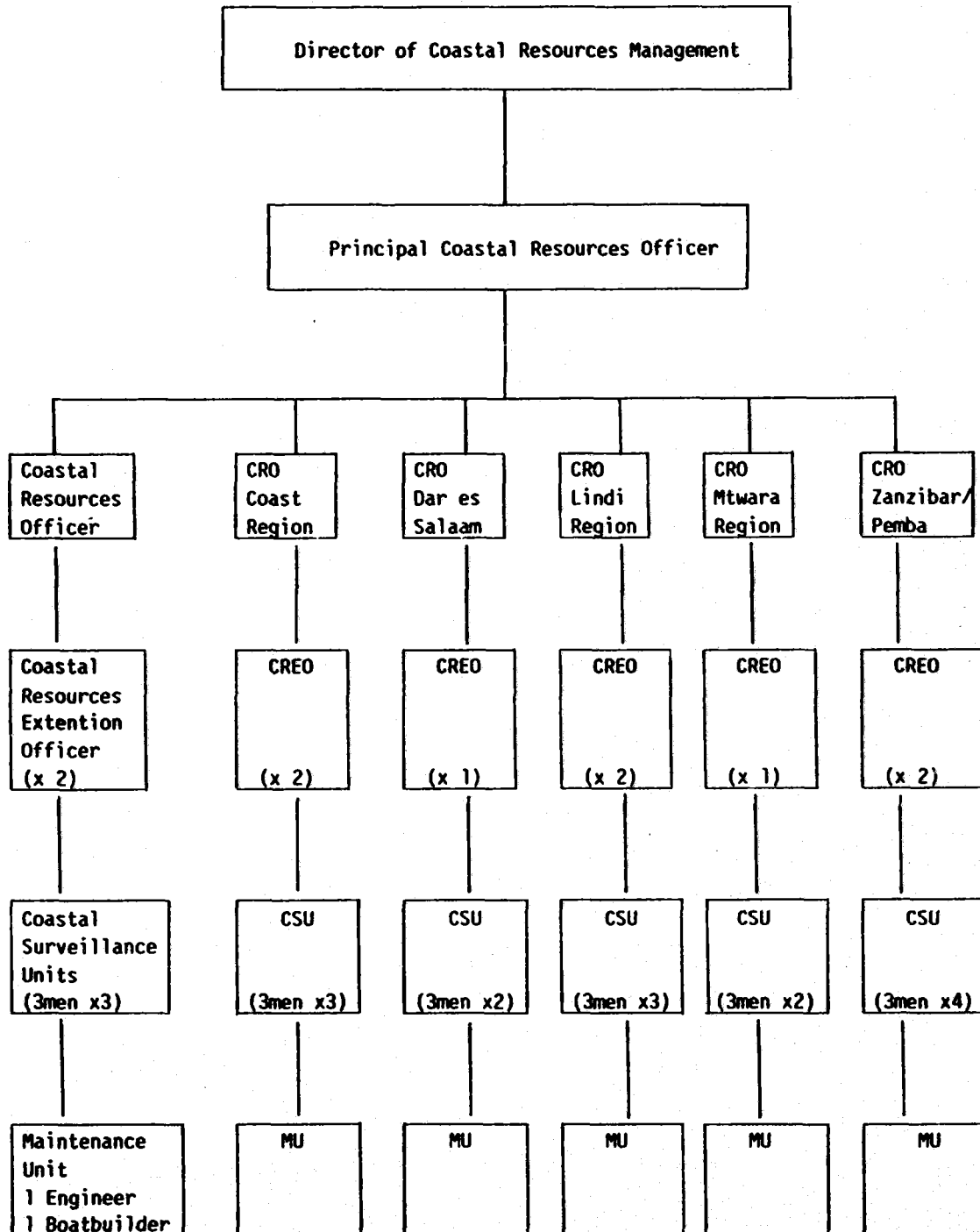
|                | 1985   |              | 1986   |              |
|----------------|--------|--------------|--------|--------------|
|                | Tonnes | TSh.FOB Val. | Tonnes | TSh.FOB Val. |
| Seashells      | 141.1  | 10,604,692   | 157.2  | 6,900,969.9  |
| Beche-de-Mer   | 132.7  | 6,914,440    | 162.6  | 9,281,271.7  |
| Turtles shells | -      | -            | 0.26   | 7,100        |
| Crustaceans    | 124.9  | 17,060,231   | 216.4  | 36,290,311   |
| Sharkfins      | 1.8    | 64,026       | 2.7    | 772,096.9    |
| Molluscs       | -      | -            | 2.4    | 49,800       |
| Totals         | 400.5  | 34,643,389.0 | 541.6  | 53,301,550.0 |

Table 11. Summary Table  
Destructive Impacts on the Marine Environment

| Impact                            | Tanga | Dar es Salaam | Latham | Mafia | Rufiji | IS.S.Mafia | Kilwa | Lindi | Mtwara | Zanzibar | Pemba |
|-----------------------------------|-------|---------------|--------|-------|--------|------------|-------|-------|--------|----------|-------|
| Urban pollution                   | X     | XXX           | -      | X     | -      | -          | -     | XX    | -      | XX       | X     |
| Industrial pollution              | XX    | XXX           | -      | -     | -      | -          | -     | -     | -      | X        | -     |
| Explosive Fishing                 | XXX   | XXX           | X      | XX    | -      | XXX        | X     | XX    | XX     | -        | -     |
| Beach seining                     | X     | XX            | -      | X     | X      | X          | X     | XX    | X      | LI       | X     |
| <u>Fishing pressure</u>           |       |               |        |       |        |            |       |       |        |          |       |
| Heavy                             | X     | X             |        |       | X      | X          |       | X     |        | X        | X     |
| Moderate                          |       |               | X      |       |        | X          |       | X     |        |          |       |
| Light                             |       |               | X      |       |        |            |       |       |        |          |       |
| Mangrove cutting                  | X     | X             | -      | X     | XX     | -          | XX    | XXX   | X      | X        | XX    |
| Salt works                        | XX    | X             | -      | -     | X      | -          | -     | XXX   | X      | X        | ?     |
| <u>Fishing species prohibited</u> |       |               |        |       |        |            |       |       |        |          |       |
| Turtles                           | X     | X             | X      | XX    | X      | XX         | X     | X     | XX     | XX       | XX    |
| Dugongs                           | NR    | NR            | NR     | NR    | NR     | NR         | NR    | NR    | NR     | NR       | NR    |
| Shell collecting                  | X     | X             | X      | XX    | -      | XXX        | X     | XX    | XX     | XXX      | XX    |
| Beche-de-Mer                      | X     | X             | -      | X     | NR     | X          | X     | XX    | X      | XXX      | XX    |
| Tourism                           | LI    | XX            | -      | XX    | -      | -          | LI    | -     | LI     | XX       | -     |
| Reserve areas                     | NE    | NE            | NE     | NE    | NE     | -          | -     | -     | -      | -        | -     |

NR: Not recorded  
NE: Not enacted  
LI: Light  
X: Medium  
XX: Heavy  
XXX: Extensive

Table 12. Personnel Structure for the Division of Coastal Resources and Management



**Table 13: Planning and Phasing Chart for the Implementation of the Action Plan**

[illegible]

## ANNEX X

## FIGURES

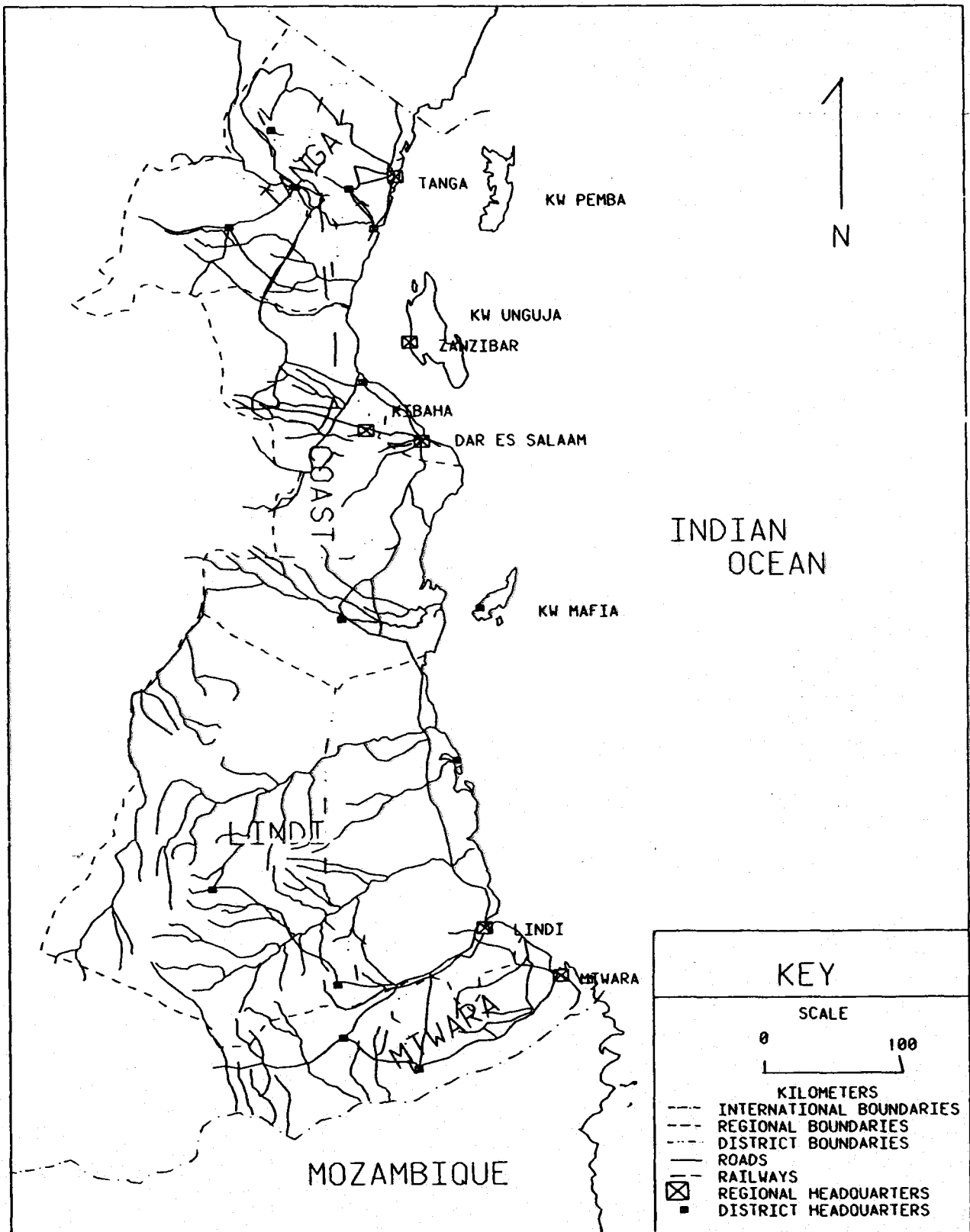


Figure 1. Regions and Districts

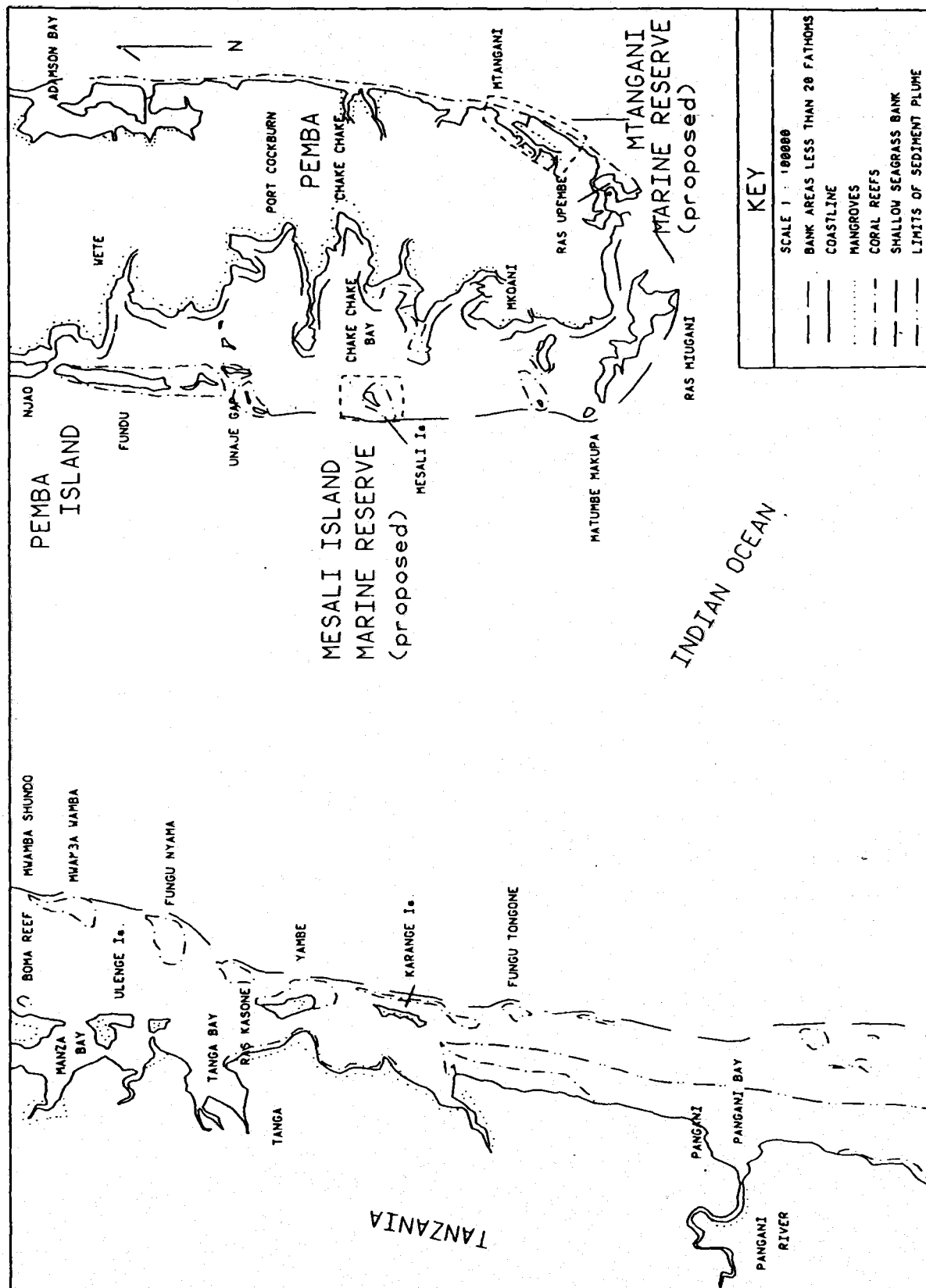


Figure 2a. Marine Protected Areas of Pemba and the Mainland Coast  
26 July 1985 NASA ERTS E-2185-86588-S011

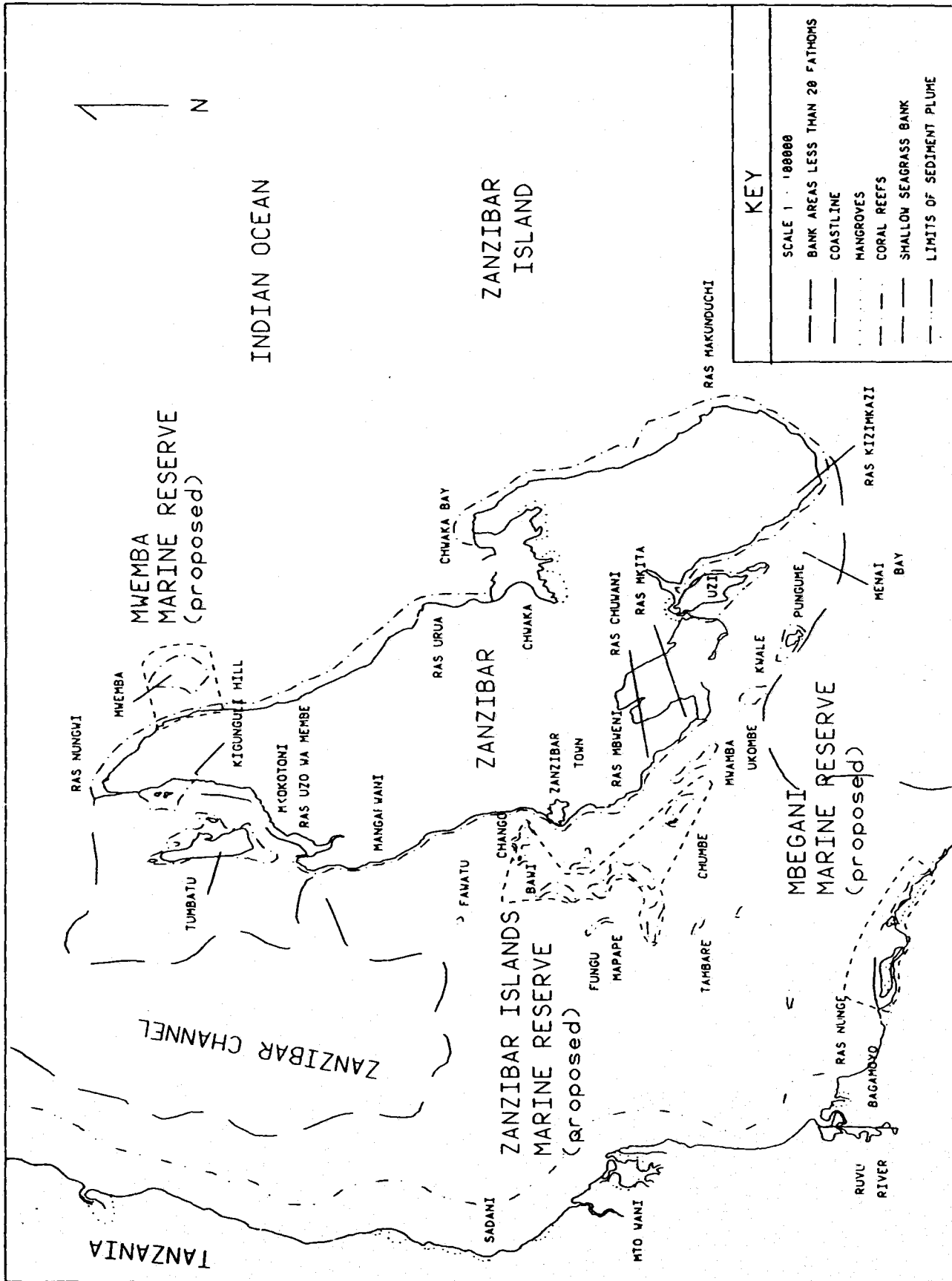


Figure 2b. Marine Protected Area of Zanzibar and the Mainland Coast  
(26 July 1975 NASA ERTS E-2185-86588-501)



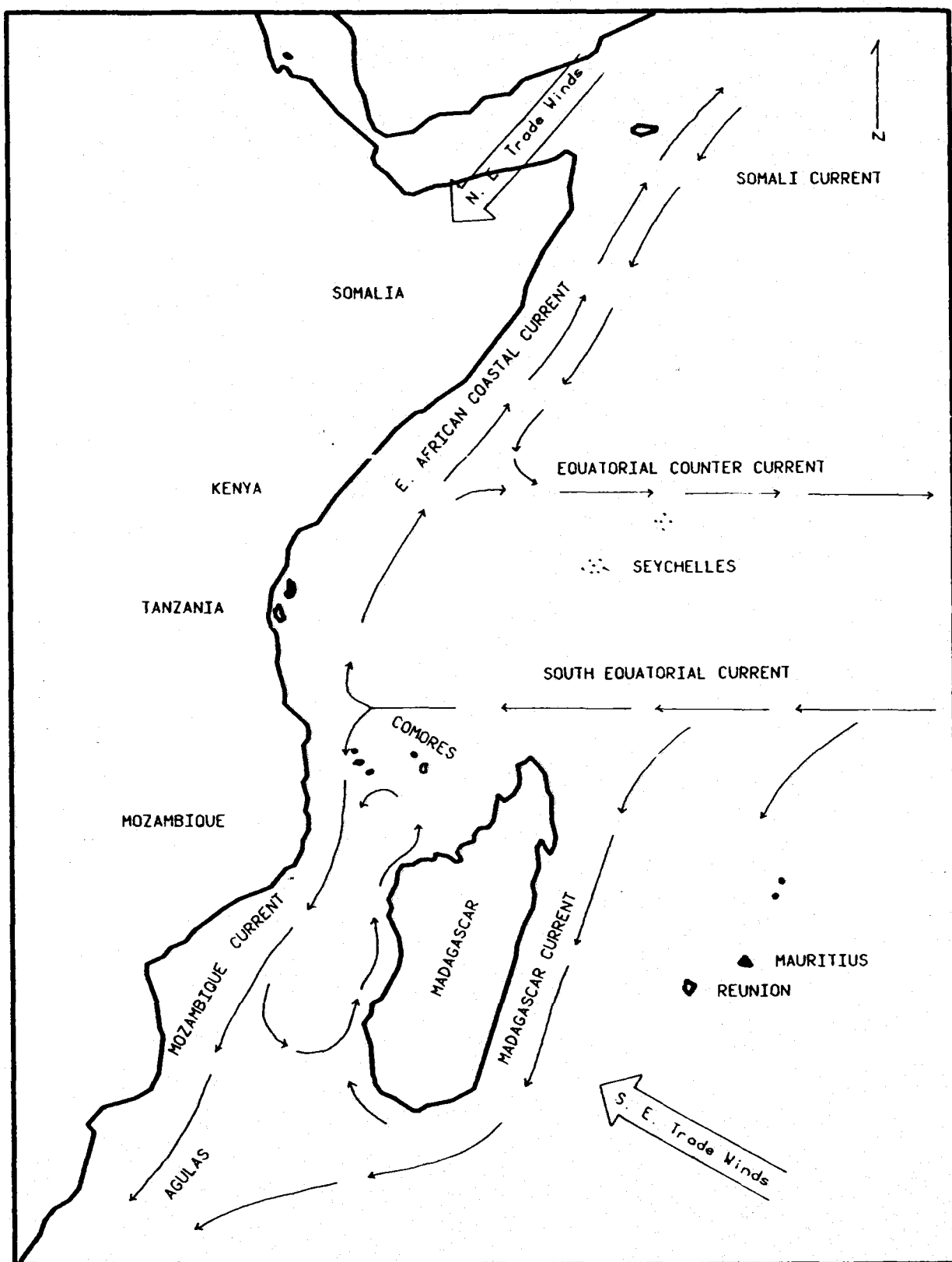


Figure 3. Ocean Currents and Winds / Eastern African Region  
(after IUCN / UNEP, 1982)

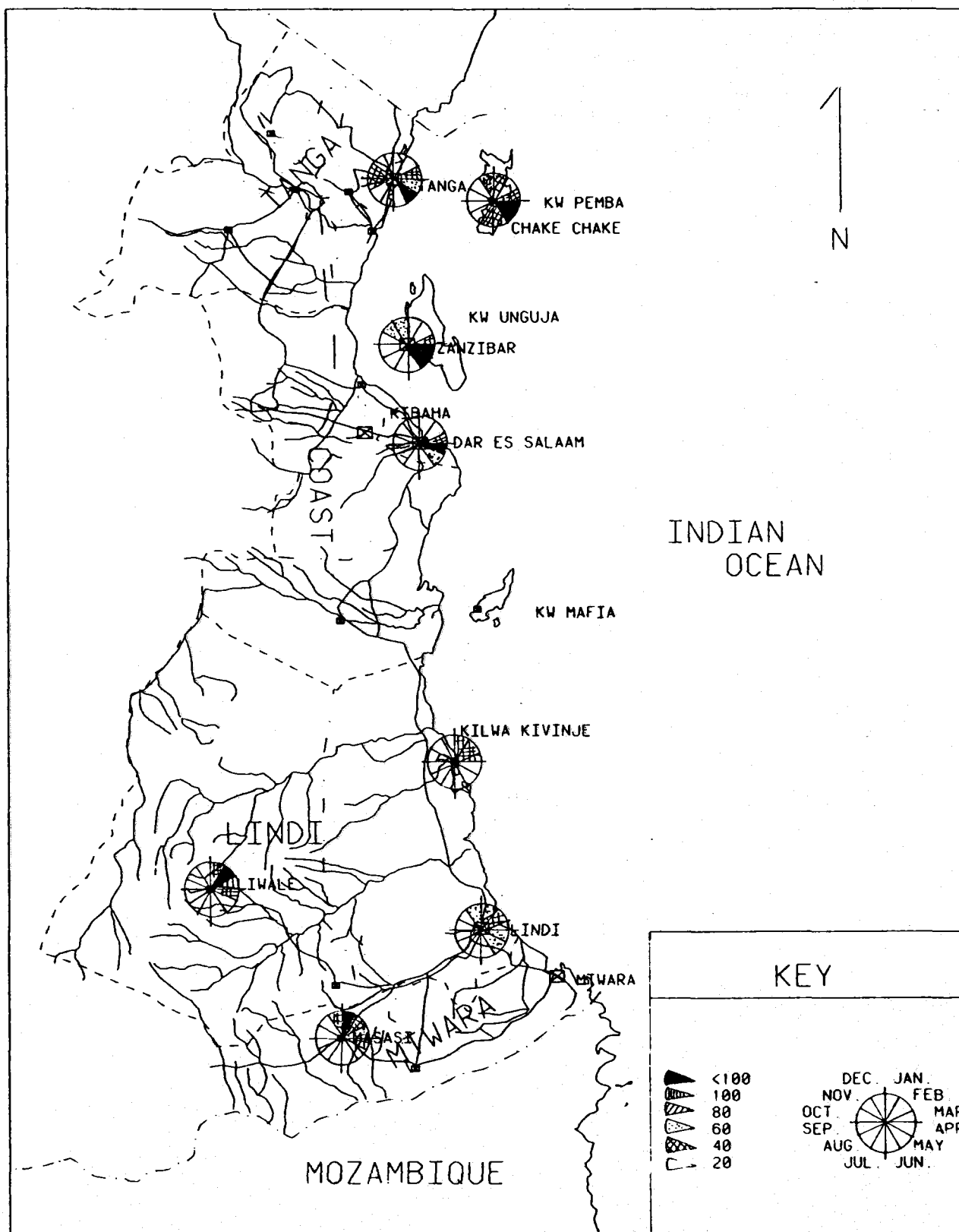


Figure 4. Climate of the Coastal Region (Maps compiled by S. Nieuwof, University of Dar es salaam)

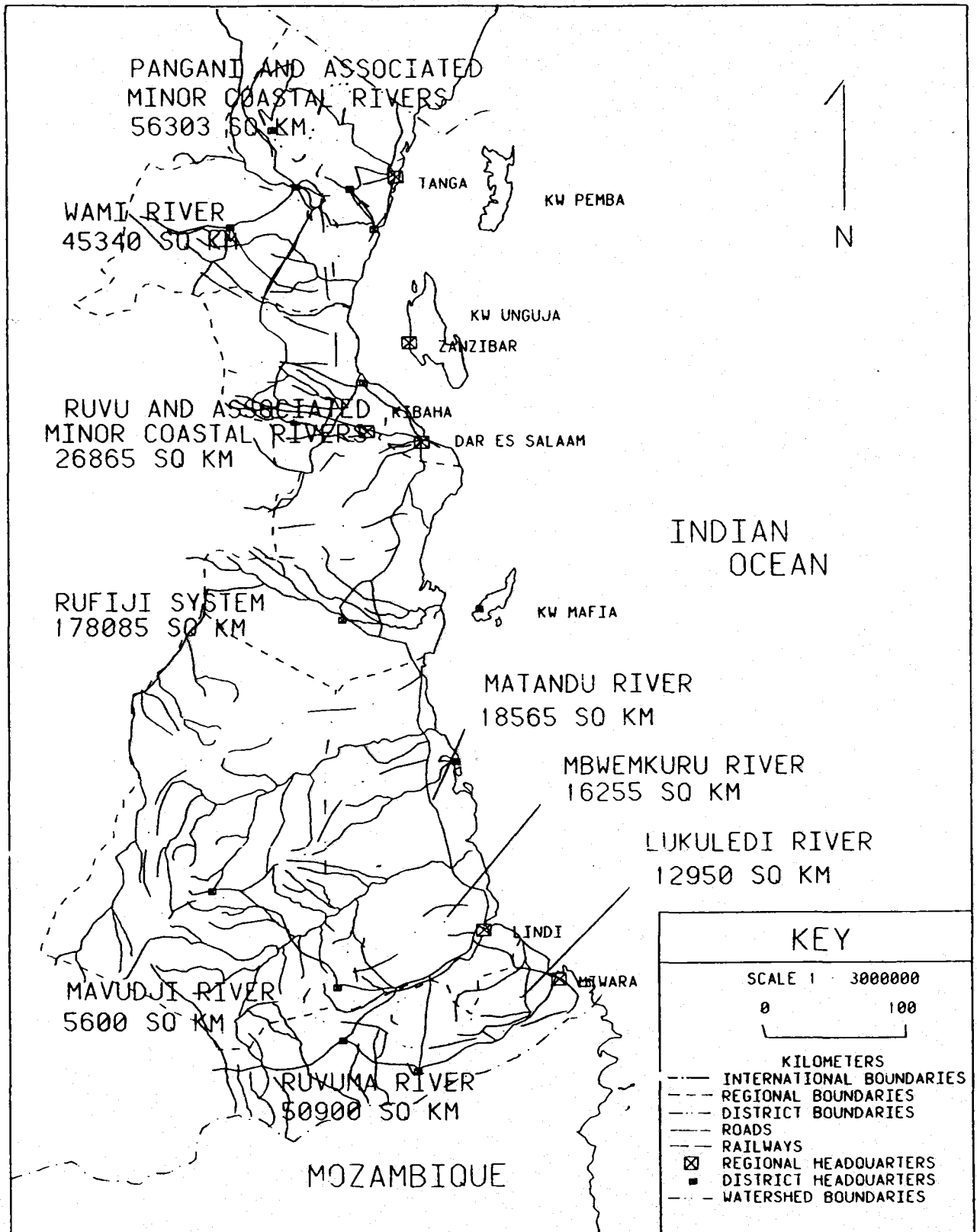


Figure 5. Indian Ocean Drainage Basin Watershed (compiled from information supplied by the Ministry of Water Development and Power, 1972)

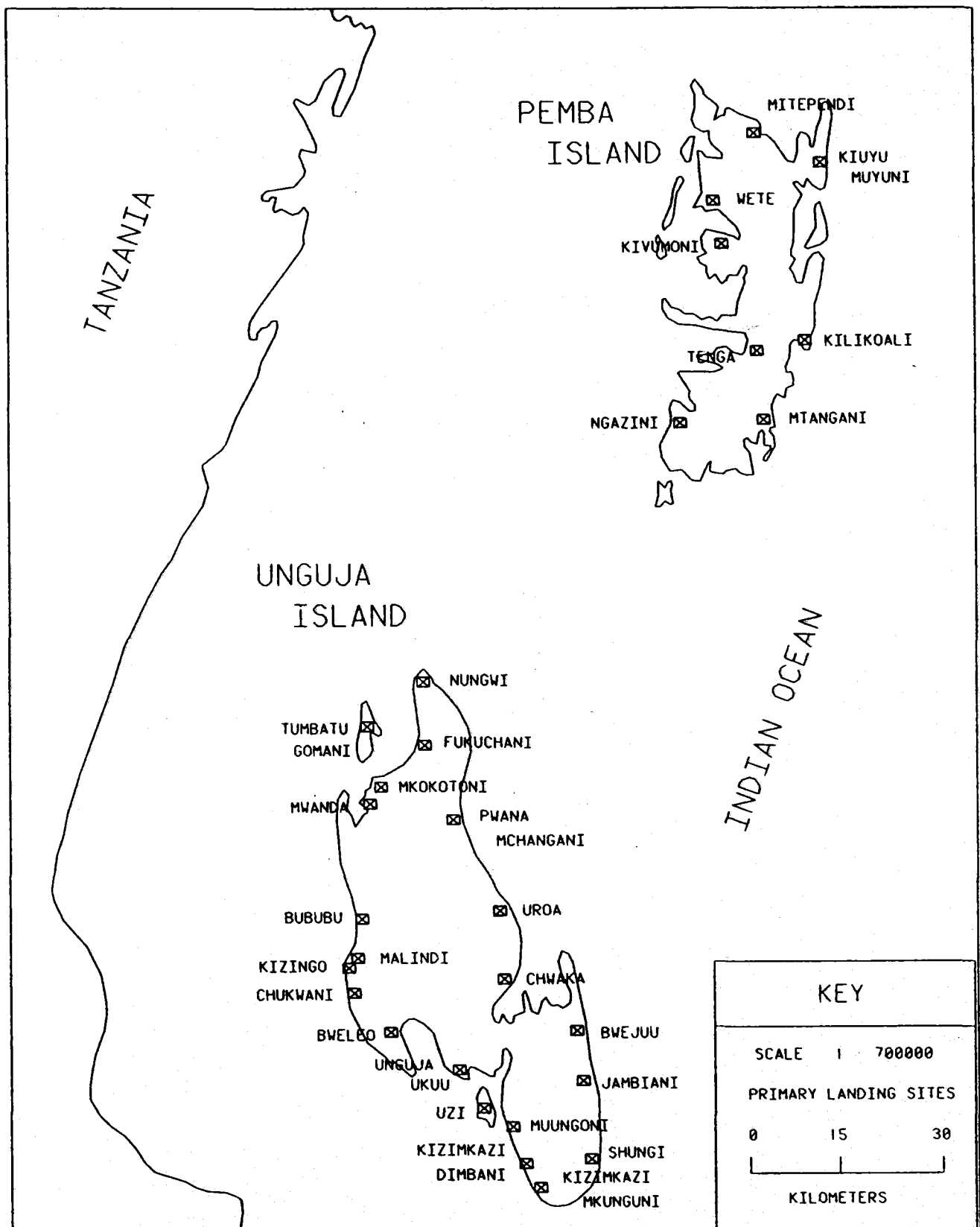


Figure 6. Fish Catch Landing Sites of Zanzibar and Pemba  
(Zanzibar Ministry of Marine Tourism and Forestry)

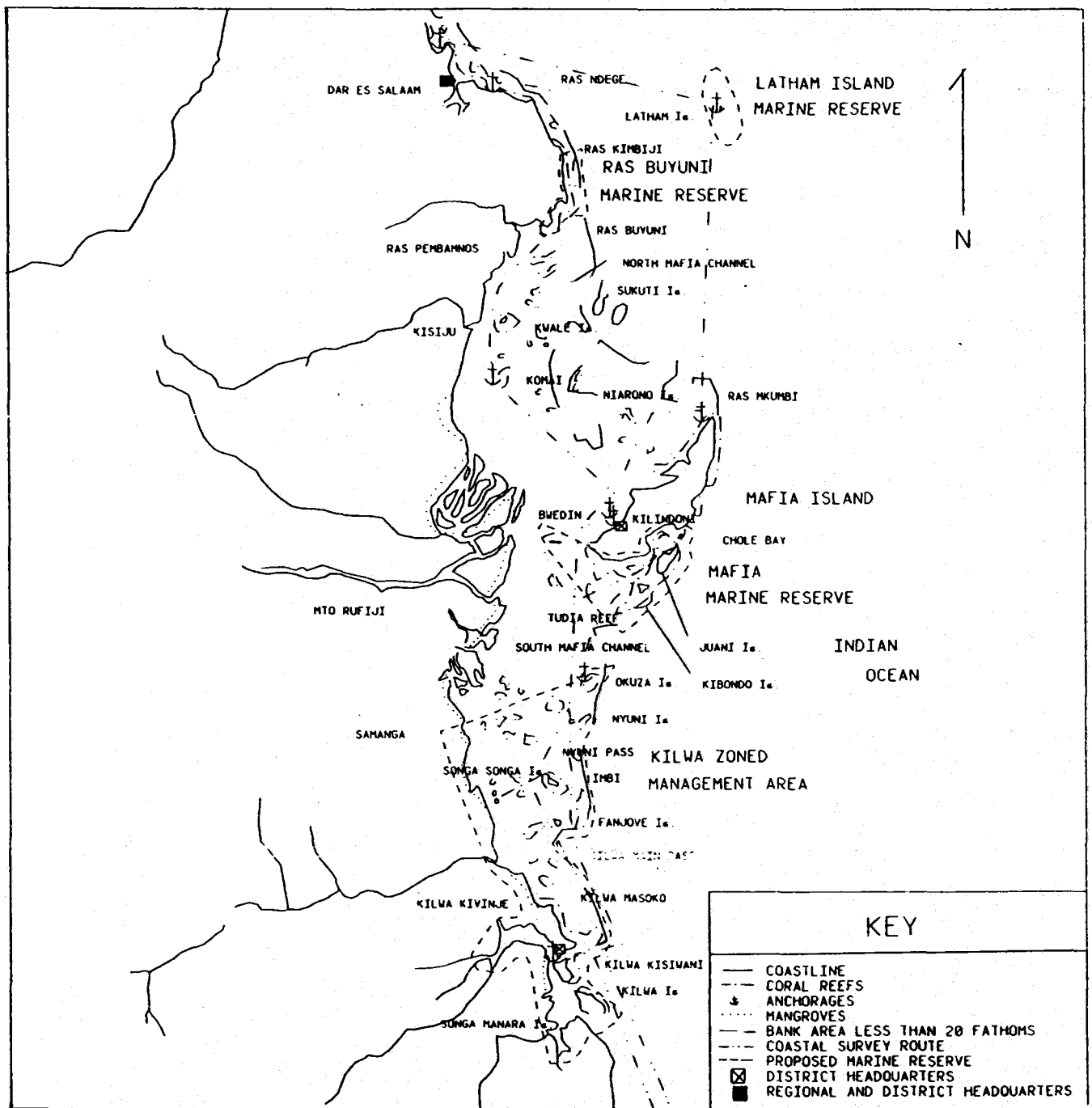


Figure 7. Proposed Mafia Marine Protected Area (Admiralty Chart 2951)

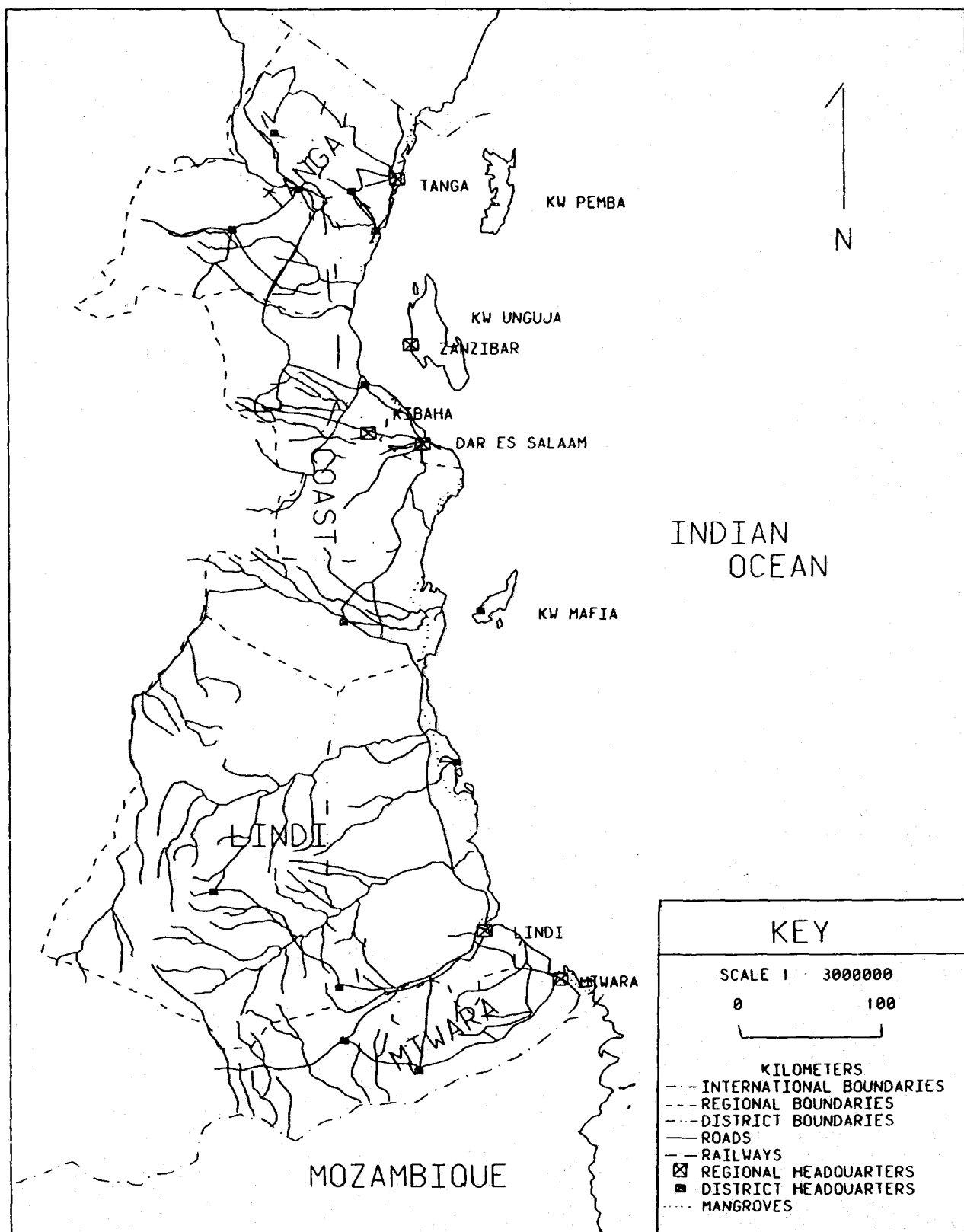


Figure 8. Mangrove Reserves (Compiled from information supplied by Forestry Division, 9 August 1972)

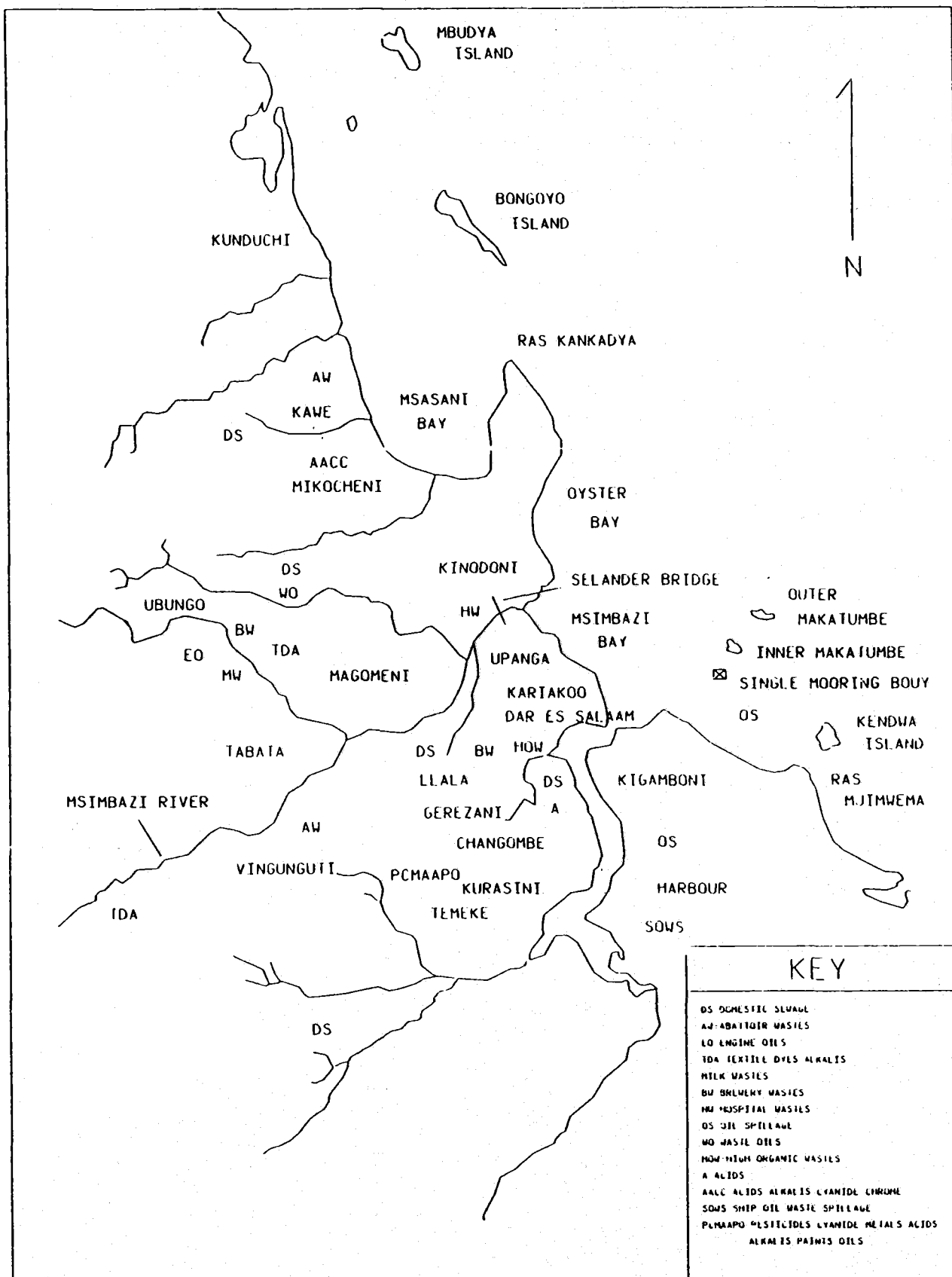


Figure 9. Types of Polluting Effluents found in the Dar es Salaam Region  
(National Environment Management Council Dar es Salaam 1987)

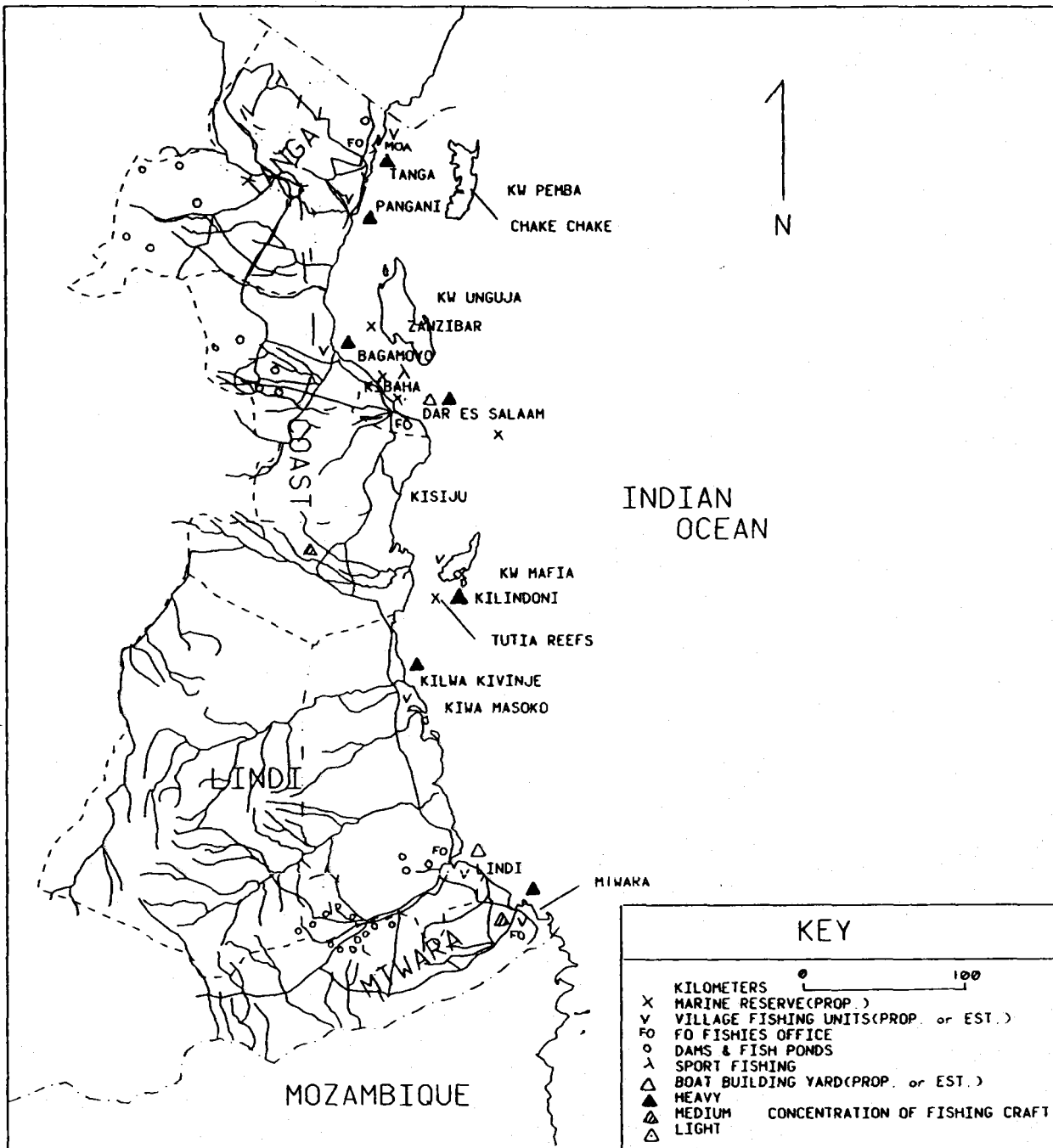


Figure 10 Concentration of Fishing Activities



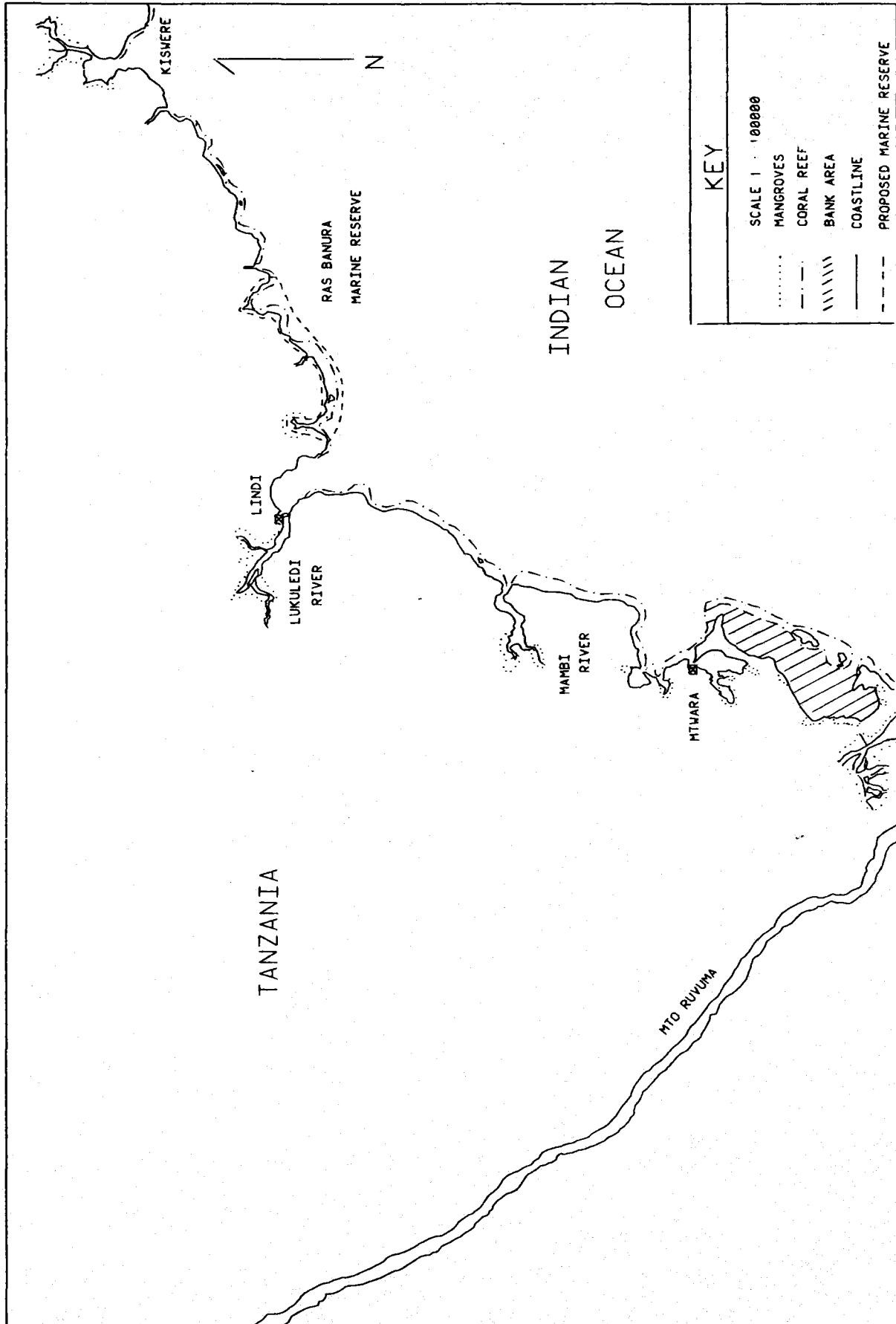


Figure 11. South Lindi and Mtwara Region (16 November 1972 NASA ERTS E-11116-06574-501)

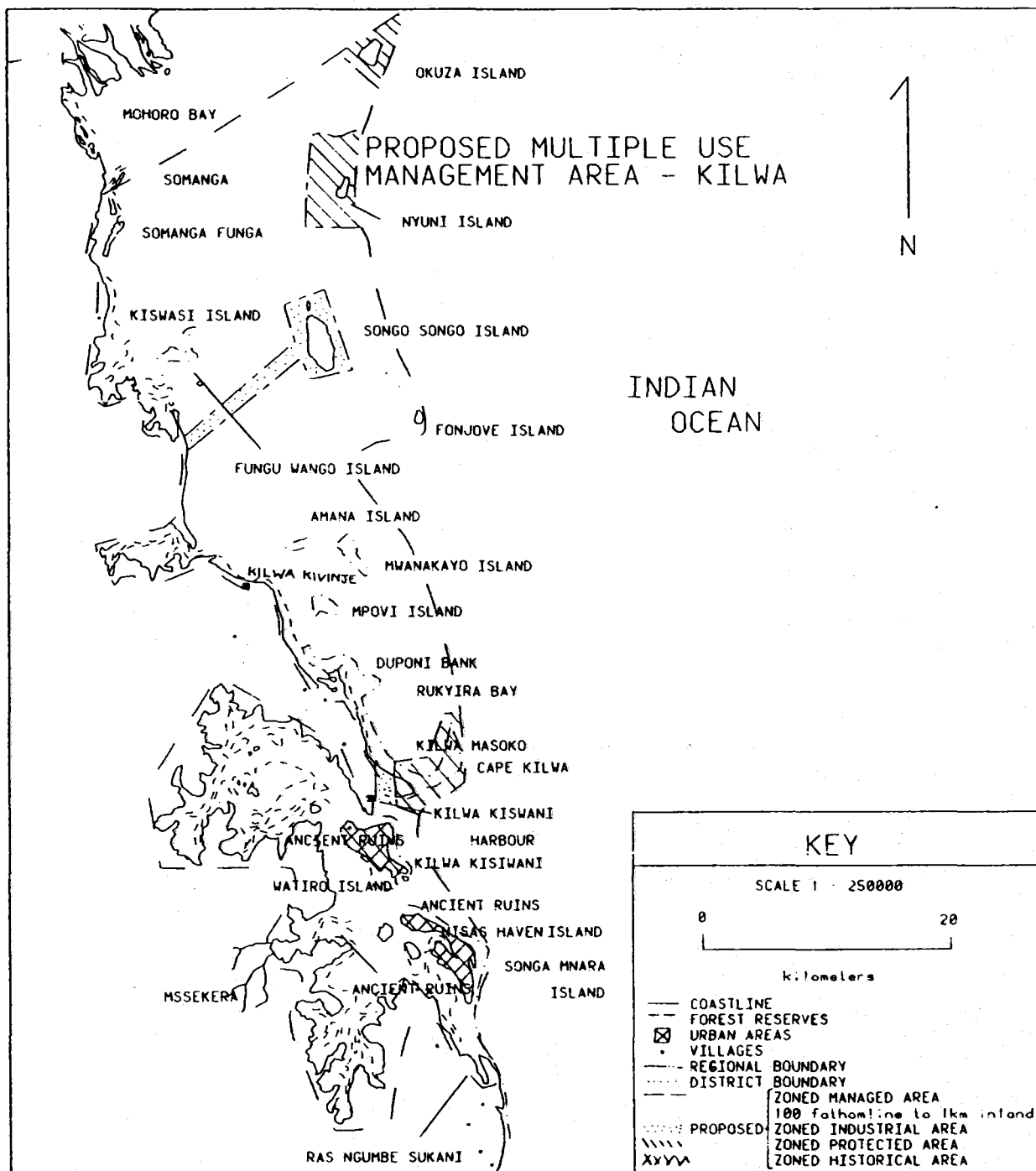


Figure 12. Proposed Multiple use Management Area - Kilwa (Compiled, drawn and printed by Surveys and Mapping Division, Ministry of Lands, Housing and Urban Development Tanzania, 1969)

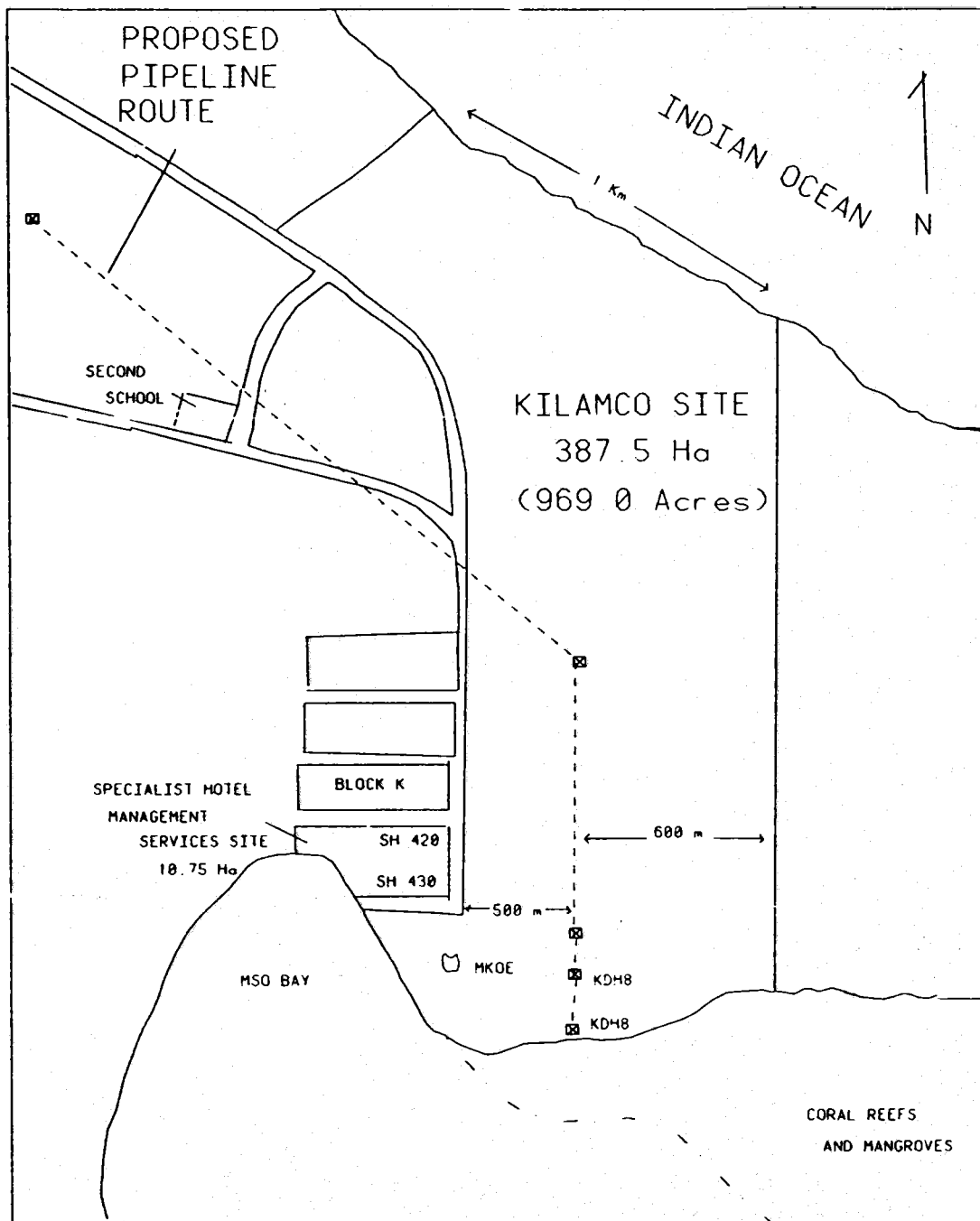


Figure 13. Status of Land Allocation near Kilamco Site, Kilwa Maroka

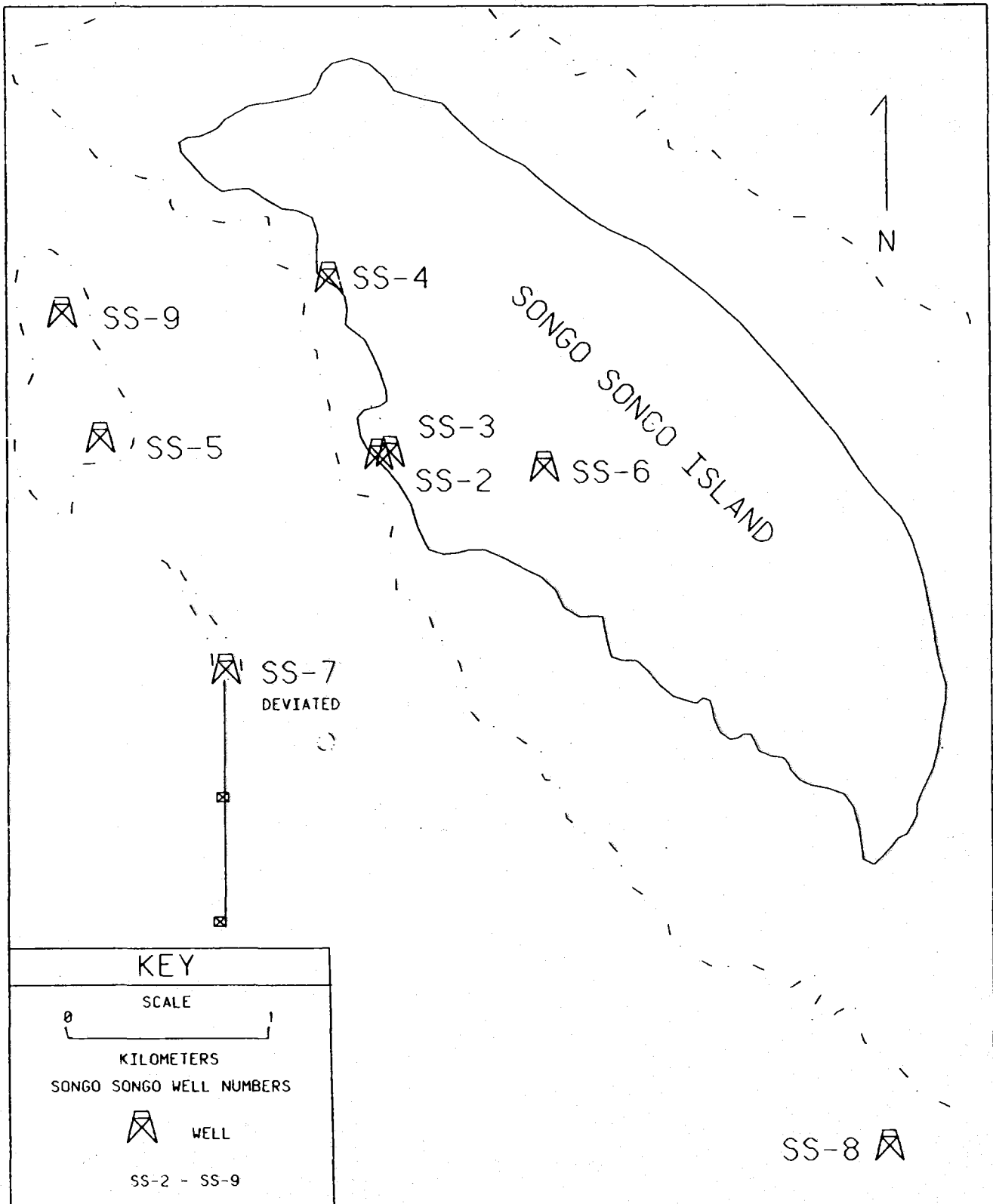


Figure 14. Songo Songo Island, Existing Gas and Producer Wells  
Tanzanian Petroleum Development Cooperation



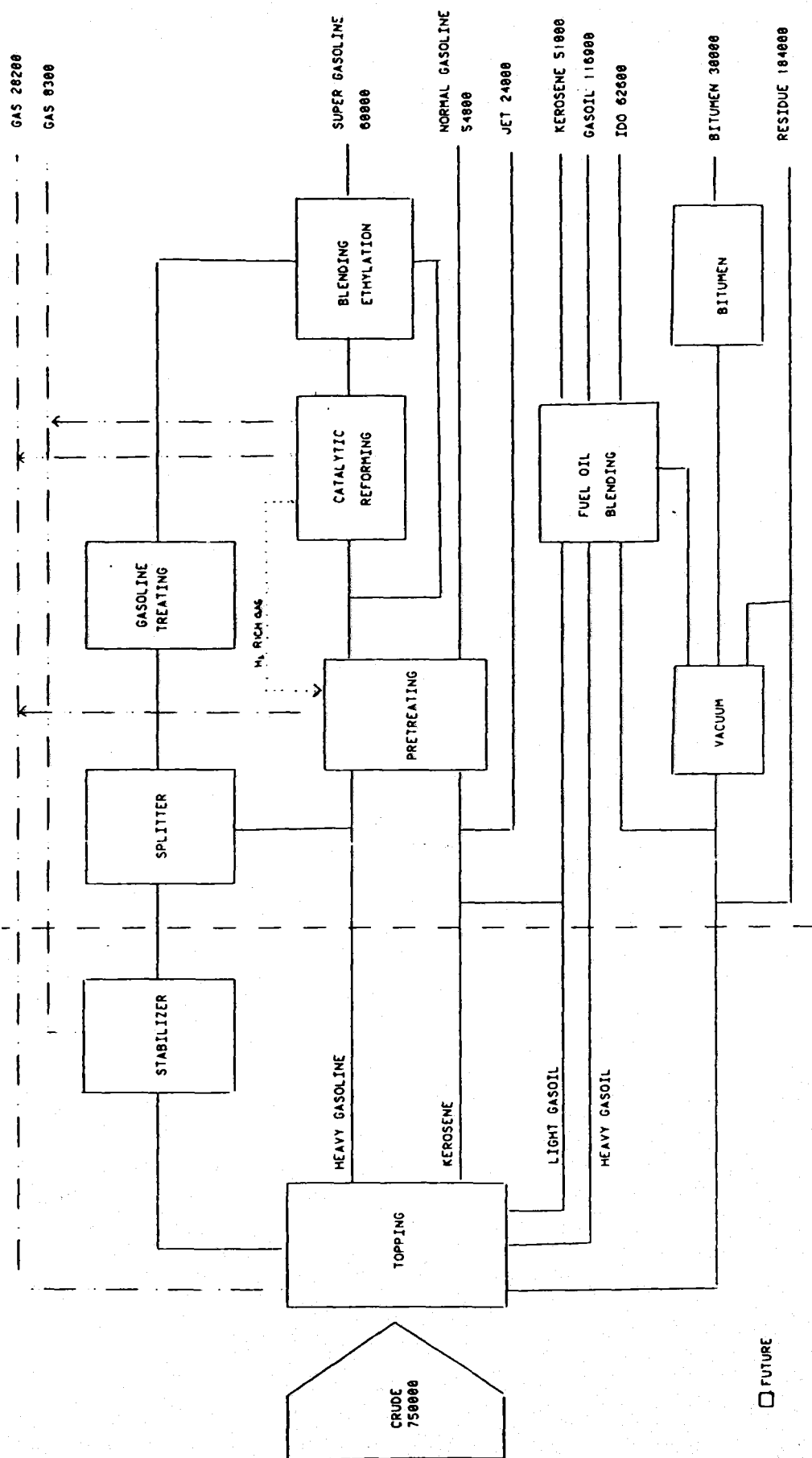


Figure 16. Refinery Flow Chart Based on Annual Designed Capacity in Metric Tons  
(Daily News, January 1987)

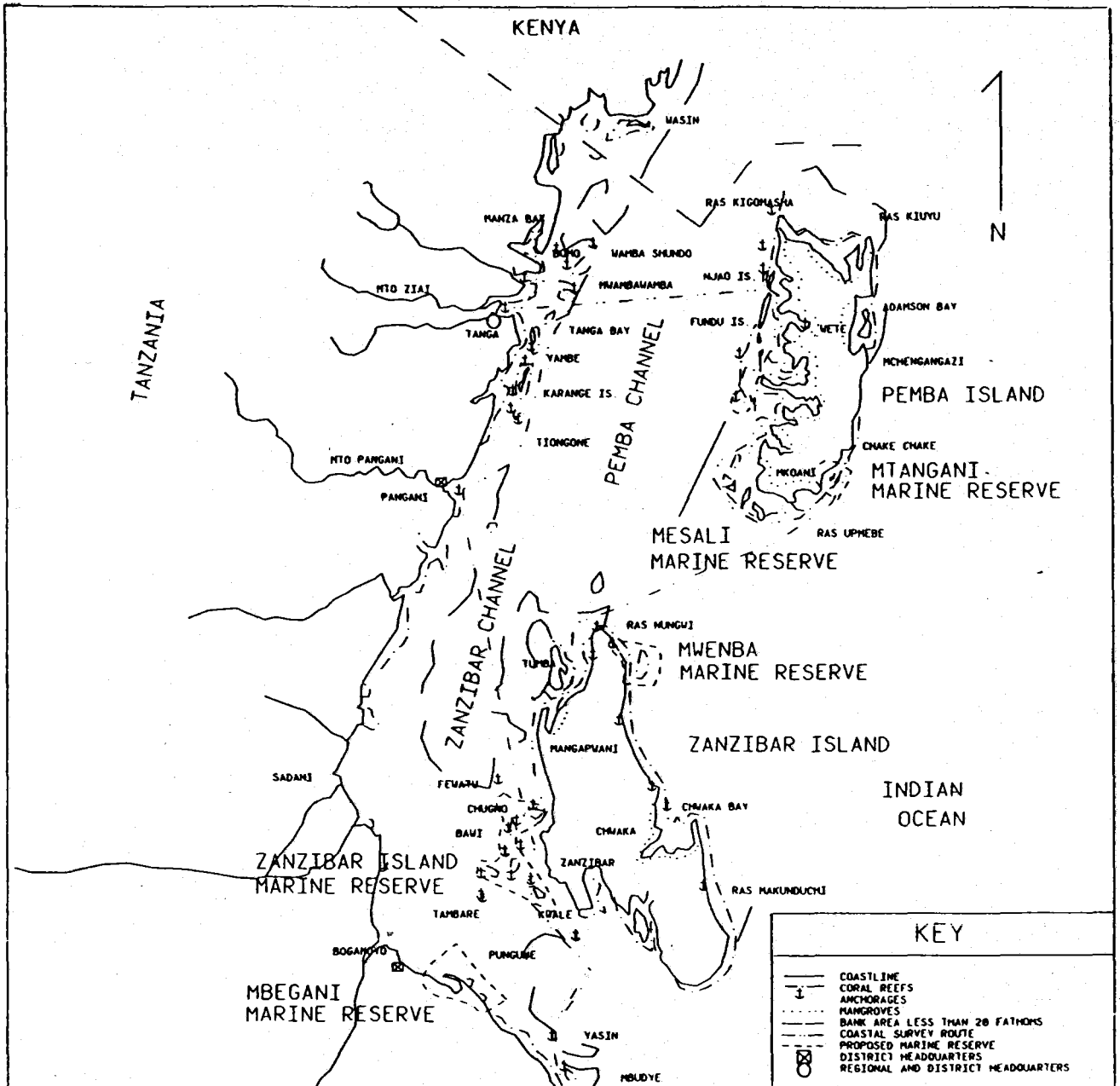


Figure 17a. Proposed Marine Reserves (Admiralty Chart 2951)

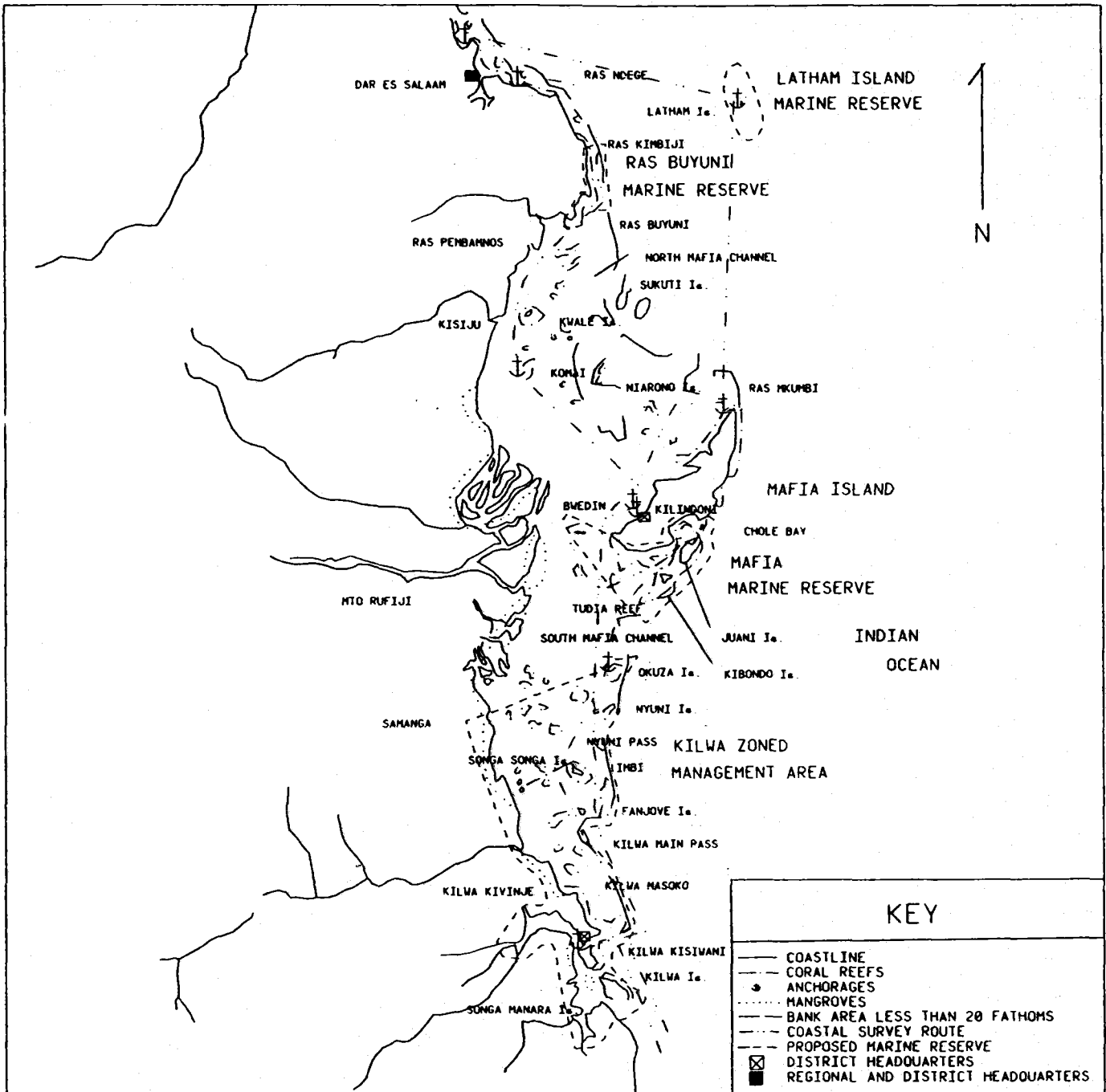


Figure 17b. Proposed Marine Reserves (Admiralty Chart 2951)





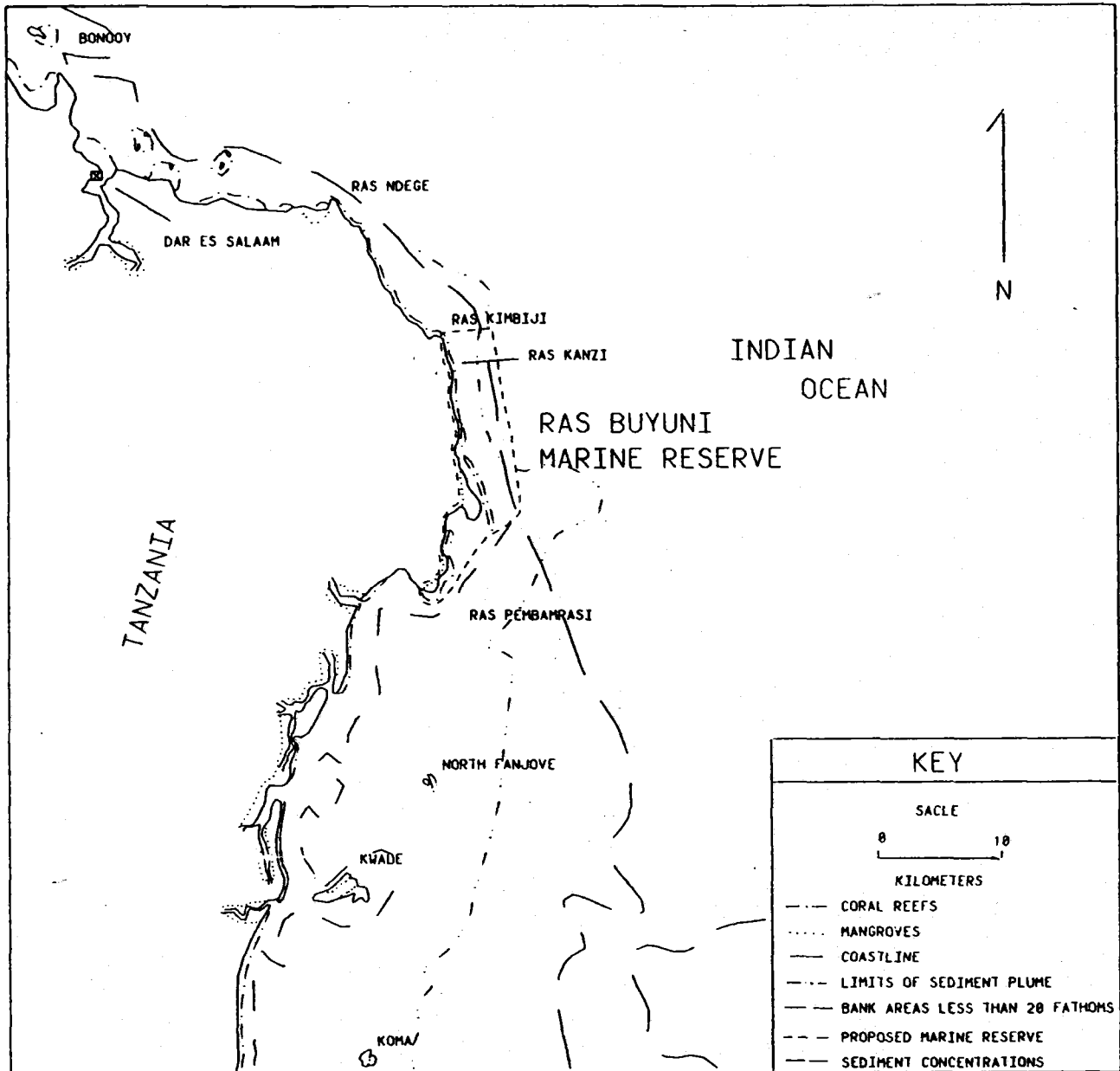


Figure 18a. The Coastline of Tanzania from Kunduchi to Samanga (24 June 81 LANDSAT MSS SCENE ID 22345-06472)

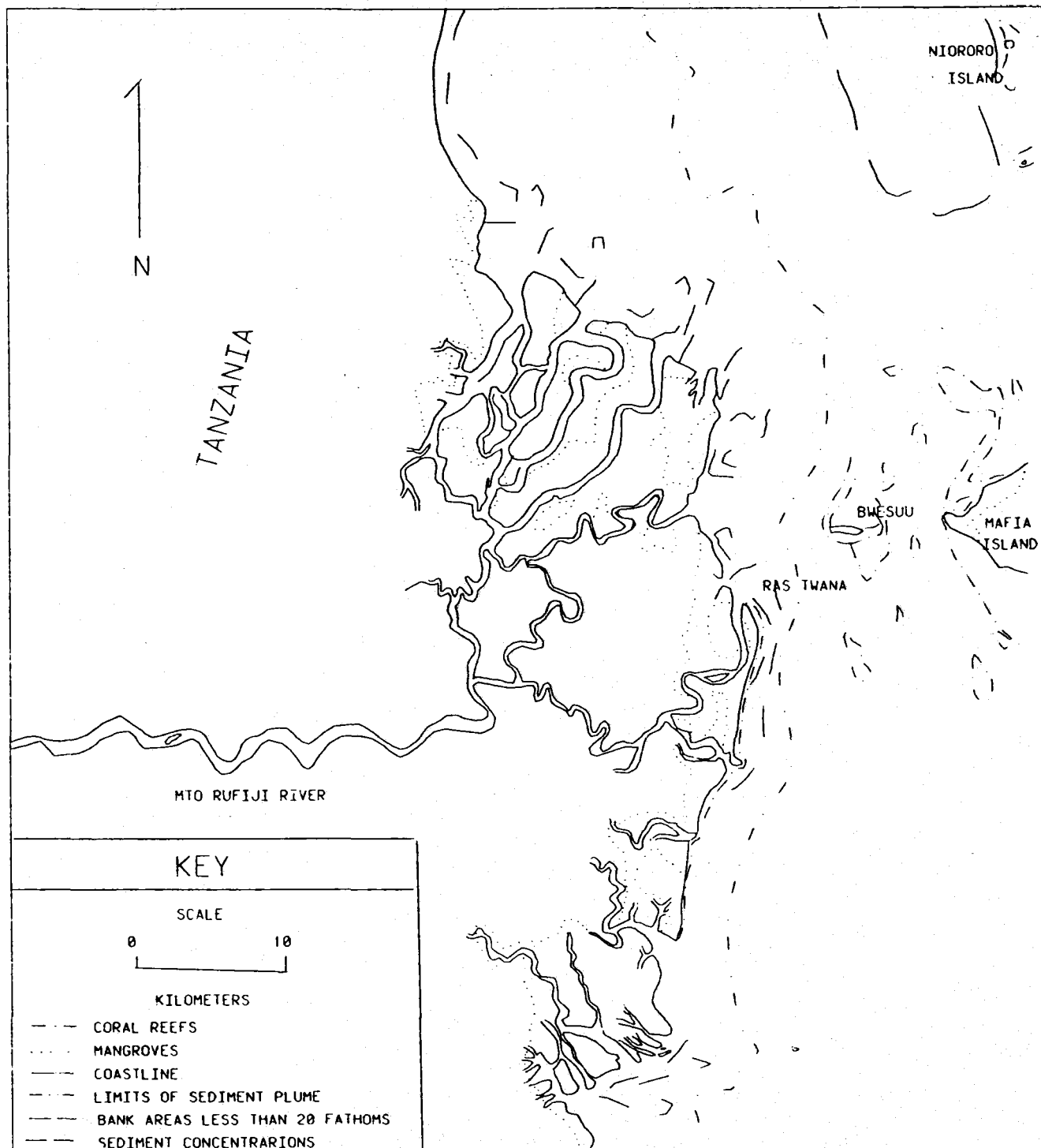


Figure 18b. The Coastline of Tanzania from Kunduchi to Samanga (24 June 81 LANDSAT MSS SCENE ID 22345-06472)

## REFERENCES

- Africa Pilot (1980). South and East Coasts of Africa from Cape Agulhas to Ras Binnah including the Islands of Zanzibar and Pemba. Volume 3 13th Edition. Hydrographer of the Navy.
- Atlas of Tanzania Second Edition (1976). Government of the United Republic of Tanzania, Survey and Mapping Division, Ministry of Lands, Housing and Urban Development, Dar es Salaam, Tanzania.
- Bryceson, I. (1978). Tanzanian Coral Reefs at Risk, *New Scientist* 80, page 115.
- Bryceson, I. (1982). Pollution of Dar es Salaam Waters by Industrial and Domestic Effluents. Workshops of the Current State of Development of Marine Sciences in Tanzania, April 1982.
- Cooper, J., Williams, A. J. and Britton, P.G. (1984). Distribution, Population Zones and Conservation of breeding Seabirds in the Afrotropical Region. In: Croxall, J.P., Evans, P.G.H., Schreiber, W. (Eds) Status and Conservation of the World's Seabirds. ICBP Technical Publication No.2 Cambridge.
- Christy, L.C. (1979). United Republic of Tanzania: Fisheries Legislation in Zanzibar. FAO - Technical Report Indian Ocean Programme 24.
- Crossland, C. (1902). Coral Reef of Pemba Island and the East African Mainland. *Cambridge Phil. Proc.* XII pages 36 to 43.
- FAO/UNEP (1983). Legal Aspects of Protecting and Managing the Marine and Coastal Environment of the East African Region UNEP Regional Seas Reports and Studies No. 38.
- FAO/UNEP (1984). Legal Aspects of Managing the Marine and Coastal Environment of the East African Region. National Reports, UNEP Regional Seas Reports and Studies No. 49, pages 133 - 163.
- Hamilton, H.G.H. and Brakel, W. (1984). Structure and Fauna of East African Reefs. *Bulletin of Marine Sciences* 34(2), pages 248 to 266.
- Harvey, J. (1977). Some Aspects of the Hydrography of the Waters off the Coast of Tanzania. A contribution to CINWIO. *University Science Journal (Dar es Salaam, University No. 3 (Vol. 1,2) pages 53 - 92.*
- IMO (1982). Tanzania National Seminar on Marine Pollution Prevention. Control and Response. 26 pages.
- IMO/UNEP (1985). Oil Spills and Shoreline Clean-up on the Coasts of the Eastern African Region. UNEP Regional Seas Reports and Studies No. 57.
- IUCN/UNEP (1984). Marine and Coastal Conservation in the East African Region. UNEP Regional Seas Reports and studies No.39, pages 51 - 234.
- IUCN/UNEP (1985). Management and Conservation of Renewable Marine Resources in the Indian Ocean Region. Overview. UNEP Regional Seas Reports and Studies No. 60.
- IUCN/UNEP (1985). Management and Conservation of Renewable Marine Resources in the Eastern African Region. UNEP Regional Seas Reports and Studies No. 66.
- Lann, H. and Mbaggi, Y. (1986). The Rivers, Msimbazi, Dar es Salaam. Investigation of the Water Quality and Discharges of Waste Water into the River and its tributaries (1984 - 1986). Ministry of Land, Water, Housing and Urban Development - Environmental Protection and Management Section.

Ministry of Communications and Works, (1984). A national Marine Oil Spill Contingency Plan for Tanzania (Restricted).

Ministry of Land, Natural Resources and tourism. (1984). Investigation of the Coliform Bacteria in Dar es Salaam Waters.

Newell, B.S., (1957). A Preliminary Survey of the Hydrography of the British East African Coastal Waters. Fisheries Publ. of the Colonial Office 9.

Newell, B.S., (1959). The Hydrography of the British East African Coastal Waters, Part II. Fisheries Publications of the Colonial Office 9.

Rahmatullah, Khan. (1982). Fisheries Legislation in Zanzibar (Third Report) FAO Regional Fisheries Law Advisory Programme (FL/IOB/82/7).

Salm, R.V.; Clark, F.R. (1984). Marine and Coastal Protected Areas. A guide for Planners and Managers. IUCN Press, Geneva.

UN/UNESCO/UNEP (1982). Marine and Coastal Area Development in the East African Region. UNEP Regional Seas Reports and Studies No. 6.

UNIDO/UNEP (1982). Industrial Sources of Marine and Coastal Pollution in the East African Region. UNEP Regional Seas reports and Studies No. 7.

UNEP (1982). Marine Pollution in the East African Region. UNEP Regional Seas Reports and Studies No. 8.

UNEP (1982). Environmental Problems of the East African Region. UNEP Regional Seas Reports and Studies No. 12. 1982.

UNEP (1984). Socio-Economic Activities that may have an Impact on the Marine and Coastal Environment of the East African Region. UNEP Regional Seas Reports and Studies No. 41.

UNEP (1985). Action Plan for the Protection Management and Development of the Marine and Coastal Environment of the Eastern African Region. UNEP Reports and Studies No. 61.

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