



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 (3,276 ft or 638 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 Mtsani 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 Msanganku 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 Domacanthrus 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 Chole 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 Ndege 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 B.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 B, annex X).

It was observed that in all the mangrove areas surveyed along the Tanzanian coastline including the islands of Pemba and Zanzibar.

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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 km². 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 dugong 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 VIII). 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 Mbeganí 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 SO₂ and 2.1 kg of SO₃ are emitted into the atmosphere. Effluent emitted into the sea is roughly 700m³/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 m³ 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 m³ 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 Keko, 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 Makatumbi 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 phytozoology 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 gazettement 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, turtleshells) 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 Pambanasi 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 Bwejuu 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°) to a point $06^{\circ} 10'30"S$; $39^{\circ} 08'20"E$. From this point a limiting line (061°) 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° . 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° to the 100 fathom line, then south along the 100 fathom line to the intersection of a 090° 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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- (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 Mbegani 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.

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