



# REGIONAL SEAS

UNITED NATIONS ENVIRONMENT PROGRAMME

## *Conservation of coastal and marine ecosystems and living resources of the East African Region*

*UNEP Regional Seas Reports and Studies No. 11*

*Prepared in co-operation with*



INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

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PREFACE

The Regional Seas Programme was initiated by UNEP in 1974. Since then the Governing Council of UNEP has repeatedly endorsed a regional approach to the control of marine pollution and the management of marine and coastal resources and has requested the development of regional action plans.

The Regional Seas Programme at present includes ten regions 1/ and has over 120 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to combating environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the Governments concerned. It is designed to link assessment of the quality of the marine environment and the causes of its deterioration with activities for the management and development of the marine and coastal environment. The action plans promote the parallel development of regional legal agreements and of action-oriented programme activities.

Decision 8/13(C) of the eighth session of the Governing Council of UNEP called for the development of an action plan for the protection and development of the marine and coastal environment of the East African region. As a first activity in the region, UNEP organized in October and November 1981 a joint UNEP/UN/UNIDO/FAO/UNESCO/WHO/IMCO/IUCN exploratory mission which visited the eight States of the region 2/ in order to:

- assess each State's interest in participating in a future regional programme;
- consult with Governments with a view to identifying activities that may usefully be included as part of a comprehensive action plan;
- make a preliminary assessment of the environmental problems in the region, including the problems related to the environmentally sound management of marine and coastal natural resources and activities influencing the quality of the marine and coastal environment;
- collect available scientific data and information pertaining to the development and implementation of the action plan planned for the region; and
- identify national institutions that may participate in implementing an action plan once it is adopted.

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1/ Mediterranean, Kuwait Action Plan Region, West and Central Africa, Wider Caribbean, East Asian Seas, South-East Pacific, South-West Pacific, Red Sea and Gulf of Aden, East Africa and South-West Atlantic.

(ii)

The findings of the mission were used to prepare the following six sectorial reports:

- UN/UNESCO/UNEP: Marine and Coastal Area Development in the East African Region. UNEP Regional Seas Reports and Studies No. 6. UNEP 1982;
- UNIDO/UNEP: Industrial Sources of Marine and Coastal Pollution in the East African Region. UNEP Regional Seas Reports and Studies No. 7. UNEP 1982;
- FAO/UNEP: Marine Pollution in the East African Region. UNEP Regional Seas Reports and Studies No. 8. UNEP 1982;
- WHO/UNEP: Public Health Problems in the Coastal Zone of the East African Region. UNEP Regional Seas Reports and Studies No. 9. UNEP 1982;
- IMO/UNEP: Oil Pollution Control in the East African Region. UNEP Regional Seas Reports and Studies No. 10. UNEP 1982; and
- IUCN/UNEP: Conservation of Coastal and Marine Ecosystems and Living Resources of the East African Region. UNEP Regional Seas Reports and Studies No. 11. UNEP 1982.

The six sectorial reports prepared on the basis of the mission's findings were used by the UNEP secretariat in preparing a summary overview entitled:

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

The overview and the six sectorial reports were used as the main working document and information documents for the UNEP Workshop on the Protection and Development of the East African Region (Mahé, Seychelles, 27 - 30 September 1982) attended by experts designated by the Governments of the East African region.

The Workshop:

- reviewed the environmental problems of the region;
- endorsed a draft action plan for the protection and development of the marine and coastal environment of the East African region;
- defined a priority programme of activities to be developed within the framework of the draft action plan; and
- recommended that the draft action plan, together with a draft regional convention for the protection and development of the marine and coastal environment of the East African region and protocols concerning (a) co-operation in combating pollution in cases of emergency, and (b) specially protected areas and endangered species, be submitted to a conference of plenipotentiaries of the Governments of the region with a view to their adoption (UNEP/WG.77/4). The conference is to be convened by UNEP in early 1984.

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## INTRODUCTION

1. This report examines the status of conservation of ecosystems and associated living resources occurring in the coastal and marine environment of the East African region. The geographical location of this region is shown in figure 1.

2. The scope of the report comprises:

- (a) Classification and survey of coastal and marine ecosystems and living resources;
- (b) Assessment of economic value of resources;
  - present use
  - proposed development
- (c) Identification of critical coastal and marine species and habitats and of environmental threats;
- (d) National policies, legislation and training relevant to conservation including legislation;
- (e) Conclusions and recommendations.

3. The diversity of plant and animal life is an essential storehouse of genetic material for meeting human needs of the region. This alone highlights how important and urgent it is that development be shaped in such a way as to protect living resources for long-term productivity. Sustainable economic growth should be inter-related with the conservation of life-support systems on which the people depend in their quest for food, health, fuel and shelter. Any deteriorating relationship between human communities and the ecological processes that sustain them may lead to an aggravation of the present situation.

4. The diversity of living resources of the coastal and marine ecosystems requires an integrated approach to management. This is even more complex along the coastal zone than in the management of marine living resources. For example, the coastal zone is likely to include the interests of: rural and urban development, agriculture, forestry, wildlife and land-based tourism, industrial development, etc., while the management of marine resources is, in most cases, under the department of fisheries and, very locally, the national parks departments and the harbour authorities.

5. Most of the information contained in this document was provided by the government agencies most directly charged with the management and conservation of forestry and fisheries resources and where possible, research institutes/centres

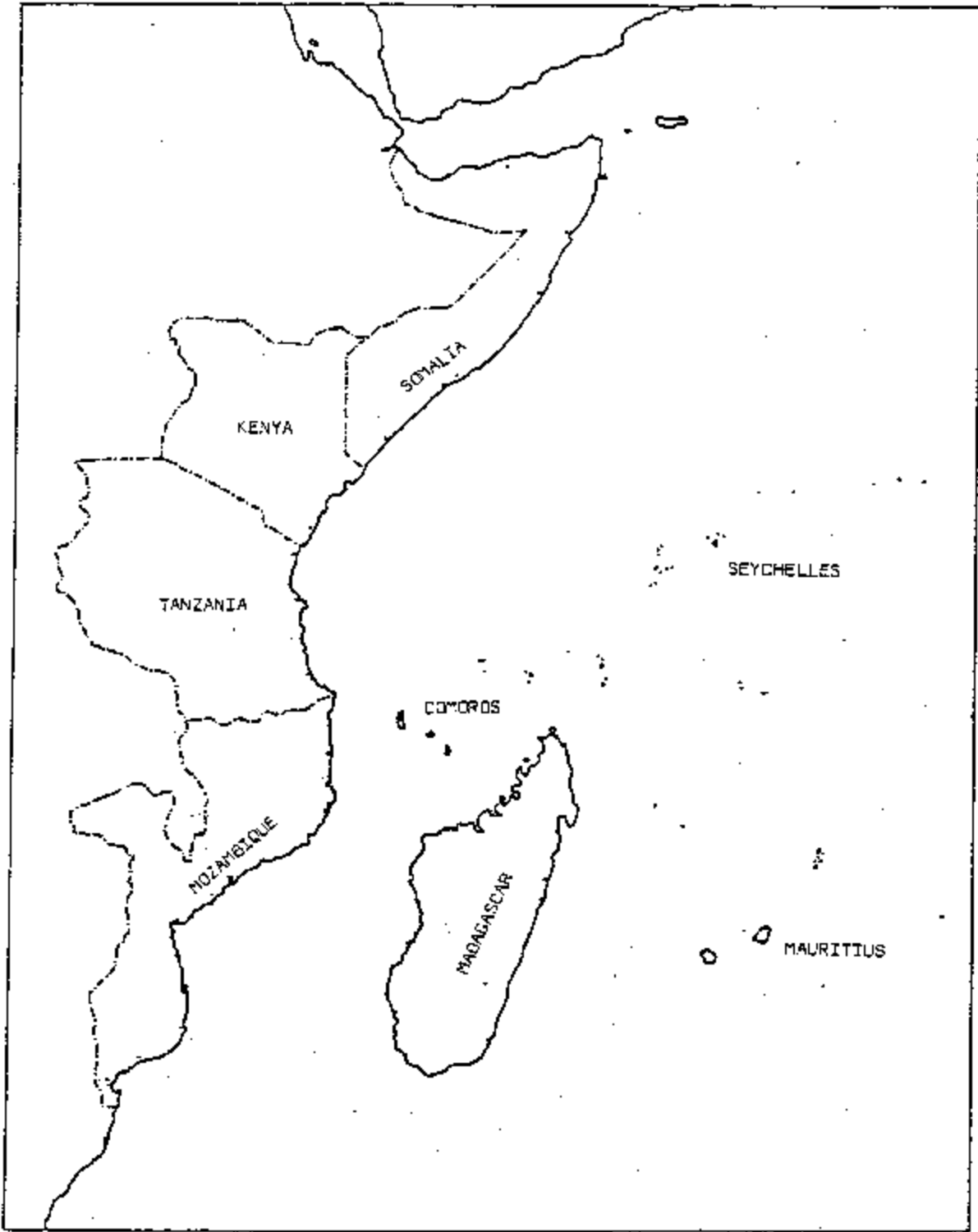


Figure 1 : The East African region

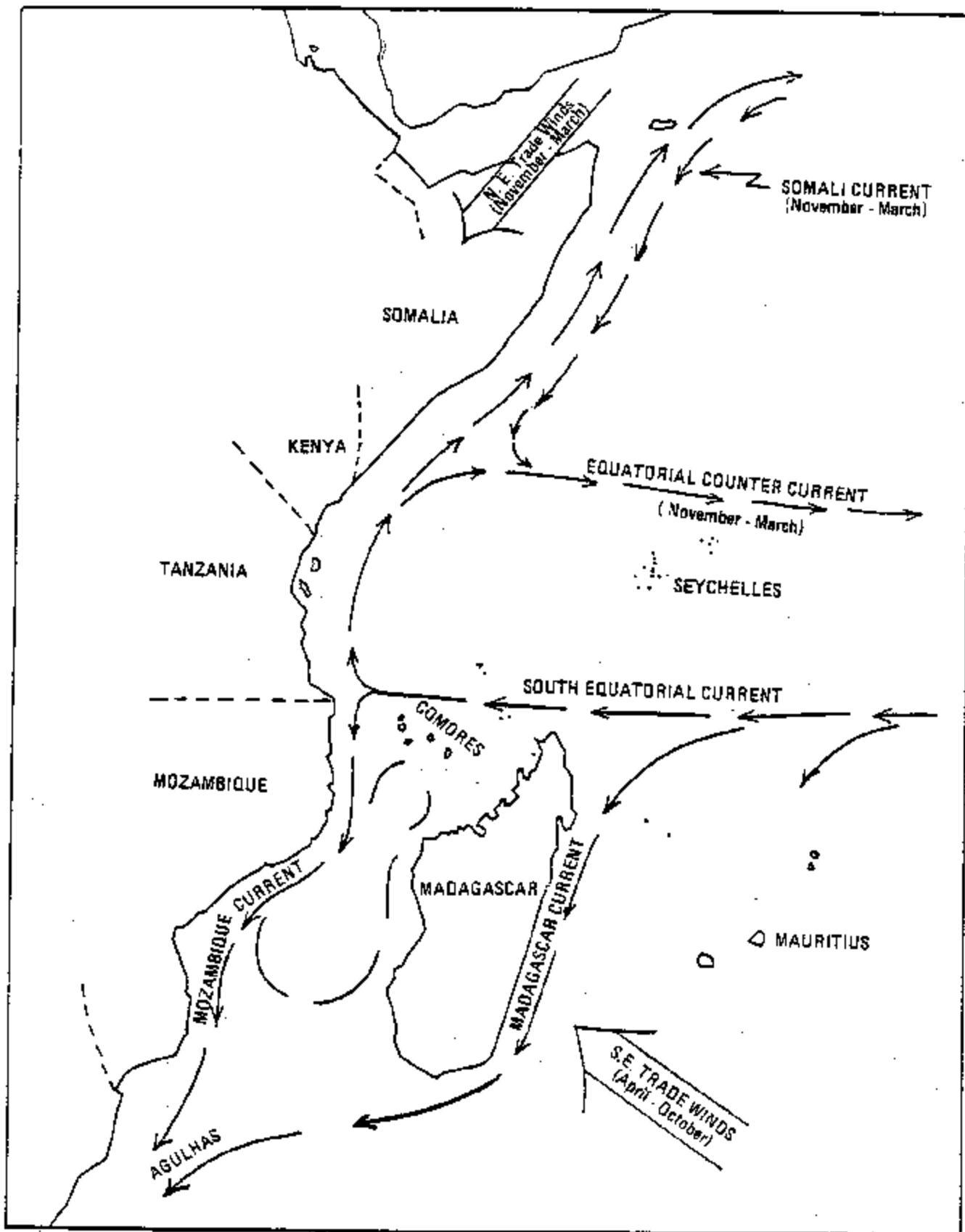


6. Supplementary relevant information has been obtained from UNEP, the United Nations Food and Agriculture Organization (FAO) and the International Union for Conservation of Nature and Natural Resources (IUCN) particularly on reports emanating from work/surveys carried out in the region under their sponsorship, at national or regional levels.
7. Despite this additional information, major gaps will still remain either because the particular aspect in question has not previously been studied or only partially so, or that information was not available.

## THE PHYSICAL ENVIRONMENT

### Climate

8. The mainland countries straddle the equator from 12°N to 27°S latitude so that the NE trade winds (monsoon), October to March, are strongest in Somalia (figure 2) and only skim northern Mozambique. This air mass blows from continental Asia, with a moisture deficiency by the time it reaches the open sea. Thus only a small amount of moisture is dropped in northern Somalia, which, however, increases southwards towards Tanzania due to the larger water surface and intervening coastal mountain ranges.
9. The SE trade winds, April to October, have a much greater impact in the region as they blow across a wider water surface before they reach the mainland. They are largely responsible for the higher rainfall received in Mozambique as compared to northern Kenya and southern Somalia. The two winds deflect towards the ocean after crossing the equator, and being from the mainland, they are relatively dry. Thus, Somalia and most of southern Tanzania down to Mozambique have a dry season lasting about six months.
10. The islands, on the other hand, are located several kilometres from the mainland, the nearest being Comoros (300 km east of Mozambique) and most of them lie south of the equator. Except for Seychelles which receives most of its rainfall from the NE trade winds, the rainfall pattern in the other islands is much influenced by the SE monsoon and can be expected to be heavy and well distributed throughout the year. The island of Madagascar, the largest in the system, stretching from latitude 12°S to about 25°S, is approximately 1,600 km long and has an approximate maximum width of 600 km, and experiences climatic conditions similar to those observed on the mainland. In addition to its large size, the land mass rises to over 1000 m above sea-level all along the east coast and immediately inland and then slopes westwards. Consequently, more rainfall is received here than along the whole of the west coast, although the difference is less pronounced south-westwards towards Icliara (Tuléar). For example, Toamasina (Tamatave) on the east coast receives 3,590 mm, while Antananarivo (Tananarive) on the plateau and Maintirano on the west coast receive 1,354 and 840 mm respectively (Dufournet 1969).
11. The temperature regime is typically tropical and the only sub-tropical conditions are those encountered in southern Madagascar and, to a lesser degree, in southern Mozambique. The southern extremity of Madagascar has a Mediterranean-type climate while near-desert conditions prevail immediately inland. It is to be noted that the coast of Somalia from just south of Mogadishu southwards is semi-desert to



### Ocean currents

12. A brief description of the ocean currents has been given by Bock (1978); see also the sectorial Reports 8 and 10 of this series, and figure 2. From April to October, the large mass of water moves westwards along the equator as the South Equatorial Current. The position of northern Madagascar relative to this current and of the mainland deflects it north and south to give rise to the East African Coastal Current (EACC), which flows northwards along the mainland coast, and the Mozambique current which flows southwards from the northern coast of Mozambique to join the Madagascar current, which flows along the eastern and south-eastern coast of Madagascar, to form the Agulhas Stream.

13. From November to March, the southern spring and summer, the influence of the NE monsoon is strongest and generates a southward-flowing current along the mainland coast, the Somali Current. This meets the northward-flowing EACC off the Kenya coast to form the Equatorial Counter Current which flows eastwards, counter to the South Equatorial Current.

14. On a more local scale, and perhaps due to the "vacuum effect" left by the interposing land mass of Madagascar, a northward current flowing counter to the faster Mozambique Current generates local circulating currents within the Mozambique Channel (Soetra and Silva 1979). The significance of the ecological process of these ocean currents can be appreciated from the similarities of the biota occurring in the region and further afield. The same species of mangroves, marine turtles, prawns and marine fishes are to be found throughout the region. A similar inference can be made from the affinity between some of Seychelles biota, e.g., the dipterocarp on Mahé Island, the coco-de-mer (from Maldives), etc., and Indomalayan biota. Perhaps the best illustration lies in the homogeneity of marine biota such as coral and coral fishes not only within the Indian Ocean but as far as the Pacific. In addition, the strength of the major ocean currents shown in figure 2 may partially explain the narrow shelf area along the mainland and eastern Madagascar coasts, possibly through shelf erosion.

### Tropical cyclones, hurricanes and storms

15. Cyclones are an important climatic feature of the inter-tropical zone causing widespread damage to fauna and flora and their habitats as well as to human beings and their property. Cyclones occur annually during the southern summer, from December to March, passing across Mauritius through Madagascar and occasionally Mozambique. In Madagascar, the impact of Cyclones Danaë (19-24 January 1976) and Gladys (29 March 1976) has been studied by Randrianarison (1978) (see table 1). The two cyclones crossed the northern part of Madagascar and the strong winds and floods associated with them left disaster in their path. At least 10 people died, 12 were injured and 8,275 more were left without shelter. Material damage amounted to about FMG 7,262,175,000 (approximately US\$ 26.5 million) including damage to buildings, roads, communications, agriculture and livestock.

16. As is often the case, damage to forest resources and associated fauna, the loss of soil, the impact on the marine ecosystems arising from excessive run-off and strong wave action, etc., appear not to have been evaluated. Table 1 will no doubt give an idea of the possible impact on the ecosystems and natural living resources of the area affected. A visual and striking example is also to be found in the Machabee/Black Gorge River forest in Mauritius where the crowns of the larger trees like the *Mimosa* (*Mimosa* sp.)

Table 1 : Characteristics of Cyclones Danaë and Gladys in Northern Madagascar  
(from Randrianarison 1978)

Town	Minimum pressure, mb	Maximum wind velocity, km/h.	Precipitation	
			in 24 hrs	Decennial
Vohémar	976.8	220	121.1	200 <sup>a/</sup>
	-	-	101.5	200 <sup>b/</sup>
Sambava	965.0	180	-	-
	1002.2	-	128.0	220
Antalaha	999.1	70	152.2	220
	1004.5	-	161.8	220
Andapa	936 <sup>c/</sup>	95	203.5	190
Nosy Bé	991.2 <sup>d/</sup>	180	306.2	200
	-	-	164.7	200
Majunga	996.2 <sup>d/</sup>	160	-	-
Maintirano	-	-	88	250

- <sup>a/</sup> cyclone Danaë recorded on 21-01-76  
<sup>b/</sup> cyclone Gladys recorded on 29-03-76  
<sup>c/</sup> not adjusted to sea-level  
<sup>d/</sup> cyclone Danaë recorded on 22-01-76

17. Hurricanes and storms are also common in the region. Hurricanes affect Mozambique as they cross from Madagascar and, according to Tinley (1971), in fifty years 12 high-intensity hurricanes and 38 near-hurricanes to medium-intensity tropical storms had occurred. Gales with a velocity greater than 56-80 km/h are experienced about eight times in a year off the coast. Although cyclones and hurricanes are an ever-present threat in the general belt from Mauritius to Mozambique, the islands and mainland coast lying to the north of this zone: Seychelles, Comoros, Tanzania, Kenya and Somalia are fairly safe.

#### Geomorphology and soils

18. The mainland coastal plain is narrow for most of its length, in northern and north-eastern Somalia and then from south-eastern Kenya to northern Mozambique, and becomes wider southwards and otherwise further inland in areas traversed by the large rivers draining into the sea such as the Zambezi, Rovuma, Rufiji, Tana and Juba rivers. Immediately inland, the topography is interrupted by a range of mountains and escarpments before rising to inland plateaux, 1,000 m above sea-level. Most of the coastal mountain ranges run parallel to the shoreline and in this way exert local orographic influence on the moisture-laden air masses from the sea. Thus, the whole coast south of Malindi receives precipitation for most months of the year.

19. Further inland, the Ethiopian Highlands, Mt. Kenya and the Aberdares, Mt. Kilimanjaro and the Pare-Usambara mountain ranges, the highlands of southern Tanzania, the mountain ranges of north-eastern Mozambique and the northward extension of the Drakensberg, by their higher altitude serve as an effective extractor of moisture during the monsoons and also through convectional air currents. This has given rise to a number of large and medium-sized permanently flowing rivers which drain into the sea, transporting dissolved minerals and silt into coastal floodplains and into the sea.

20. Of the islands, only Madagascar is large and topographically diversified enough to bring about influences similar to those observed on the mainland. It is a sub-continent but, unlike the mainland, the land mass rises to over 1,000 m all along the east giving way to a high plateau which slopes gradually westwards. There is thus an observable and remarkable moisture gradient with high precipitation on the eastern board, decreasing westwards as mentioned earlier. There is also a gradient from north to south and south-west, Antseranana (Diégo Suarez) in the north receiving an annual average of 902 mm compared to 344 mm at Faux Cap on the extreme south coast.

21. This moisture gradient between east and west, north and south, is one major factor which gives rise to distinct biotic communities found on this island. Also of importance is the fact that the major rivers flowing to the west coast of Madagascar start from the high plateaux and mountains in the east. The high rainfall on the plateaux, combined with damage to forest cover since man set foot on this island, has led to severe soil erosion and consequent sedimentation of swamps, deltas, estuaries and nearby coral reefs. This problem is discussed in detail in another sectorial report (UNEP Reg. Sea Rep. Stud. No. 6).

22. Of the remaining islands, only Mauritius and Grande Comores are sufficiently large - 1865 and 1148 km<sup>2</sup> (Baumer 1978) respectively - to demonstrate significant differences in biota relative to topographic influences.

their much smaller size of less than 150 km<sup>2</sup> (except Anjouan and Moheli, which are 359 and 290 km<sup>2</sup>, respectively, with a ridge running their length) experience the influence of the sea and the monsoons almost uniformly. The area of the coastal plains on most of these islands is negligible. It must be borne in mind that they lie within a high rainfall belt, and where topography is accentuated in populated islands there is an equally high risk of excessive soil erosion with immediate impact on the shore and nearshore coastal and marine ecosystems; this was observed in Moheli and Anjouan islands (Comoros).

23. The soils in the coastal plains and on the islands are derived from four principal types (Baumer 1978, Tinley 1971, atlases of Tanzania 1956, Kenya 1959 and Madagascar 1969, Salm 1978, and Randrianarison 1976):

- Soils associated with volcanic activity. Included are the Mascarenes, Comoros and parts of Madagascar. Within the Mascarene group, Mauritius is the oldest of the islands while Grande Comores, where Mt. Khartala (2,400 m) erupted as recently as 1977, represents the youngest of the volcanic islands. In Madagascar volcanic eruptions date back to the Quaternary. The principal volcanic zones include the Massif D'Ambre and Bobaomby, Nosy-Bé, Ankaizima and Ankasimbelo in the extreme north, the Itasy and Ankaratra south to Tananarive and Takarindiona (Vatomandry) (Sesairie, 1969). On the mainland, volcanic activity is closely associated with the rift-valley system somewhat far inland and, in this connection, cannot be considered a major environmental factor influencing coastal and marine ecosystems other than through erosion, natural or caused by man, and inflow of freshwater to the sea.
- Soils derived from granitic and sedimentary rocks are the principal constituent along the mainland coast and Madagascar and of about 37 of the 100 islands comprising Seychelles. A radius of 35 km drawn around Mahé Island includes almost all of the granitic islands, the principal ones being Mahé, Praslin, La Digue and Curieuse (Knightly, 1981).
- While Quaternary deposits occupy a large area north of Malindi into Somalia, these deposits occupy only a narrow strip immediately inshore southwards towards Mozambique, followed by Tertiary and/or Jurassic deposits further inland; the area occupied by deposits from Quaternary to recent times extends further inland south of 16°S latitude as the coastal plains broaden.
- Coralline derived soils, characterized by undifferentiated calcareous rocks, occur along parts of northern Mozambique and in patches along the Tanzanian and Kenyan coasts. Coral is the principal base rock constituent of the remaining 63 islands of Seychelles: i.e., the Amirantes, Farquhar and the Aldabra group (Aldabra, Cosmoledo, Assumption and Astove) and those under the jurisdiction of Mauritius: the Cargados Carajos (St. Brandon, Raphael and five islets) and the islands of Agalegas and the Chagos Archipelago. A number of islands along the mainland coast are principally coralline and include Zanzibar, Mafia (Tanzania) and the Primeira and Segunda Archipelago (Mozambique).
- Alluvial plains are associated with the major rivers which flow across coastal plains on the mainland and Madagascar. In the smaller islands the location of extensive areas of alluvial deposits is largely a factor of the land morphology; even then, such areas are relatively small though of agricultural significance.

kilometres. It is only a few hundred metres wide off Nagala in Mozambique and plunges to 2,500 m below sea-level only 30 km off the coast (Tinley 1971). The plunge continues down to over 4,000 m only to be interrupted by submerged platforms and islets associated with the island systems referred to in the preceding section. Seychelles is probably the only system of islands in the West Indian Ocean with a large area of shallow waters, as can be observed from oceanographic maps.

25. The Continental Shelf along the whole of eastern Madagascar is even narrower and steeper than that of the mainland. For example, the 500 m and 2,000 m contour lines are located 12 and 32 km off Tamatave. On the west coast, the shelf extends farther offshore, except that the drop to the 2,000 m is still very steep, if not abrupt in some places. Thus the 500 m, 1,000 m, and 2,000 m contour lines are 56, 72 and 88 km west of Morondava while north of the Bay of Baly these contours are about 48, 52 and 56 km respectively (AGM 1969). In addition, large amounts of sediment are carried down by the many rivers flowing from the high plateaux further east and are deposited on the sea floor with resulting build-up of extensive sand banks. This process was observed at Tuléar and along the coast northwards to Morondava, and in the vicinity of Majunga during a visit in 1979 and from the air on the flight from Comoros to Mauritius during the mission. On the mainland, a similar pattern of past and current submarine sandbank build-ups appears to be associated with the large rivers, for example the Mafia Channel due to the Rufiji River.

26. In some places, along the edge of the shelf, deep channels and canyons occur and this has facilitated access by large ships leading to the development of harbours, especially where there are protected bays. Dar es Salaam, Mombasa, Port Amalia and Tamatave are good examples.

27. The barrier reef, such as occurs off north-eastern Australia, is virtually absent from the West Indian Ocean. The Continental Shelf is, however, colonized by coral-building polyps and, as such, the fringing reef is a dominant feature along most of the edge of the shelf depending on the depth, usually above 45 m, and water temperature normally above 18°C (Bock 1978). Behind the fringing reef, one finds a body of calm, shallow water, or lagoon, varying in width from 8 to 10 km. As will be clarified in the next section, this body of water is an extremely important factor in the productivity of the offshore ecosystems.

#### THE BIOTIC FACTORS

28. The most important of biotic factors is without doubt man himself. Through his ability to occupy and utilize a wide range of ecosystems and species, man has been able to change whole ecosystems with far-reaching, frequently deleterious, effects on other organisms. This is best illustrated in Madagascar where excessive deforestation of humid forest and overstocking with livestock has led to severe soil erosion, and more importantly, the loss of rich top soil. The soil is carried down to the coast and into the marine environment resulting in the silting up of mangrove swamps, estuaries, lagoons and coral reefs. The final effect on the marine environment is loss of fisheries productivity since the algae and coral polyp, upon which fish and other organisms depend for food require clean, clear waters. A similar situation has been observed with regard to the large amounts of silt carried down the Galana-Sagaki River on to the coral reefs off Malindi, Kenya.

deltas and nearshore marine ecosystems. It has been observed, for example, that sardine productivity in the Mediterranean Sea off Egypt has declined since the impounding of the Nile River with the Aswan Dam, and so has the fertility of the Nile Delta itself. The Cahora Bassa Dam (1975) on the Zambezi River, Mozambique, has reduced the river flow and flooding regimes downstream to the delta, and officials of the Fisheries Department now fear a reduction in shrimp productivity while salt water comes some 80 km upstream. Since most of the large rivers in the region are under consideration for hydroelectric power and agricultural development projects, a thorough study of environmental and ecological impacts is not only essential but the findings of such assessments need to be given every consideration and the project plans and programmes modified accordingly.

30. The interaction between different species of plants and animals is usually of local significance, particularly in terrestrial ecosystems where physical barriers such as mountain ranges, large bodies of water, tolerance to temperature and soil conditions may restrict the extension of its geographical range. The ecological term "succession" is very much another way of saying "the natural modification" of the physical and chemical environment by a given biotic community association and in the process creating an environment less suitable to some of the individuals, giving way to a more stable (but dynamic) biotic community association - the climax community.

31. In the case of mangroves, for example, Avicennia and Sonneratia are the first colonizers trapping soil and silt, including their own dead leaves, by their pneumatophoric roots. The soil thus trapped builds up creating suitable conditions for Rhizophora and then for Ceriops on less raised ground and finally for Bruguiera (Rabesandratana and Rabesandratana - no date). As trees, they provide shelter for birds and other dryland organisms, the submerged trunks become colonized by oysters such as Crassostrea cucullata, the roots and shade provide hiding for fish hatchlings, while trapped silt and decomposing organic matter provide hiding and feeding grounds for shrimp larvae, plankton, etc. and a whole food-chain is fully in operation. So that what was in effect barren, is now a community of living organisms.

32. In the same way, the coral-growing polyp establishes itself on a bare rock and with time a completely new living environment is created. Here is the breeding, hiding, feeding and resting place for many of the coral fishes often even satisfying special feeding habits, like those of the parrot fish which feed on the coral polyp itself. At the same time the spread and massive growth of coral continues, especially along the reef edge, and as the corals grow upwards to the surface, they create a wall sufficiently strong to break the force of waves. Between this wall and the shore, the body of water or lagoon is much calmer and both coral polyps and other organisms which cannot withstand the stronger waves and currents find here a suitable environment. But another very important secondary effect not obvious to the majority of the coastal peoples in the region, is the protection of the coast from erosion through the breaking of wave energy by the barrier created by the coral reef front. It is regrettable therefore to see destruction of coral reefs proceeding unchecked in places like Comoros and Iuléar (Madagascar), when there is more to gain by protecting them.



stable unit. Thus, from the environmental factors discussed in the preceding sections, it can be expected that some ecosystem types will have a region-wide distribution, especially where physical barriers are least restrictive, while others are to be found only in small localities depending largely on the tolerance by their biotic components of physical and chemical elements of the environments.

34. The fauna and flora of the the East African region falls into fairly distinct major Biogeographical Provinces (Upvardy 1975) (see table 2). That on the mainland, and some of the West Indian Ocean islands, is typically African, while that on some of the other islands is derived principally from the Indo-Malayan Realm, especially the plants (table 2). While this characterization is especially applicable to terrestrial biotic communities, the ocean currents have facilitated the wide distribution of marine organisms. For example, some fish groups such as groupers (Serranidae: Epinephelus tauvina), mullets (Mugilidae: Liza macrolepis and Mullidae: Upeneus vittatus), snappers (Lutjanidae: Lutjanus kasmira) and wrasses (Lacridae: Cheilinus undulatus), invertebrates such as coral polyps, sea-urchins, and the various species of sea-grasses and seaweeds, occur throughout the Indo-Pacific region.

35. Another important aspect relates to the geologically long time during which these islands have been separated from the mainland, for example, Madagascar. The "birth" of some of the islands, through either volcanic action or the rising of the sea floor (or the lowering of the sea level) or from coral rock growth, and the long distances between the mainland and these islands as well as between themselves, have led to a high degree of separate evolution and endemism. For example, in Madagascar at least 80 per cent of flowering plants and 81 per cent of the vertebrate species are endemic (Jolly 1978), while the Aldabra Atoll in Seychelles is unique amongst the Indian Ocean islands and globally famous for its large population of giant land tortoises, equalled only by the Galapagos Islands of the eastern Pacific Ocean (Beamish 1970).

36. This biogeographical characterization is especially useful when considering the creation of an adequate and representative regional network of protected areas. This matter will be discussed further in subsequent sections. Suffice it to say that the dissimilarities in biological components of ecosystems to be described in the next section will be reflected in these broad biogeographical units.

37. The following classification and characterization of the various ecosystems has been facilitated by proceedings of three conferences namely: The AETFAT symposium of 1966 which reviewed the conservation of vegetation in Africa south of the Sahara (Hedberg and Hedberg 1968), the Tananarive Conference which reviewed the conservation of nature and the resources of Madagascar (IUCN 1972), and the 1974 UNEP/IUCN sponsored survey of the state of conservation of biotic communities of Eastern Africa (Lamprey 1975). The classification of coastal and marine ecosystems described by Ray (1975) has also been useful as have been the reports of Salm (1978), Tinley (1971) and Proctor (1970).

#### Tropical moist forest

38. Evergreen to semi-evergreen lowland forests in relatively well drained deep soils, year-round precipitation and little varying high temperatures and humidity. Includes groundwater gallery forests associated with the large rivers and/or freshwater swamps and edges of flood plains. Structurally stratified into ground

Table 2 : The biogeographical provinces of the East African region relative to coastal and island ecosystems (from Upvady 1975)

Realm	Biogeographic provinces	Country/Islands covered
Afrotropical	Somalian (semi-arid)	Somalia, Kenya, Tanzania south to Rovuma River
	Miombo (Brachystegia) Woodland/Savanna	Rovuma in Tanzania, north Mozambique south to Zambezi River
	South African Woodland/Savanna	Zambezi River to the southern border of Mozambique
	Malagasy Rain Forest	eastern Madagascar
	Malagasy Woodland/Savanna	central and western Madagascar
	Malagasy Thorn Forest	south-western Madagascar
	Comoros Islands and Aldabra	Comoros and Aldabra group of islands (Seychelles)
	Mascarene Islands	Mauritius and Rodriguez group of islands
Indomalayan	Seychelles and Amirantes	Seychelles
	Maldives and Chagos Islands	Mauritius (Chagos islands group)

39. Characteristic fauna and flora: northern mainland coast flora includes Chlorophora excelsa, Sterculia appendiculata, Antiaris usamberensis, Newtonia paucijuga and Memecylon verruculosum, while south from Rufiji River basin to northern Mozambique the canopy is likely to be dominated by Khaya nyasica, Parkia filicoidea, Adina microcephala, Erithrophleum suaveolens, Cleistanthus holstii, etc., especially in riverine gallery forests (Castro 1978). In Madagascar, the canopy is dominated by members of the family Myristicaceae and Lauraceae, with Anthostema (Euphorbiaceae) and Dilobeia (Proteaceae). In Mauritius Sapotaceae and Myrtaceae dominate with notable species like Mimusops (Dodo tree) and Diospyros being conspicuous in Machabee Forest. In Seychelles Calophyllum inophyllum, Imbricaria sechellarum, Dillenia ferruginea and Northea sechellana dominate the lowland and medium-level forest ecosystems; Vateria sechellarum, the only dipterocarp outside Asia and Australia is practically extinct. Palm forests dominated by the coco-de-mer (Lodoicea maldivica) mixed with latanias, screw pines (Pandanus spp.) or Dillenia ferruginea occur in Praslin and Curieuse islands (Proctor 1970).

40. This ecosystem type occurs along the mainland coast from Malindi (Kenya) south to northern Mozambique, especially under the influence of coastal mountain ranges such as the Shimba Hills (Kenya), the Usambaras, Nguru and Uluguru mountain ranges (Tanzania), etc. Very extensive along the eastern and northern coasts of Madagascar. On the other islands, except where strongly influenced by altitude (e.g., Morne Seychellois in Mahé) or soil depths (Mauritius), humid forests cover, or used to cover, most of the land surface. Information on ecosystems found in Comoros was not available but during the visit such forests were seen to be a dominant cover on all three islands, except where cleared for cultivation or suppressed by lava (Grande Comores).

41. Fauna ranges from the large ungulates of the mainland which include elephants and buffalo, primates such as the lemurs of Madagascar, to such rare birds as the pink pigeon and the kestrel of Mauritius, and the serpent eagle of Madagascar.

#### Woodlands and woodland savannas

42. These occur in sandy leached soils or lateritic soils and are often subjected to annual fires; many of the plants are fire resistant or fire loving (pyrophytic); the canopy is not closed and usually below 20 m or less. Although temperatures are high they vary much more than in the humid forest, as do the humidity and precipitation. There are usually one or two rainy seasons and one dry season lasting from three to six months depending on the geographical position north or south of the equator and on the influence of the trade winds (monsoons). During this period most of the trees lose their foliage (deciduous forests).

43. Characteristic flora include fairly dense and high herbaceous cover of such genera as Hyparrhenia, Heteropogon and Panicum on the mainland. Trees are principally leguminous: Brachystagia spp., Albizia spp., Pterocarpus angolensis, Azelia guazensis, Isobertonia spp., Burkea spp. and members of Combretaceae, e.g., Terminalia spp. and Combretum spp. and other species like Uapaca and Sclerocarya caffra. In the islands, such as in western Madagascar, Hyparrhenia dominates the herb layer while species of Dalbergia, Hildegardia, Tamarindus, Chlorophora and Poinciana are common. This type of vegetation feeds many large wild ungulates found along the mainland coast including elephants, buffalo, kudu, impala and also the big

44. Distribution: significant along the whole mainland from the south coast of Somalia; of increasing importance in Tanzania and northern Mozambique. In Madagascar the type is found in sizeable stretches along the west coast from Baie des Assassins to Anorotsangana.

#### Semi-arid ecosystems

45. Climatically-induced vegetation due to high moisture stress resulting from long dry seasons, very low rainfall and high temperatures. The vegetation is typically dominated by grass and shrub cover, the trees are below average height and widely spaced; shrubs and trees lose foliage during the dry season. Annual fires are a common feature as in the woodland savannas.

46. Characteristic flora includes species of Acacia and Commiphora and Adansonia digitata, which dominate the canopy, and in drier areas Euphorbia spp. are common. The African savanna fauna, particularly antelopes, dominate, but are decreasing with the shortage of water and grazing land in the drier desertic conditions. In Madagascar genera of Euphorbiaceae, and Didiereaceae dominate; information on principal fauna species is not immediately available but lemurs are known to be included.

47. Distribution: north of Kismayu (Somalia) and, in Madagascar, Morombe north-west of Ambovombe. This type is practically absent on the other islands.

#### Coastal thicket and bush

48. Soil-induced, for example shallow soils on coral rags or derived from former forest types. Emergent trees are sparse and of comparatively low height. Fairly wet and humid in some localities.

49. Characteristic tree flora includes Sideroxylon, Mimusops, Manilkara, Grewia, Elaeodendron, Erythroxylum and Suregada on mainland and offshore islands. No information on Madagascar and other islands but fauna in Madagascar includes lemurs.

50. In Tanzania around Dar es Salaam north to Bagamoyo, Kilwa south to Lindi, with Acacia as one of the dominants. In Mozambique this occurs in the sublittoral areas of the north, and main tree species include Guibourtia schliebenii and Pseudoprosopis euryphylla.

#### Coastal dune thickets

51. Occur along parts of mainland, and probably south-west of Madagascar on former sand deposits (dune rock) brought about by either wave action, or receding shoreline, or raised former beaches. In Somalia the NE trade winds and the deflected SE trade winds which blow fairly strongly along the coast have accentuated the impact of the droughts of the early 1970s and a large, long strip of about 200 km comprising 500,000 ha, from the lower Schebeli River northwards, has been converted into shifting sand dunes. Some 500 ha around Merca and the Lower Schebeli have been stabilized. In Mozambique a number of marine sand dunes are being reclaimed, partly as an anti-desertification measure and partly to provide wood for fuel.

meritimus, Ipomoea pescaprae, Canavalia maritima, Sophora tomentosa, Dactyloctenium aegypticum, etc., and on the dunes in Mozambique most important thicket species include Diospyros rotundifolia, Mimusops caffra and Sideroxylon inerme (Tinley 1971). In Somalia, Acacia spp. dominate.

53. Occur in Somalia and Mozambique, from Bazaruto southwards. Information on distribution in the other countries is inadequate.

#### Grassland and floodplains

54. These are grass-dominated ecosystems often associated with large rivers on alluvial soils, or where edaphic conditions do not permit the growth of trees (edaphic grasslands) or are fire-induced. In edaphic types, e.g., the flood plains, the soils are clay-loam and alkaline; in other cases the soil is shallow due to a hard pan below the surface reducing percolation.

55. The gramineae of the flood plains are dominated by tall, often more than 2 metres high Hyparrhenia and Heteropogon species with Panicum maximum and Pennisetum in some areas. Where a hard pan is close to the surface, or in depressions, rain and seepage water collect and, together with pools formed during the flooding, they make up an important area for resident and migrant waterfowl. Elephants and buffalo penetrate the high grass. In association with rivers, flood plains provide important breeding and nursing grounds for many economically important freshwater fishes.

#### Freshwater marshes, swamps, lakes and rivers

56. Occur inland from the shore and are associated either with large river basins, for example, Rufiji (Tanzania); Zambezi (Mozambique); Boka, Manambolo and Tsimbihina (west coast of Madagascar) or topographical configurations of the coastal plain, e.g., Lake Ihotsy in south-west Madagascar.

57. Information on the fauna and flora of these ecosystems is not immediately available although Phragmites and Typha are likely to dominate the grass cover, grading to Hyparrhenia, Pennisetum and Heteropogon as edaphic conditions allow. On drier areas, or on high termitaria, tree flora is likely to include Ficus, Sideroxylon, Tamarindus, Euphorbia, etc. (Hedberg and Hedberg 1968) and giant palm Raphia australis groves in southern Mozambique. The aquatic fauna is principally freshwater cichlid fishes such as Tilapia, whereas waterfowl, buffalo, hippopotamuses, elephants and crocodiles dominate the larger fauna. The palm vulture Gypohierax angolensis is an inhabitant of giant palm groves where it is threatened by the cutting down of this palm (Milstein and Zaloumis 1976). Information on Madagascar is not immediately available.

#### Brackishwater swamps and lakes and salt flats

58. As for freshwater marshes above but under the influence of sea-water especially during the high tide. Swamps are likely to occur in the large estuaries and deltas of such rivers as the Rufiji and Zambezi; silt carried down may create sandbanks high enough to create pools. In some cases, as in southern Mozambique, deep lakes occur behind dune barrier coasts (high ground in the interior) with

59. The swamps in estuaries and river deltas are often lined with mangrove species such as Avicennia spp., Rhizophora mucronata, Ceriops boiviana (table 3), etc. This ecosystem supports a variety of aquatic fauna and avifauna including sea birds: coastal waders, cattle egret Ardeola ibis, sacred ibis, mangrove kingfisher Halcyon senegaloides, pelican Pelecanus onerattalus and P. rufescens, fishing owl Scotopus peli (Milstein and Zeloumis 1976) and fish eagle Haliaeetus vocifer. In Madagascar, one needs to include lemurs which inhabit mangrove forests and the Madagascar fish eagle Haliaeetus vociferoides.

#### Mangrove forests

60. Halophytic formations in estuaries, river deltas and creeks as colonizers of silt mud carried down and deposited at the mouths of rivers, and in sheltered creeks and bays due to coastal erosion and run-off. Table 3 shows the common species associated with these formations as well as the economic uses of some of them.

61. The mangrove swamps are an important, if not critical habitat of a variety of marine organisms which play an important economic role in most of the countries visited. They include crustaceans and fish which either breed, nurse, shelter or feed in these swamps. The crustaceans include prawns such as Penaeus indicus, P. monodon, P. semisulcatus, Metapenaeus monoceros, and mangrove crab Scylla serrata, Uca spp., Sesarma, robber crab Birgus latro, molluscs such as oysters Brachydontes spp. and Crassostrea cucullata, and cockles (Donay spp.) (Rabesandratana and Rabesandratana (no date), Salm 1978, Chong Seng 1981).

62. Mangrove forests occur all along the mainland and island coasts in sheltered bays with alluvial deposits, especially in mouths of large rivers. Like the humid forests, the area of mangrove forests is continually being reduced not only for settlements and urban expansion but also due to timber exploitation. This has serious implications on marine fishery resources to the extent that conservation of mangrove forests has become an international concern (IUCN's Commission on Ecology 1982).

#### Mudflats

63. These occur in shallow calm water bays associated with silt mud deposits from rivers. The water is often turbid and as such inhibits the growth of sea-grass and/or corals. Occur along all the coasts linked with river estuaries and shallow shelf with bays, e.g., Maputo Bay in Mozambique.

64. Fauna include primary decomposers and other benthic fauna, shrimps, molluscs and other crustaceans, and a variety of small fishes similar to those found in swamps but with higher salt water tolerance. Mudflats are, like mangrove swamps, important prawn feeding grounds due to the higher organic matter content, hence the high catches in the Bay of Maputo and the high productivity of north-western Madagascar.

#### Sandflats

65. Occur in areas of the shelf where wave action is too strong to allow the settling of silt and the growth of sea-grasses Cymodocea spp. and Diplanthera

Table 3 : Importance of common mangroves species, their distribution and use from various Government-sponsored study reports

	Somalia v. small Rismayu	Kenya 62,027 (46,184 in Lamu)	Tanzania (3200 in Rufiji Delta)	Mozambique 84,800 (67,000 in Cen- tral Delta)	Nadagascar 320,700 (McNae 1974)	Comor v. s
TOTAL AREA IN HECTARES						
<u>Rhizophora mucronata</u>	Possible use for local housing & fuel	Timber, fuel, bank for tanning	Timber	Locally for firewood and fuel to sugar factories	Locally for enclosures, firewood and tanning	hard expl
<u>Ceriops tagal</u>		Timber, fuel- wood tanning	Timber			
<u>Cerriops boiviniana</u>						
<u>Bruquiera gymnorrhiza</u>		Poles	Poles			
<u>Bruquiera cylindrica</u>						
<u>Avicenia marina</u>						
<u>A. officinalis</u>						
<u>Sonneratia molluccensis</u>						
<u>Xylocarpus molluccensis</u>						
<u>X. granatum</u>						
<u>Hertiera littoralis</u>						

66. Fauna and flora is diverse but largely composed of plankton feeders and secondary feeders such as fish, including rays, sardines and anchovies, and sand-dwelling eels.

#### Sea-grass beds

67. Occur in clear, shallow waters of the lagoons and raised platforms, protected from strong waves. The sea-grasses are rooted flowering plants of the family Potamogetonaceae: Cymodocea ciliata, C. serrulata, C. rotundata, Diplanthera univervis, Syringodium isoetifolium, etc. and family Hydrocharitaceae: Halophila ovalis and Thalassia hemprichii (Tinley 1971). The composition is likely to differ northwards and around the islands. Associated with these plants are algae such as Caulerpe, Cladium, Codium, etc. The sea-grass beds are an important habitat for many small and large marine organisms, for feeding, nesting and nursing. These range from the dugong (Dugong dugon), marine turtles such as the green turtle (Chelonia mydas) and hawksbill turtle (Eretmochelys imbricata) echinoderms like sea-urchins, a variety of crustaceans and coelenterates, and fish such as wrasses (Cheilio inermis, Cheilinus and Halichoeres), the parrot fish (Leptoscarus vaigiensis) and the rabbitfish (Siganus oramin) (Bock 1978).

#### Coral flats, back-reef lagoons and reef platforms

68. Principally on raised submarine platforms and shallow lagoons, up to 10 m, where protected from strong, violent waves and currents; clear water (as opposed to turbid waters of mudflats) and relatively high temperatures, above 18°C with optimum at about 30°C (Bock 1978), and hard substrate such as former coral rock. Often the lagoon or shelf may be shallow enough for some coral heads to be exposed during low tide and the coral grows laterally to form a flat top.

69. The coral is built by a coral animal, or polyp, belonging to the coelenterates, in symbiotic association with a unicellular protozoan Zooxanthellae, and in this combination deposits calcium which forms the coral - actually a house for the polyp itself. The corals provide a habitat for shelter, hiding, breeding, feeding, etc., for a variety of fishes and other marine organisms. Some species like the parrot fish and the crown-of-thorns starfish, Acanthaster planci, are specialized predators on coral polyps. The list of fish species associated with this habitat would be too long and incomplete but the following families and examples may be mentioned: moray eels (Muraenidae), damselfishes (Abudefduf armulatus, A. xanthurus), Acanthuridae (Acanthus triostegus), Apogon (cardinal fish family), wrasses, angelfish (Centropyge multispinis), scorpion fishes, etc. Other fauna include the longspined sea-urchin (Diadema setosa) whose long spines often provide shelter to Apogons and razor-fishes (Aeolisus strigatus), a variety of beautiful molluscs often anchored to the coral, the giant sea anemone which provides a home for the anemone fish (Amphiprion akallopisos and A. ephippium), lobsters and turtles. The coral types include: the families Poritidae (Porites and Goniopora spp.) and Faviidae (Meandrina and Favia species) (Kenya Nat. Parks, (no date), MacNae and Kalk 1969).

#### Fringing coral reef



the survival of the protozoon and so limits the growth of corals (Bock 1978). Thus in areas of the shelf edge below this depth corals are likely to be absent. The reef front is a rough environment due to strong wave and tidal action and as such the exposed reefs are low and wind-blown of aspect with very few branching corals, but luxuriant soft corals in the upper reaches of the fringe (Ray 1968, Bock 1978). In the small granitic and volcanic islands the shelf is extremely narrow or non-existent. The land more or less continues its slope into the deep reaches of the water. The coral grows on the submerged island slope itself where the upper reaches are subjected to exposure during low tides; here the soft corals are dominant.

71. The shelf is not only irregular in its depth but is also broken by channels and submarine canyons. This factor, combined with the influence of sediments and turbid waters from the large rivers, contributes to the discontinuity of the fringing reef along the mainland coast, and around the islands, submerged platforms and islands.

72. The fauna is very much similar to that of the coral flats but includes visiting larger fishes such as barracuda, sharks, tuna, etc.

#### The open sea

73. From the Continental Shelf the sea floor drops off rather steeply to depths of over 4,000 m, for example, along the eastern coast of Madagascar. This is a region of strong currents and waves. The fauna and flora is pelagic and varies from plankton to whales. The larger stronger swimmers like the sailfish, marlin, tuna, barracuda, etc., are to be found here. Productivity and therefore the biomass, decreases with depth and there is stratification in species. Off Madagascar and in the deeper colder waters is the rare chambered Nautilus which is recorded in only one other place, the Palau Islands in the Pacific. However, specimens of its shell were seen on sale to tourists in Mogadishu suggesting that this animal may be found off the Somali coast, unless such shells are carried by the Equatorial Current all the way from Madagascar.

#### Sandy beaches

74. Beaches are a transition or ecotone between land and the sea water low tide line and are associated with sheltered areas of shallow shelf and low lying dryland which permit accumulation of sand; often the sand is derived from a previous sand bank. Where coral reef and coral flats are abundant the sand is light in colour (coral sands). In volcanic islands such as Moheli (Comoros) the sand is dark.

75. The beach is regularly bathed during high tide, and depending on the season the high tide line can reach and overflow the high edge of the beach. The coral sand beaches are a habitat for a variety of molluscs and crabs such as the ghost crab. Tinley (1971) reports over eleven rare molluscs along the northern coast of Mozambique including such species as Conus spp., Phalium fimbria, Laevicardium selicum, Murex clavus and Cymatium ranzani. This is also the nesting and safe resting site for marine turtles which hide their nests under the fringing beach vegetation cover.

as the Amirantes, St. Pierre, Assumption and Astove have been used by large numbers of birds, and for such a long time that there are rich deposits of guano which are being exploited as fertilizers for export and local use. Common species using these cliffs include sooty tern (Sterna fuscata), noddy terns (Anous stolidus and A. tenuirostris), fairy tern (Byqis alba), white-tailed tropic-birds (Phaeton repturus), frigate birds (Fregata spp.) and shearwaters (Puffinus pacificus).

77. In other small islands like Desnoueufs (Seychelles) eggs of the sooty and the noddy tern are being collected for sale in Mahé. The collection of eggs and the killing of nesting birds or hunting them down from their hiding-places in rock crevices, under shrubs, etc., for food is common practice in most of the islands and during a visit to Round Island (Mauritius) in 1979 accompanied by officials of the Forestry and Fisheries Departments, a number of sites with decapitated bird heads were witnessed. During the same visit several tropic-birds, sooty and noddy terns were approached to within less than a metre. According to Salm (1978), in Seychelles "young shearwaters (Puffinus pacificus) are removed from their underground nests shortly before fledging, killed, sometimes salted and eaten". Rookeries are also present offshore of the mainland coast, on Latham Island, for example, south of Dar es Salaam, Tanzania and north of Mauritius Island, and Nosy Mangabe in Madagascar.

78. The foregoing ecosystem types are by no means the only ones to be found in the region. The study of coastal and marine ecosystems in the East African Region is generally incomplete and only in Mozambique was it possible to secure a sufficiently detailed document to meet the requirements of this sectorial report, at least so far as the coastal formations are concerned. However, isolated studies appear to have been carried out in Madagascar under the auspices of the University of Madagascar (Marine Research Station, Tuléar, and the Institute of Oceanography, Nosy Bé); in Kenya under the auspices of the University of Nairobi and the Marine and Fisheries Research Institute at Mombasa; in Tanzania under the Department of Zoology of the University of Dar es Salaam and the Marine Fisheries Research Station in Zanzibar; in Mozambique by the Centro de Ecologia and by various visiting scientists. All the literature deriving from these studies needs to be collated in order to identify gaps requiring further research or ecological surveys.

#### ECONOMIC VALUE OF LIVING RESOURCES

79. As can be gathered from the foregoing classification, the potential resources of this region are diverse. Man has not failed to put most of them to economic use; land for cultivation and settlements; extraction of timber from forests; utilization of fauna as food and for recreation; use of beaches and lagoons for recreation; extraction of some life forms (terrestrial and marine) for decoration; etc. This section briefly surveys these various uses and the impact they have upon the various ecosystems which provide them.

##### Land-based resources

80. Humid forests: practically all the humid forests on the mainland coast and on the coast of Madagascar and the other islands have been exploited for timber and the land converted to other uses, especially agricultural. The valuable timber species include Chlorochora, Khaya species, and Dalbergium. Species etc.

cloves, vanilla, cinnamon, coffee, bananas, etc. And with the conversion to agriculture or fast-growing exotic timber species, let alone overhunting, has led to the modification of the preferred physical and biological environment for many species of fauna and flora, most of which have now disappeared. What remains of the original forest is to be found in inaccessible areas but the size of such areas is often ecologically inadequate to meet the needs of some large or specialized fauna like some of the lemurs. Thus the range of the distribution of elephants, buffalo, etc., has been reduced to small localities along the coast. On the islands where cultivable land is scarce, the coastal forest exists only in protected patches having first been depleted of their valuable timber species. Existing forest reserves are principally chosen for their timber value and/or watershed protection. Those on some of the islands have been specifically set aside for the protection of endemic species of fauna and flora, e.g., Machebe Forest Reserve in Mauritius, Morne Seychelles in Mahé and Nosy Mangabe in Madagascar.

81. Woodlands and woodland savannas have also been converted to other uses, particularly agricultural. Where soil conditions allow, such cash crops as the cashew nut, coconut and sugar, food crops like bananas, cassava, etc. and livestock production have replaced tracts of former woodlands, while other areas have been, and continue to be cleared and replaced with artificial forest plantations. Nevertheless, some large tracts of coastal woodlands still exist in Tanzania and Mozambique where the presence of tsetse-fly or difficulties of access have prevented serious human encroachment. Such areas still provide some useful timber, e.g., Dalbergia, Azalia and Pterocarpus. Like the humid forests, the woodlands have been a source of fuelwood in rural areas and charcoal for urban centres.

82. Coastal thickets, most of which are derived from former humid and woodland forests, have been equally affected by man for similar reasons. Perhaps the most important economic value of these thickets lies in providing fuelwood for domestic use. Areas converted for cultivation sustain coconut groves, cashew-nuts and food crops such as rice (wet and dry) and cassava, and cattle ranching.

83. Coastal dune formations: soils of coastal dune formations are very poor and too unstable to sustain viable agriculture. The type is thus either exploited for fuelwood or grazing. Both practices are, however, ecologically destabilizing and with exposure and strong coastal winds, some of these formations have turned into shifting sand dunes.

84. Semi-arid, open woodland savannas, and grasslands although playing a minor role in so far as cultivated crops are concerned (except with irrigation), are good grazing areas for both domestic and wild ungulates. These ecosystems occupy the whole of the Somalia coast from the lower Schabelle River northwards and inland for some kilometres and it can be expected that they contribute significantly to revenue earned from livestock export, which amounts to about 80 per cent of total export. Randrianarison (1976) has made an analysis of the livestock industry in Madagascar and reports that the entire north-west and southern parts are traditionally livestock areas, with a density of between 5 and 10 heads/km<sup>2</sup> (or per 100 ha).

85. The formation is also heavily exploited for charcoal and fuelwood and the removal of the larger trees for this purpose has tended to intensify desertification. In some cases, as in Kenya and Tanzania, export of charcoal was banned in the mid-seventies as an anti-desertification measure.

alluvial deposits and silt brought down by the major rivers. It is in these areas that most of the rice and sugar-cane is grown; for example, the Majunga area in north-west Madagascar is one of the major rice-producing zones on the island. This applies equally to the Rufiji flood plain and many of the rivers in central and southern Mozambique.

87. Flood plains, freshwater marshes and lakes, including the rivers themselves, contribute significantly to freshwater fisheries. Again this has to do with the high nutrient content of the flood waters and the availability of large areas suitable for breeding and nursing grounds (habitats) for fish. In the Rufiji Basin, EUROCONSULT (1980) estimated catches of 26.4 kg/ha for 1,450 km<sup>2</sup> of inundated flood plain which, under optimum exploitation would give a total annual catch of 3,841 tonnes. Not surprisingly, therefore, flood plain fisheries are considered more important than those of the delta both in terms of total production and effort (AL&WM, 1981).

88. It can be expected that the level is similarly high for the Zambezi River except for the reduction of flood waters by the Cabora Bassa Dam and also in the flood plains of the large rivers of the west coast of Madagascar. The Rufiji River Basin Development Project presents a very interesting environmental study case for decisions on resource development. It is inevitable that conflicts of interest will arise between fisheries, forestry, wildlife and agricultural development. Concerning wildlife, the potential for exploiting buffalo, hippopotamuses, elephants and crocodiles for meat and/or skins and other trophies, has yet to be fully assessed. At present, buffalo populations in the Marroneo Reserve (Mozambique) are being cropped, the meat being utilized locally. The provision of such wild animal protein under careful management of the wild stock is especially important in areas where the tsetse-fly is the limiting factor in domestic livestock production.

89. Mangrove forests are exploited variously in the different countries visited. From table 3 it can be seen that only three countries have large enough concentrations of these forests but in only two, Kenya and Tanzania, is there large-scale exploitation locally and for export. In Kenya, the Lamu lagoons mangrove forests are being managed for exploitation of timber and poles. Thus in a 1980 annual report to the Conservator of Forests (Mung'ala 1980), the Divisional Forest Officer in Mombasa reported an income, in royalties, of K.Shs. 254,918,90 from all forest produce. Mangrove timber and poles contributed K.Shs. 94,210,10 (or 37 per cent of the total). The value for different classes of mangrove pole sizes is shown in table 4.

90. To the extent that mangroves are an important economic resource, especially to the local peoples, a recent ban on the exploitation of the Lamu mangrove forest has, according to Shuma (1980), created a serious unemployment situation. The poles are widely used for the construction of local housing. And in the Rufiji Delta, where the mangrove forest accounts for the bulk of the total mangrove forest area, 30,000 scores were exported from the delta of which two thirds were exported to Iran and one third to Dubai (AL&WM 1981). Local sales include exports to Zanzibar, Mafia and Dar es Salaam for making outer frames for local housing. While an inventory of the Rufiji Delta mangrove forest has been carried out by AL&WM (1981) attention also needs to be given to similar forests in Kilwa, in the Ruvu and Wami river mouths, and in creeks and lagoons north of Tanga, as well as Zanzibar and Pemba Islands.

91. Surprisingly, and despite large areas of mangroves in the Majunga area and elsewhere along the west coast of Madagascar, these forests have not been exploited for timber on a large national scale. Instead, local inhabitants use poles for

Table 4 : Mangrove pole sizes and their relative value in royalties in Kenya  
(Extracted from Shuma, 1980)

Name of pole size	Diameter at butt end, cm.	Royalty rates per score (K.Shs.)
Nguzo	Over 14.0	6.00
Boriti	11.5 - 14.0	5.00
Mazio	7.5 - 11.5	4.00
Pau	3.8 - 7.5	3.00
Fito	under 3.8	0.20

development of equally efficient synthetic tanning agents, this export has since ceased although the bark is still in use locally (Rabesandratana and Rabesandratana (no date)). Thus there does not appear to be immediate danger to mangrove forests of Madagascar from commercial exploitation - at least as informed by the national experts consulted. In Kenya, mangrove bark is also used for tanning.

92. The Forestry Department in Kenya is exploring the possibility of culturing mangrove forest species and some experimental work on regeneration is under way. An inventory of the Lamu mangrove forest (46,184 ha) is about to be completed but such evaluation is also badly needed for the mangrove forests around and south of Mombasa. These include North Creeks (6,375 ha), South Coast (66,345 ha with Gazi 477 ha, Funzi 2,371 ha, and Vanga 3,486 ha) and Mwachu Creeks (3,120 ha), most of which are proposed to become forest reserves.

93. Apart from timber and fuelwood, local inhabitants visit mangrove swamps for fishing, and the collection of edible oysters and crabs. In Madagascar, for example, all molluscs are eaten and of some, like Cassia rufa, the shell is used for making pendants. The value of such local products rarely appears in national statistics.

94. Deltas, estuaries, mudflats and mangrove swamps: because of their rich organic matter content these areas are a habitat to a variety of fish, crustaceans and molluscs. In association with mangroves, brackish water marshes and swamp habitats provide nursing areas for post-larval stages of prawns (see paragraph 61), which feed on the organic matter found on the muddy bottoms (Freitas 1966). They remain here until sub-adult stage when they retrace their way to deeper sea to shed eggs. Thus in the intertidal Lingamo mudflats (Mozambique) Freitas found that most catches consisted of these sub-adults with P. indicus and M. monoceros, and adults of Acetes erythraeus (73 per cent of catches), making up the bulk of the catches.

95. Prawn fisheries are an important activity in the region, especially in Tanzania, Mozambique and Madagascar. In north-western Madagascar there are active traditional prawn fisheries now using pirogues with 20 hp motors. Industrial fisheries are being carried out by five companies, three based at Majunga and two at Nosy-Bé. It should be mentioned that the mangrove swamps here constitute the most productive prawn area in the region, and it is possible that circulating currents within the Mozambique Channel provide a passive passage for larvae to the Mozambique coast (see paragraph 14), which is the next most productive area in the region (Freitas 1966) comparable only to the Rufiji Delta. Thus, in Mozambique, three local and three joint venture companies are exploiting prawn stocks between Save River and Maputo Bay and during 1978 to 1980 the country earned some US\$ 17.0 million; the prawns are processed on board (deep freeze) while a small-scale canning factory is operating at Beira.

96. In the Rufiji Delta, AL&WM (1981) reports a figure of 2,714 kg whole prawns valued at T.Shs. 20,248 during 1979. The offshore area of the shelf probably most suitable for prawns, in the Mafia channel, is 3,111 km<sup>2</sup> with a potential of 3,149 tonnes. The Rufiji Delta provides more than 50 per cent of the prawn catch in Tanzania and this represents only about half of the potential. A trawl catch composition of fish from one of the delta channels is shown in table 5. Some of these fishes seem to come up the delta channels to feed, e.g., the mullet Liza, and others to breed, e.g., Hilsa, while others spend almost their entire life in this habitat, e.g., some species of Johnius and Pomadourys.

97. Regarding economically important fishes. Freitas (1966) conducted a...

Table 5 : Trawl catch composition in two Rufiji Delta channels  
(extracted from AL&WM 1981)

Species	Salale Channel Trawl	Kiomboni (using wando)
<u>Tachysurus</u> sp.	3	7
<u>Johnius</u> sp	72	69
<u>Liza macrolepis</u>	1	1
<u>Thryssa vitrirostris</u>	1	12
<u>Hilsa kelee</u>	20	2
<u>Polydactylus</u> sp	14	10
<u>Equula equula</u>	6	1
<u>Therapon jarbua</u>	1	1
<u>Upeneus vittatus</u>	2	1
<u>Pomadourys hasta</u>		
<u>Solea</u> sp		2
<u>Drepane</u>		7

nasta, Thrissocles malabaricus, Sardinella jussieu, Sillago sihama, Hyporhamphus improvisus and Heteromvteris sp. However, small-scale fisheries contribute some 20,000 tonnes/year and with the proposed development under the Ten-Year Development Plan to involve some 15,000 fishermen in co-operative fishing societies in the Matangula and Cap Delgado areas, the catch is bound to increase. In Kenya, small scale fisheries are also important and according to an analysis carried out (FAO, 1979) these reach an average annual value of K.Shs. 424,250.

#### Seawater-based resources

98. Sea-grass beds, sand flats and lagoons provide a variety of economically important fisheries and include the more mature specimens of those fishes caught near the estuaries and mudflats. These areas are also trawlable using larger net mesh size and in this way various species of rays, Lethrinus sp., Carangids, Siganus and Acanthopagrus, and octopus, holothurians, etc., are fished. These areas are also the feeding grounds for marine turtles such as the green turtle Chelonia mydas and the dugong Dugong dugon.

99. In addition to the fisheries, at least Kenya, Tanzania and Madagascar are looking into the possibility of exploiting seaweed (algae) as a source of protein. Investigations of this nature had already been initiated by the former East African Community Marine Fisheries Research Organization, off the Zanzibar coast in Tanzania. Some of this work is still going on in Zanzibar and Kenya under the Kenya Marine and Fisheries Research Institute, Mombasa (Ruwa 1981). These algae include the blue-green algae (Cyanophyta), green algae (Chlorophyta), red algae (Rhodophyta) and brown algae (Phaeophyta). In Tanzania, the brown algae Sargassum, Turbinaria and red algae Eucheusma, Hypnea and Gracilaria are being exploited. Eucheuma is actively picked around Zanzibar, Pemba and Mafia, while brown algae (Cystoseira, Turbinaria, Sargassum), green algae Ulva sp and Hypnea are used as bait (op.cit.). Of the angiosperms, Enhalus acoroides leaves are used for weaving mats while the rhizomes are eaten, particularly by Lamu people in Kenya.

100. Coral flats and coral reefs: the channels which open into the lagoons allow some of the larger fish, particularly the predators, to move into the shelf area where they are sometimes caught. In Somalia, Grande Comoros, Madagascar and Mauritius, fishermen were seen fishing just off the reef front in small canoes and often came back with large fish specimens. Coral flats do not allow easy fishing with nets and in Seychelles, as along most of the mainland coasts, the local fishermen have designed suitable fish-traps.

101. In Comoros and Madagascar (Tuléar) the collection of coral rocks for building and making lime is an active employment for some of the local people. In Comoros this practice is so intensive that large areas of fringing coral and coral flats have been completely destroyed leading to appreciable impoverishment of the fisheries resources and the destruction of the shoreline. The Government is, however, very much aware of this threat and is trying to find a solution.

102. Practically all of the countries are developing artisanal fisheries and emphasis has been laid on creating and strengthening fishing co-operative societies. For example, in Somalia where fishing is not a tradition, 22 co-operative societies are actively engaged in this activity. The Governments of Mozambique, Tanzania and Kenya started much earlier. In Seychelles, exploitation of coral rock for housing and road construction stopped some time back, and for lime 10 years ago. At present



103. It needs to be stressed that the shelf area along the mainland coast (see table 6) is very narrow, from less than 100 m off Rovuma River to about 1000 m offshore. This factor, together with the discontinuity of the coral reef, and the strong waves which are a feature of these waters, up to 12 m high, implies that demersal fisheries potential is low. Similarly, the lack of permanently flowing rivers north of Kismayu in Somalia does not improve the situation. In this connection, the practice of destroying the little there is of the coral reef front as pointed out earlier, or the use of dynamite to fish (Bryceson 1978), must be taken seriously.

104. Deep sea fisheries : Practically all the countries in the region are exploiting, or have plans to exploit the fisheries within their Exclusive Economic Zone (EEZ) and national companies have been created for this purpose. The main objective in creating these national commercial agencies is to cater for the export market. Since few of the countries have the necessary expertise and equipment, the exploitation is carried under joint venture with a foreign company. Thus one finds Japanese, Korean, Italian, Spanish, German, French, etc., interests fairly well represented in the region. In other instances, however, lack of fishing and patrol vessels leaves the EEZ open to illegal fishing. In Seychelles, the Government has imposed a heavy fine, SR (SR Seychelles Rupees) 75,000 for not reporting catch data (Harris 1980), and recently a foreign fishing vessel was confiscated for illegal fishing. Perhaps due to this and organized patrolling, during the period October to May 1979/80, the Government realized some SR 3,405,057 as licence fees from a total of 6,370 tonnes at SR 40 per tonne from longliners (Harris 1980).

105. In conjunction with the development of commercial fisheries, surveys of fisheries resources have been carried out by most of the countries under bilateral or multilateral arrangements such as under the auspices of the Indian Ocean Commission on Fishery (IOFC), which has an ongoing Indian Ocean Programme (IOP), especially for the offshore stocks of tuna and sardine (Herklotsyctys sp. and Sardinella spp.). Table 6 shows the fisheries potential in the trawlable area of the shelf up to 200 m depth and the biomass density based on the surveys carried out. A large variety of fishes and crustaceans have been caught during these surveys and they include species of Epinephelus, Gymnocranius, Lethrinella, Lutjanus, Dermatolepsis aldabrensis, Aprion virescens, Abalistes sp., Thunnus albacores, Euthynnus officinis, etc. (Marchal et al. 1979). The survey undertaken by Marchal et al. estimated a concentration of about 50,000 tonnes in Seychelles Bank (10 tonnes/mile<sup>2</sup>). Rogers has provided the following MSY figures from Tarbit, who estimates the pelagic stocks of tuna to stand at  $1.5 \times 10^6$  tonnes, as 300,000 tonnes MSY at 0.2 mortality equivalents with the following composition (in tonnes):

Albacores	20,000	Bluefin	25,000
Yellowfin	45,000	Skipjack	100-360,000
Big-eye	30,000	Bonito	500,000

However, an analysis of Korean longline fishing landings by Harris (1980), showed that the 106 vessels averaged 26.3 tonnes per month/boat during October 1979 to May 1980 which was below the 30 tonnes/month estimate. The big-eye Thunnus obesus and albacore (T. albacores) together accounted for 87 per cent, with marlins over 6 per cent, dorade (or dolphin fish Coryphaena hippurus) and sailfish (Istiophorus gladius) accounting for 5.5 per cent.

106. In Mozambique, bottom and pelagic trawls taken in Sofala Bank, 10-50 m depth, included anchovies (Stolephorus sp.), barracudas (Savranidae), mackerel

Table 6 : Area of shelf off the mainland and island countries of the East African region and their trawl potentials

(extracted from FAO/IOP 1979)

Country	Total shelf area (km <sup>2</sup> )	Trawlable area (km <sup>2</sup> )	Coral km <sup>2</sup>	Trawl surveys (d) Biomass density t/km <sup>2</sup>
Somalia	n.a.	n.a.	n.a.	n.a.
Kenya	19,120	10,994	not indicated	2.12 (d)
Tanzania	18,908	nil	over 2,183	1.82
Mozambique	86,090	71,592	2,500	1.33
Madagascar (a)	130,700 (b)			1.21
Comoros	900 (b)	nil		
Mauritius + banks	117,102	61,625	36,073	
Seychelles (c)	48,334	14,176	20,093	2.08
TOTAL	421,154	158,387	68,859	

(a) from 0-400 m depth

(b) from 0-400 m

(c) area over 200 m negligible

(d) averages

bottom trawls were crustaceans, including the prawn species mentioned earlier, and lobsters (10 and 48 tonnes in 1971 and 1975 respectively, by industrial and semi-industrial fisheries). Table 7 summarizes the fishing resources potential within Mozambique waters, but Soetre and Silva advise fishing below maximum potential yield until better estimates are available.

107. The biomass estimates given in table 6 would seem to indicate that a sustainable fisheries industry could indeed be supported. However, the natural habitats which would help to maintain this productivity, especially the coral reefs, mangrove swamps and mudflats, are limited and are in critical need of protection and rational use.

108. It should also be mentioned that the waters around Madagascar and Comoros are the home of two rare living fossil animals, the coelacanth Latimeria, a primitive fish which evolved some 400 million years ago, and the cephalopod Nautilus dating back 300 million years.

109. Coral sand beaches: quite apart from playing an important ecological role especially as the habitat of some molluscs and copepods, they are a major tourist asset in the region especially when combined with tropical sunshine, warm waters and marine life in the coral flats and coral reef itself. Since the importance of tourism and environmental impact of this recreational activity are described in other sectorial reports a few examples will suffice. Kenya has long been an attraction for tourists and about 380,000 visited the country in 1980, approximately a third of them opting for the coast, principally Mombasa and Malindi. This may explain the early location, the establishment and proper management of marine parks in Kenya compared to other countries along the mainland coast apart from Mozambique. In Mozambique, the bulk of the 291,574 tourists in 1972 and 68,826 in 1974 (Pelisser 1981) were attracted more by the coast than they were by business and/or inland wildlife areas. In Seychelles, tourism is the principal foreign exchange earner and, according to Capt. James Ferrari and Knightly (1981), 71,762 tourists visited Seychelles in 1980 earning the country RS 400 million in foreign exchange. In Mauritius, earnings from tourism come second only to sugar exports. In 1978 alone about 108,322 tourists visited Mauritius earning the country RS 238 million; a target of 200,000 tourist arrivals has been set up for 1985 (Carroll 1981).

110. With tourism, however, has developed trade in souvenirs: not only of wood carvings such as those of the Makonde of southern Tanzania and northern Mozambique, who exploit the African mahogany, Dalbergia melanoxylon, for this purpose, but also terrestrial and marine fauna such as ivory, crocodile skins, shells of molluscs, polished marine turtle shells, corals, etc. The impact of this is so great that some areas such as that around Dar es Salaam have been depleted of beautiful shells. In Seychelles, Chong Seng (1981) reports over-exploitation of shells, while in almost all the countries visited shells and coral heads were openly on display for sale to tourists.

111. To illustrate the extent to which tourism has a negative impact on marine life a few examples will be given. According to Allen (1978), the Government of Mauritius is much concerned about the over-exploitation of the porcelain mollusc Harta sp. while in 1974 Tanzania is reported to have exported 266,700 kg of coral and shells. In Mauritius the black coral, which is reckoned to be globally threatened and is now rare around the island, was being offered for sale to tourists as necklaces at a relatively high price. The decline of green and hawksbill turtle

Table 7 : Summary of the marine fishery resources of Mozambique  
(thousands of tonnes; from Soetre and Silva 1979)

	Maximum stock size	Present catch	Maximum potential yield
DEMERSAL FISH			
- St. Lazarus Bank	10	0	1
- Rest of the Coast	200	30	50
PELAGIC FISH			
- Anchovies	300	0	300
- Other small pelagics	300	30	150
- Larger pelagics	?	less than 0.5	?
- Sharks	?	2-3	?
MESOPELAGIC FISH	1,000	0	1,000
CRUSTACEANS			
- Shallow-water shrimps	16	12	15
- Deep water shrimps*	0.5-1	less than 0.5	?
- Spiny lobsters	1	less than 0.1	0.3
- Crayfish	0.1-0.5	?	?
REEF FISHES	?	?	5-10
IN-SHORE FISHERIES	?	?	5-10

\* include only the stock south of Bezaruto Island

## THREATENED COASTAL AND MARINE SPECIES AND HABITATS

112. A "critical habitat" is defined as one whose physical and biological characteristics are essential either for:

- the maintenance of one or more ecological processes, these processes being essential for the overall productivity of that habitat; or
- the survival of a particular species of fauna and flora.

113. A "threatened habitat" is a habitat whose natural physical and/or biological characteristics/qualities have been modified so that it is no longer as productive or able to support one or more of the species identified with it (see table 8). Such modification may be imposed through a natural agent, like a drastic change in climate leading to droughts and the extension of deserts, or through the hand of man, e.g. conversion of forest land for agricultural purposes, using estuaries as dumping grounds for industrial and domestic wastes leading to habitat degradation for certain organisms, and reclamation projects for urban expansion.

114. Species requiring special attention are shown in table 9 which could be extended to include the many endemic species of flora and avifauna, especially those of the islands; the list would even then be incomplete. There is as yet little information available on the conservation status of most marine biota, or indeed of the macroflora and fauna of the coastal ecosystems. A completion of a factual dossier such as presented in table 9, or an extension of it, would seem an urgent matter, both as a means of raising awareness and as a guide for establishing conservation priorities.

115. When examining tables 8 and 9, two unique features in the East African region command global attention. The first of these is the Aldabra Atoll in Seychelles which has the only surviving population of Giant Land Tortoises in the Indian Ocean and the largest nesting population of green turtles. The atoll is in a way the Galapagos of the Indian Ocean but, unlike the Galapagos, it has been spared from human interference - except for a small research station. In this way the populations of tortoise and other unique endemics such as the flightless rail have continued their existence obeying only the natural evolutionary forces of the environment. A considerable body of research has been carried out on both the tortoise and the turtles under real situations of limited space and food supply which will find application in managing stocks of other wild species in the region. In this sense, Aldabra Atoll is an ideal outdoor laboratory.

116. Threats to develop this island, particularly for foreign military bases (Beamish 1970), have fortunately been averted by a decision of the Government of Seychelles. Threats from uncontrolled tourist development, and use of some of the resources of the Aldabra group of islands, e.g. exploitation of mangroves and turtles do however exist there. In recognition of the global scientific value of this group of islands and its surroundings, the Government of Seychelles established The Seychelles Island Foundation in 1980, with an international management body, to oversee the management of this sanctuary and other equally important islands and to seek international financial support for this purpose and for research. Further, the Government nominated Aldabra to the World Heritage list in 1981 and a decision by UNESCO's World Heritage Committee is expected in late 1982.

Table 8 : Threatened critical habitats and associated threatened endangered

Habitat type	Ecological significance	Threatened/endangered fauna and/or flora	Type/source of threat
<b>1. Moist rain forest</b>			
Incl. groundwater gallery & swamp forests, riverine forests	Stabilization of soil and climate; habitat for diverse economic forest birds, primates and plants; water	<p><b>KENYA:</b> Tana R. Mangabey and Colobus; <u>Otus irene</u>; Clark's weaver &amp; Sokoke Pipit; <u>Manilkara-Diospyros assoc.</u></p> <p><b>TANZANIA:</b> No details but include palms, Zanzibar Red Colobus, in Pemba the palm <u>Chrysalidocarpus pembanus</u> sole representative in E.A. also the Avaceae <u>Typhonodorum lindleyanum</u> native of Madagascar but not mainland; <u>Elaeis</u>, <u>Phoenix</u>, <u>Pandanus</u>, and <u>Anthoecelsta</u>; endemics in Pugu forest; large ungulates (elephants)</p> <p><b>MOZAMBIQUE:</b> Elephants, other details not immediately available</p> <p><b>MADAGASCAR:</b> Lemurs; many endemic species of flora and avifauna (info incomplete). Mad. serpent Eagle</p>	<p>Logging, as fires</p> <p>Much reduce timber extr. cultivation; cements in ic of Pugu Hill es Salaam), plantations exotics</p> <p>Logging, fi settlements tivation; c to fast gro ber species</p> <p>Shifting cu timber extr. cultivation crops, esp. (cloves &amp; v</p>

Table 3 continued.....

Habitat type	Ecological significance	Threatened/ endangered fauna and/or flora	Type/source of threat
	Protection of waters; catchment; only habitat for some endangered forest birds and some palms	<p>MAURITIUS: Pink Pigeon (<u>Nesoenas mayeri</u>); Mauritius Kestrel (<u>Falco punctatus</u>); Mauritius ring-necked parakeet (<u>Psittacula echo</u>); <u>Foudia rubra</u> and <u>F. flavicans</u>; many endemic plants include the Dodo tree <u>Mimusops canari</u>, <u>Tombourissa</u>, endemic palms and <u>lataniers</u></p> <p>SEYCHELLES: Seychelles black parrot <u>Falco araea</u>, endemic palms &amp; <u>lataniers</u></p>	Cyclones, <u>Ligustrum</u> and <u>rubus mollucanus</u> ( <u>Psidium c</u> )
	Catchment area protection	COMOROS	Settlement, vation, th afforestation.
2. <u>Flood plains, coastal marshes and lakes</u>			
	Habitat for fishes; rest & feeding grounds for waterfowl	SOMALIA: No information but may include elephants, rhino etc. waterfowl (migratory); crocodiles and hippopotamus	Conversion culture for bananas, su pans
	Fertile alluvial soils annual flooding, provision of water supplies esp. in dry season; nursery ground for many fishes	KENYA: No info., probably similar to Somalia, crocodiles, elephants, hippos	Agriculture dams, sedim

Table 8 continued.....

Habitat type	Ecological significance	Threatened/endangered fauna and/or flora	Type/source of threat
		TANZANIA: elephants, rhino, hippopotamus, crocodiles, migratory waterfowl, fisheries	Conversion culture, estates, by & irrigation
		MOZAMBIQUE: Fishing owl <u>Scotopus peli</u> , Palm-nut Vulture <u>Gypohierax angolensis</u> , giant palm <u>Raphia australis</u>	Hydropower agriculture, salt effluents & factories
		MADAGASCAR: Avifauna, a number of Lemurs	Rice cultivation overgrazing leading to
	Negligible since coastal plain narrow or practically non-existent on some islands	MAURITIUS, COMOROS, SEYCHELLES: Chinese Bittern ( <u>Ixobrychis sinensis</u> ), Seychelles Pond Turtle	Seychelles cattlegrazing & reclamation
<b>3. Mangrove forests and swamps, estuaries &amp; mudflats</b>			
	Silt binding & reclamation of land from sea; protection of coral reef & lagoons from sediments, retention of organic matter & creation of favourable habitat	SOMALIA: Information not available	Foes for hydroelectric dam (Juba River) to reduced oil near ha



Table B continued.....

Habitat type	Ecological significance	Threatened/ endangered fauna and/or flora	Type/source of threat
		KENYA: Mangrove kingfisher mangrove habitat & fisheries	Timber & poles ( <u>Rhizophora</u> & <u>Cerriops</u> ) for local use & export; reclamation projects creeks; firewood charcoal; settlements; oil near ports; industrial pollution
		TANZANIA: Fisheries; no other information nor on Zanzibar, Pemba and Mafia Islands	Rufiji River Basin Dev. project; timber & poles for local export; land reclamation esp. urban oil around ports; industrial pollution
		MOZAMBIQUE: fisheries; mangrove kingfisher ( <u>Halcyon senegaloides</u> ), waterfowl	Ricefields; oil ports; industrial pollution; reclamation projects for settlements; poles for houses; firewood logging for sugar factories
		MADAGASCAR: Lemurs; oysters due to silting	Not exploited for timber but local sedimentation & silting near ports; waste disposal; agricultural expansion

Table 8 continued.....

Habitat type	Ecological significance	Threatened/endangered fauna and/or flora	Type/source of threat
		MAURITIUS	Reclamation and disposal; oil & industrial pollution
		SEYCHELLES: Palourde in mudflats	Reclamation pro waste disposal. Demand for grav (mudflats)
		COMORES	Reclamation, sedimentation and c
4. <u>Sandy beaches</u>			
	Ecotone inter-tidal zone; habitat for many molluscs & nesting habitat for marine turtles; coastal waders	SOMALIA: Molluscs, hawksbill turtle, green turtle	Collection of shell turtle for stuffing; meat & medicine (aphrodisiac); shells and oil
		KENYA: Molluscs, marine turtles, nesting habitat waders	Shell collection; beach tourism; killing of turtles on beach; tar & oil; sediments
		TANZANIA: Green hawksbill turtle shells, waders	Tourist development e.g. Kunduchi; killing & capture of turtles for meat & eggs in Tanga, Z

Table 8 continued.....

Habitat type	Ecological significance	Threatened/endangered fauna and/or flora	Type/source of threat
		TANZANIA (cont.)	Kilwa & turtle shell; tar balls
		MOZAMBIQUE: Molluscs, marine turtles, waders	Reclamation, developments, development of tourism; sedimentation, beach erosion, collection
		MADAGASCAR: Molluscs, marine turtles, waders	Sedimentation, collection, shell collection, tar balls
		MAURITIUS: Molluscs, marine turtles, waders	Reclamation; development, collection of shells
		SEYCHELLES: Marine turtles, shells, waders	Collection of shells for tourism dev.; tar balls & oil reclamation project
		COMOROS: Marine turtles, molluscs, shore birds	Sand collection; reclamation; oil from ships, tourism

Table 8 continued.....

Habitat type	Ecological significance	Threatened/endangered fauna and/or flora	Type/source of threat
5. <u>Coral flats and lagoons</u>	Breeding, resting & feeding habitat for many species of fauna including marine turtles; protection of coast from erosion	SOMALIA: Corals, molluscs, benthic fauna	Collection of coral heads & shells for sale to tourists; oil prospection
		KENYA: Coral, molluscs, coral reef fishes	Dynamiting for fish; shell collection; boat anchors; sedimentation (Sabaki R); sewage disposal; recreational uses (spear fishing); oil prospection
		TANZANIA: As for Kenya	As for Kenya; sewage disposal & industrial effluents (DEM and Tanga); overfishing (artisanal); oil
		MOZAMBIQUE: As for Kenya	Sedimentation; recreational uses; oil & oil prospection

Table 8 continued.....

Habitat type	Ecological significance	Threatened/endangered fauna and/or flora	Type/source of threat
		MADAGASCAR: As for the other countries	Coral & shell collection; overfishing coral rock for building; sedimentation of coral flats; over collection of molluscs for food eg. <u>Cassia</u> echinoderms (sea-ur oil prospection)
		MAURITIUS: Porcelain <u>Narta</u> spp.	Sewage outfalls; high tourist use; shell & coral head collection; spear fishing; oil prospection
		SEYCHELLES : Octopus, marine turtles	Sedimentation; over fishing by local people; industrial domestic effluents; oil prospection
		COMOROS : Coral, molluscs coral fishes shoreline habitats, marine turtles	Sedimentation, collection of coral rock for building & chalk; collection of shells and coral heads; overfishing

Table B continued.....

Habitat type	Ecological significance	Threatened/endangered fauna and/or flora	Type/source of threat
6. <u>Sea-grass beds</u>	Nursery area for fishes, crustaceans; feeding habitat for dugong, turtles (herbivorous or otherwise)	<p>SOMALIA: Marine turtles, dugong, benthic fauna &amp; sedentary organisms incl. algae &amp; seaweed. Information inadequate</p> <p>KENYA: As for Somalia</p> <p>TANZANIA: Dugong, marine turtles, etc.</p> <p>MOZAMBIQUE: Dugong, marine turtles, etc., molluscs, crustaceans, echinoderms, etc.</p>	<p>Fishing activity with nets (the Juba R. and erosion</p> <p>Sedimentation of rivers</p> <p>Sedimentation from major rivers &amp; coastal erosion; overfishing (with nets (trawling)</p> <p>Sedimentation from major rivers &amp; coastal erosion; overfishing (artisanal) with net (trawling)</p>

Table B continued.....

Habitat type	Ecological significance	Threatened/ endangered fauna and/or flora	Type/source of threat
		MADAGASCAR : As for Mozambique	Serious sedi encroachment fishing activ
		SEYCHELLES: Molluscs, crustaceans, fishes, marine turtles	Coastal eros: fishing (loc: fishing activ
		MAURITIUS: Marine turtles	Coastal eros: overfishing ( fishing activ
		COMOROS: Dugong, marine turtles, crustaceans	Sedimentation destabilizati meadows due t strong wave a arising from to coral reef collection of life for food tourist attra fishing activ

Table 8 continued.....

Habitat type	Ecological significance	Threatened/endangered fauna and/or flora	Type/source of threat
<b>7. Seabird rookeries</b>			
Small coralline and granitic islands	Resting & nesting habitat for seabirds; resting & nesting marine turtles; Giant land Tortoise	ALL COUNTRIES: seabirds, marine turtles, tortoises	Collection of birds & guano (tourist development); offshore oil production, eg. Is. Isl. (Tanzania); introduced spp. rabbits on Round Island (Mauritius)
<b>8. Oyster beds</b>			
On rocky base in granite coasts & also mangrove swamps & mudflats		MADAGASCAR: Oysters locally exploited	Siltation in Majunga area
		OTHER COUNTRIES: No information	

- N.B.**
1. This information is incomplete and it is hoped that national experts will be in a position especially on measures taken/proposed. This includes correction.
  2. Sources of information included: Red Data Book (RDB), Hedberg & Hedberg (1968) and Government



Table 9 : Some threatened/endangered coastal and marine fauna of the East Afr.

Status according to the Red Data Book (RDB)

(V = Vulnerable; T = Threatened; E = Endangered; EF = Critically Endangered; U = Unk

Species	Status & Habitat	Problem
<b>MAMMALS - PRIMATES</b>		
1. Tana River Red Mangabey <u>Colobus <del>hadius</del> rufomitratu</u> (Peters, 1879)	E KENYA: riverain gallery forest	Shifting cultivation, wild fires, fuelwood, hydro-agricultural schemes
2. Tana River Mangabey <u>Cercobebus galeritus galeitus</u> (Peters, 1879)	E KENYA: riverain gallery forest	
3. Zanzibar Red Colobus <u>Colobus kirkii</u> (Gray, 1868)	R TANZANIA (ZANZIBAR): swamp forest of <u>Elae</u> - <u>Pandanus</u> - <u>Calophyllum</u> - <u>Eugenia</u> association	Human encroachment and killi on pretext of crop protectio
4. Black Lemur <u>Lemur macaco macaco</u> L	E MADAGASCAR: north & west humid forest	Cultivation (cocoa, ylang-yl
5. Red-fronted Lemur <u>Lemur m. rufus</u> (Audebert 1975)	MADAGASCAR: west coast forests and high plateau	Fires, woodcutting, grazing livestock
6. Sclater's Lemur <u>L. m. flavifrons</u> (Gray, 1867)	UR MADAGASCAR: north-west coast; coastal forests	Forest exploitation & hunting

Table 9 continued...

Species	Status & Habitat	Problem
7. Mongoose Lemur <u>L. Mongoose</u> (L., 1766); <u>L. m. mungoz</u> & <u>L. m. coronatus</u>	MADAGASCAR: north-west forests & scrub to Betsiboka River; <u>L.m.m.</u> in forest while <u>L.m.c.</u> savannah, dry bush & forest edge	Degradation of habitat; hunt for food
8. Nosy-Bé Sportive Lemur <u>Lepilemur mustelinus dorsalis</u> (Gray, 1870)	R MADAGASCAR: humid forest	Forest destruction & degradation
9. White-footed Sportive Lemur <u>Lepilemur m. leucopus</u> (Forsyth-Major, 1894)	CE MADAGASCAR: throughout southern, xerophytic Didieaceae Bush vegetation but sometimes in gallery forests	Habitat degradation
10. Grey Gentle Lemur <u>Hapalemur griseus</u> Link, 1797, <u>H. g. olivaceus</u>	V MADAGASCAR: Hgg shoreline to plateau of north-east & east & bamboo zone; the second form (Hgo) lives in marshes of L. Aloatra	Destruction of primary forest; hunting for food
11. Fat-tailed Dwarf Lemur <u>Cheirogalens medius</u> (E. Geoffrey, 1812)	E MADAGASCAR: western & southern dry forests; also damp forest of west with <u>Phaner furcifer</u> & in southern bush with <u>Lepilemur m. leucopus</u>	Habitat destruction through clearing and degradation (see trees with cavities for semi-hibernation)
12. Coquerel's Mouse Lemur <u>Microcebus coquerel</u> (A. Grandidier, 1867)	V MADAGASCAR: humid parts of forests of west Madagascar	Loss of habitat through climate changes (droughts), destruction and degradation of forests, agricultural developments

Table 9 continued...

Species	Status & Habitat	Problem
13. Fork-marked Mouse Lemur <u>Phaner furcifer</u> (Blainville, (no date))	U MADAGASCAR: high & coastal forests of west, high forest & savanna of west & east (Maroantsetra)	Rapid degradation through burning & cutting for cultivation
14. Indri <u>Indri indri</u> (Gmelin, 1788)	E MADAGASCAR: humid rain forest of east: Antongil Bay, Manora River eastwards to forest limit of plateau of west	Destruction of forest & hunting. Forest and shifting cultivation
15. Verreaux's Sifaka <u>Propithecus verreauxi</u> (A. Grandidier, 1867) 5 sub species: <u>P. v. verreauxi</u> , <u>coquerelli</u> , <u>deckeni</u> , <u>coronatus</u> and <u>majori</u>	E MADAGASCAR: forest of north-west, south-west & south (mixed forests) <u>Pvv.</u> : s. & sw, <u>Pvc</u> : Betsiboka R. <u>Pvd</u> : nw Manambola - Mahavavy Rivers, <u>Pycor</u> : Betsiboka - Mahavavy, <u>Pum</u> : southcentral north of Amboasary west of Port Dauphin	Forest destruction and degradation, over-hunting, fires
16. Western Woolly Ayele <u>Ayele laniger occidentalis</u> (Lorenz, 1898)	CE MADAGASCAR: western deciduous/savannah forests subject to fires; exact range inadequately known	Encroaching savanna fires

Table 9 continued...

Species	Status & Habitat	Problem
17. Aye-Aye <u>Daubentonia madagascariensis</u> (Gmelin, 1778)	E MADAGASCAR: Lowland humid forest of east & northwest presently only few individuals in northeast. (requires tall trees)	Habitat degradation through exploitation of timber
MAMMALS: UNGULATES		
18. African Elephant <u>Loxodonta africana</u> (Blumenbach, 1797)	V/T ALL MAINLAND COUNTRIES: wide range of habitats: humid forests to semi-arid, requires large annual range and water	Loss of habitat to cultivation and settlements. Poaching. Reclamation projects, eg., of flood plains
19. African Black & White Rhino <u>Diceros bicornis</u> L. and <u>Ceratotherium simum</u> Burchell	CE ALL MAINLAND COUNTRIES: semi-arid to humid forests, (exhibits territorial behaviour)	Poaching for horn, loss of habitat to agriculture and settlements
MAMMALS: CHIROPTERA		
20. Mauritian Flying Fox <u>Pteropus niger</u> (Karr, 1972)	R MAURITIUS: forest habitats with fruit trees; now using cultivated fruit trees	Very high hunting pressure, cyclones
21. Rodriguez flying fox <u>Pteropus rodricensis</u> (Dobson, 1878)	CE MAURITIUS: Rodriguez Island in former mixed forest with fruit trees	Hunting, cyclones and possible starvation.

Table 9 continued...

Species	Status & Habitat	Problem
<b>MAMMALS: CETACEANS</b>		
22. Fin whale <u>Balaenoptera physalus</u> (L., 1758)	V Open seas; areas rich in krill, <u>Euphausia superba</u> and caprellid, <u>Mallotus villosus</u> ; Antarctic to southern Indian Ocean and South Atlantic	Over-hunting; krill fisheries
23. Blue whale <u>Balaenoptera musculus</u>	T Oceanic areas rich in krill <u>Euphausia superba</u>	Krill fisheries
24. Humpback whale <u>Megaptera noveangliae</u> (Borowski, 1781)	E Oceanic but frequently visits inshore waters	Over-hunting; vulnerable to coastal pollution; krill fisheries; incidental catch
<b>MAMMALS: SIRENIANS</b>		
25. Dugong <u>Dugong dugon</u> (Muller, 1776)	VE Strictly marine in sheltered shallow tropical & sub tropical coastal waters; feed in intertidal & sub-tidal areas in sea-grass meadows	Fishing activities. Active hunting in Moheli (Comoros now banned)

Table 9 continued...

Species	Status & Habitat	Problem
REPTILES - CROCODILES		
26. Crocodile, Nile <u>Crocodylus niloticus</u> (Laurenti, 1768)	V Rivers, lakes and adjoining swamps and marshes including estuarine & deltaic habitats	Hunting for valuable skin. Habitat destruction/degradatio through damming, draining of swamps and lakes, etc. Predation of eggs by monitor lizard
REPTILES - TURTLES		
27. Green turtle <u>Chelonia mydas</u>	All marine turtles use beaches to lay eggs, all suffer from degradation of this habitat, e.g., removal of sand or tourist use, etc.	Trawl nets, exploitation for meat & eggs, souvenir trade. Degradation of sea-grass and potential chemical pollution Oil pollution
27. Green turtle <u>Chelonia mydas</u>	E Sea-grass meadows in warm waters; carnivorous as juvenile, vegetarian as sub adult and adult on seaweed and sea-grass (Hughes, 1976)	

Table 9 continued...

Species	Status & Habitat	Problem
28. Hawksbill Turtle <u>Eretmochelys imbricata</u>	E Reefs & hard bottom inshore waters; nests on mainland and island beaches in small numbers. Littoral tropical, carnivorous throughout life, principally on sponges	Over-hunting for tortoise shell and plastron for turtle soup, souvenirs and rheumatic (Somalia), oil and spondylia Loss of nesting area. Harassment and killing before females have a chance to lay eggs. Incidental catch high
29. Olive Ridley Turtle <u>Lepidochelys olivacea</u> (Eschscholtz, 1829)	T Mainland coast and large islands' shores; Indo-Pacific; areas of low salinity; feeds on crustaceans, e.g., prawns, shrimps, crabs, etc.	Egg collection, e.g., in southern Madagascar. Fishing activities especially from prawn trawlers
30. Leatherback Turtle <u>Dermochelys coriacea</u> (L., 1766)	Nests throughout the region, feeds on coelenterates	Egg collection. Exploitation for leather. As for others

Table 9 continued...

Species	Status & Habitat	Problem
31. Loggerhead Turtle <u>Carella caretta</u>	T Littoral, carnivorous, esp. molluscs, e.g., <u>Bufo</u> sp., a temperature nester 25°-28°C	Egg collection. Loss of nesting beaches
32. Seychelles Pond Turtle	Freshwater marshes on Mahé	Grazing and draining of marshes (Chong Seng 1981)
REPTILES - TORTOISES		
33. Madagascar Spider Tortoise <u>Fyxis arachnoides</u> (Bell, 1827)	R Extreme southern Madagascar In arid to semi-arid thorn/ bush	Habitat degradation Over-collection for pet trade
34. Madagascar Tortoise <u>Testudo yniphora</u> (Vaillant, 1885)	VR In small bamboo-forested islands, Soala to Cape Sada region (west Majunga)	Bush fires, habitat destruction by pigs. Over collection by inhabitants as garden pets
35. Giant Land Tortoise <u>Testudo elephantina</u> ( <u>gigantea</u> )		Potential tourist development

N.B.: AFRICON = African Convention on Conservation of Nature  
 CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora  
 IWC = International Whaling Commission



years ago. The lemurs represent not only a separate evolution and consequent diversifications, but as a link in the evolution of man himself, may hold the key to many unanswered questions. The ever continuing reduction and disappearance of their habitats has attracted international attention for some time now. And although those in the Government responsible for the conservation of fauna and flora are very much conscious of the imminent danger of extinction of some of the lemurs, this awareness and concern has yet to transcend all levels of Government and public. It is encouraging however that the Government is co-operating with IUCN and the World Wildlife Fund (WWF) in a large-scale conservation programme focusing on tropical forests and lemurs.

118. While lemurs are a first priority, Madagascar is endowed with other equally unique fauna: snakes, chameleons, birds, butterflies and other insects, some of which are following or may be following the same dangerous path as the lemurs. Madagascar has already lost the giant ostrich, crocodile, land tortoise, the pygmy hippo, etc. and it is hoped that further losses can be avoided through better land-use policy, legislation and institutional measures. There is also a strong case for an all-out effort in public awareness and environmental education programmes.

119. Concerning whales and other cetaceans, the Government of Seychelles has been particularly concerned and was responsible, as a member of the International Whaling Commission (IWC), for the proposal which led to the creation of the Indian Ocean Sanctuary in 1980. For the sanctuary to be effective, in April 1980 the President of Seychelles invited the Heads of Government and Presidents of the countries bordering the Indian Ocean to a special meeting in Mahé to consider, amongst other things, co-operation in collective protection of the Sanctuary. Countries which participated in this meeting included Bangladesh, Comoros, Djibouti, Kenya, India, Iraq, Iran, Maldives, Mauritius, Oman, Pakistan, Seychelles, Sri Lanka, Tanzania and the Democratic Republic of Yemen, all of whom agreed to form the Indian Ocean Alliance. It is suggested that countries of the East African region should give full support, morally and politically, to the recommendations of that meeting, which embrace environmental and resources conservation within the Indian Ocean area.

120. The plight of marine turtles is global and as will be seen from table 9 those stocks of the East African region are indeed in need of urgent conservation measures. Already, an international marine turtle conference organized in Washington in 1979 proposed a programme of action for this region's turtles which could provide a good start if implemented.

121. Finally, and with the exception of Seychelles, the number of coastal and marine protected areas in the East African region is discouragingly low. A list of these areas with indications of the type of protection, is given in table 10. Further expansion of this network is urgent, either through creation of new areas (e.g., a marine national park to protect the coral reefs at Tuléar, Madagascar) or through raising the status of existing marine fisheries reserves to that of national parks (e.g., in Tanzania and Mozambique).

122. Tourism appears to be one of the major factors influencing the establishment of protected areas in the region, either as national parks or wildlife sanctuaries. Yet there are more fundamental reasons in favour of an increase in the numbers and sizes of existing protected areas. The more immediate of these is their reservoir function for re-stocking areas under exploitation. Thus the protection of mangrove swamps to sustain exploitable stocks of prawns, or the protection of coral gardens

Table 10 : Marine and coastal protected areas

C = Coastal      E = Estuarine      L = Littoral  
M = Marine      I = Island      Cor = Coral  
\_\_\_\_\_ = Data sheet held for this area

Please note that some areas do not qualify for the United Nations List

Country	Biogeographical code	IUCN cat.	Area (km <sup>2</sup> )
<b>INDIAN OCEAN</b>			
- Indian Ocean Cetacean Sanctuary			
N.B. See IUCN/WWF report project 1405, Workshop on Cetacean Sanctuaries. Tijuana & Guerrero Negro B.C., Mexico			
<b>KENYA</b>			
- <u>Dodori NaR</u> (E)	3 14 07	II	87,
- <u>Kisiti/Mponguti NP</u> (M)	3 14 07	II	2,
- <u>Malandi Watamu MNP</u> (Cor)	3 14 07	II	1,
- <u>Boni NaR</u> (L)	3 14 07	VI	133,
- <u>Malindi/Watamu NMR</u> (Cor)	3 14 07	VI	21,
- <u>Kiunga NMR</u> (M/L)	3 14 07	VI	25,
- <u>Kiunga BR</u> (M/L)	3 14 07	IX	60,
- <u>Malindi-Watamu Marine Area BR</u> (Cor)	3 14 07	IX	19,

Table 10 continued...

Country	Biogeographical code	IUCN cat.	Area (H)
MADAGASCAR (*)			
- <u>Lokobe NR (L)</u>	3 09 04	I	...
- <u>Nosy Mangabe Spécial R</u>	3 03 01	IV	...
- <u>Cap Sainte Marie Spécial R</u>	3 10 04	IV	1,...

(\*) Possibly up to five other coastal Special Reserves. (Andriamampianina, J. Les Réserves naturelles et la Protection de la Nature à Madagascar. In: Oberlé, P. (ed.) Madagascar, Un Sanctuaire de la Nature (1981).

There are also a number of reserves established to protect certain birds and tortoises:

Nosy Anambo	Sugar-loaf Islands
Sepulchre Island	Heron Islands
Nosy Iranja	Nosy Trozona
Nosy Ve	Nosy Maniten
Nosy Vorona	Saint Auguste
Manomba	Vatomandry
Sand Islands	

Griveaud, P. & Albignac, R.: The Problems of Nature Conservation in Madagascar. In: Battistini, R. and Richard-Vindard, G. (eds.) Biogeography and Ecology of Madagascar (1972).

Table 10 continued...

Country		Biogeographical code	IUCN cat.
MAURITIUS			
-	Round Island NR (I)	3 25 13	I
-	Gunners Quoin NR (L)	3 25 13	I
-	Machaboo/Bel Ombre BR		
The following reserves proclaimed, but no subsidiary legislation and areas not demarcated on ground:			
	Perrier	3 acres	
	Corps de Garde	314 acres	
	Pouce	163 acres	
	Cabinet	42 acres	
	Ile aux Aigrettes	70 acres	
	Ile Plate		
	Ilot Marianne		
	Combro	490 acres	
MOZAMBIQUE			
-	Pomane R (L/E/M)	3 04	I
	Contains dune forest, acid grassland, mangrove swamps & associated estuarine environment; dugongs, dolphins, 5 species of marine turtles		
-	Marcemou R (C)	3 08 04	I
-	Maputo NP (L/M)	3 08 04	II
	Beach, coastal dune forests, swamp forest, mangrove forest, leatherback & loggerhead turtles; proposal to extend coastal zone to South African border		

Table 10 continued...

Country	Biogeographical code	IUCN cat.	A (
- Bazarutu (Cor) Protection of dugongs & turtles located on Ilha Santo Antonio; extensive coral formations	3 08 04	II	8
- Paradise Island MNP (I/M) For protection of dugongs & turtles	3 04	II	1
- Ilhas de Inhaca e dos Portugueses (I/M/Cor) Corals; a fauna protection area	3 08 04	IV	1
SEYCHELLES			
- Boudeuse Cay NR (I/M)	4 16 12	I	1
- Cousin Island NR (I) Administered by ICBP, intended to extend boundaries 400 m offshore and as Special Marine Reserve	4 16 12	I	1
- Ste. Anne MNP (I) Islands, intertidal & shallow reefs includes Ste. Anne, Moyenne, Round, Long & Cerf Islands. Parts of reef seriously disturbed; also proposed BR	4 16 12	II	1
- Islands of Beacon NR (I) Protects birds only; intended to become a Special Reserve	4 16 12	IV	1
- Ile aux Fous NR (I) Protects birds; intended to become a Special Reserve	4 16 12	IV	1
- Boudeuse NR (I) Protects birds; intended to become a Special Reserve	4 16 12	IV	1

Table 10 continued...

Country	Biogeographical code	IUCN cat.	
- Etoile NR (I) Protects birds; intended to become a Special Reserve	4 16 12	IV	
- King Ross NR (I) Protects birds; no habitat protection, intended to become a Special Reserve	4 16 12	IV	
- Les Mamelles NR (I) Protects birds; no habitat protection, intended to become a Special Reserve	4 16 12	IV	
- Desnoefs Special R (I)	4 16 12	IV	
- Yache Marine NR Protects birds; no habitat protection, intended to become a Special Reserve	4 16 12	IV	
- Vallée de Mai NR Protects birds, no habitat protection, intended to become NP for nature preservation	4 16 12	IV	
- North Island African Banks Special R (I) Sea-bird & turtle rookery; uninhabited	4 16 12	IV	
SEYCHELLES - Aldabra Islands			
- Aldabra SNR (Cor) Proposed as World Heritage site	3 24 13	II	1
SOMALIA			
- Lag Badana (Cor)	3 14 07	II	33
N.B. This area was proposed as a site which would include 50 km of coastline. However, the proposed size was 480,000 ha and the existing one being only 334,000 may or may not include the coastal zone.			

Table 10 continued...

Proposed Marine and Coastal Protected Areas

Please note that these areas do not qualify for the UNITED NATIONS List

Introduction

The following information has been extracted from a draft of: Ray, G.C. and McCormick, M.G., Critical Marine Habitats - List of Areas, IUCN/WWF Project Number 1037, April 1976, and Bjorklund, M.I., Achievements in Marine Conservation, I. Marine Parks, Environmental Conservation, 1 (3), (1974).

KENYA

- Diani MNP (L/M)
- Shimoni Kiriti MP (L/M/Cor)

MADAGASCAR

- Grand Récif de Tuléar MNP
- Moçambique Coral Reefs

MAURITIUS

- |   |   |                                      |
|---|---|--------------------------------------|
| - Baie de l'Arsenal MP                  | - | Proposed area of 100 ha              |
| - Flat Island/Gabriel MP                | - | Proposed area of 420 ha              |
| - Flicq en Flacq MNP                    |   |                                      |
| - Grande Baie North MNP                 |   |                                      |
| - Poste de Flacq MNP                    |   |                                      |
| - Le Chaland/Blue Bay MP                | - | Proposed area of 390 ha              |
| - Le Morne Brabant MNP                  |   |                                      |
| - L'Harmonie/La Preneuse MNP            |   |                                      |
| - Poste (de) Lafayette MNP              |   |                                      |
| - Roches Noires MNP                     |   |                                      |
| - Trou aux Biches MNP                   |   |                                      |
| - Trou d'Eaux Douces/Iles aux Cerfs MNP |   |                                      |
| - Iles aux Cerfs                        | - | Mangroves & lagoon coral communities |
| - Trou d'Eaux Douce                     | - | Interesting coral reef community     |

MOZAMBIQUE

- |                              |   |  |
|------------------------------|---|--|
| - Primeiras Island MNP (I/M) | - | For protection of dugong & turtle                                  |
| - Segundo Island MNP (I/M)   | - | To protect green turtle and coral reef; exceptional fringing reefs |
| - Inhaca Island (I/M)        |   |  |

Table 10 continued...

REUNION

- Coral Islets (I/M/Cor)

SEYCHELLES

- Aride Island NR (IM)
- Baie Ternay MNP (L/M) - North part of Mahé, shallow water reef; rich fish life
- Bird Island Special R (I/M)
- Curieuse MNP (L/M)
- La Digue Island (I/M) - To include NP and NR
- Port Launay MNP (L/M) - North part of Mahé
- Praslin NMR (L/M) - Protects wildlife
- Felicite Island Special R (I) - For protection of bird life
- Fregate Island Special R (I) - For protection of bird and animal life
- Cosmoledo Special R (I) - For protection of bird life and marine turtles
- Curieuse/Praslin Special R (Cor) - To protect the rich and varied reef
- Récif Spécial R
- L'Ilot Spécial R

TANZANIA

- Dar es Salaam Coral Gardens - (Includes: Mbudiya, Songoyo, Pangavini and Fungo Yasini Islands) Habitat destruction; intensive fishery, turbid water
- Tanga Coral Gardens - (Includes: Mwamba wamba, Mwamba shumda, Fungu nyama) Outer reefs very rich; intensive fishing, some local pollution
- Maziwi Islands (now submerged) - Green turtle sanctuary, coral gardens, restricted use by non park or government personnel; egg destruction
- Kilwa Reservee - Protect dugong and turtles
- Mafia Island (parts protected) - Diverse habitats, dugong, crocodiles, rich fishery, turtle feeding ground, increasing tourism, siltation problems



marine ecosystems and associated biota is anything but complete. The establishment of biosphere reserves within the framework of the inter-governmental Man and the Biosphere Programme (MAB) (UNESCO, 1977 and 1981) (Project 8: Conservation of Natural Areas and of the Genetic Material they contain; Project 7: Ecology and Rational Use of Island Ecosystems, and Project 5: Ecological Effects of Human Activities on the Values and Resources of Lakes, Marshes, Rivers, Deltas, Estuaries, Coastal Zones and National Parks), deserves every encouragement. One other important reason for the establishment of a network of coastal and marine protected areas is their value as bench-marks upon which local and global environmental factors can be monitored, as well as the status of the living resources in surrounding areas.

#### NATIONAL POLICIES, LEGISLATION AND TRAINING RELATING TO THE CONSERVATION OF COASTAL AND MARINE LIVING RESOURCES

##### Policy

123. A policy arises out of a need to guide and regulate human behaviour on a particular issue of a national and sometimes international nature. Such a policy may be simple - for example, when dealing with a single issue such as education, or a complex issue, for example, when considering environmental management. As regards sustainable management and exploitation of living resources, national policies and enabling legislative instruments relating thereto, differ widely between countries.

124. In Mozambique, for example, the wise use and protection of living natural resources is embodied in the national constitution. The value of forest cover in soil protection has been recognized, and on fauna and flora the policy calls for effective protection and utilization in line with national and international norms.

125. The level of awareness of conservation issues and their complex nature is also reflected by the mechanisms which Governments have established to manage and develop the different categories of living resources, and the level of importance accorded that agency, relative to other organs of the Government. For example, the Governments of Kenya and Tanzania have created a ministry to embrace agencies specifically charged with conservation of natural resources. In other countries of the region the relevant Government agency is often attached to the ministry responsible for agriculture or rural development; in Somalia wildlife is a section within the National Range Agency itself under the Ministry of Agriculture. In Comoros an agency dealing with the conservation of natural resources is only now being considered, although both Departments of Forestry and Fisheries exist there.

126. A suitable framework for the development of national conservation strategies is now provided by the World Conservation Strategy (IUCN/UNEP/WWF 1980) (see paragraph 133). Several countries in the region actively participated in the launching of the strategy, and a number of Governments have formally endorsed its objectives and, in some cases, have already requested technical assistance for the preparation of national strategies.

##### National and international legislation

legislative texts to the UNEP secretariat for information, these will need to be completed from other collections in order to provide a basis for comparison and critical evaluation.

128. It is recommended that a systematic study be undertaken to determine the adequacy of current legislation in the region, including the participation of the countries concerned in relevant international conventions and agreements with a view to determining the needs for further legislative and regulatory measures in support of conservation of living resources.

#### Specialized training

129. The staff resources of the various national agencies managing natural resources are, in most countries, very limited. And while there exist national institutions for specialized training, the curricula and subsequent field work after training are very much biased towards the management and development of terrestrial resources. While there is a regional training college for parks and wildlife administrators, the College of African Wildlife Management at Mweka (CAWM) in Tanzania, the curriculum lays emphasis on terrestrial ecosystems and not enough on marine ecosystems. The island countries and Mozambique have not yet been able to make use of this college due to their focus on marine conservation ecosystems or, in the case of Mozambique, to language problems. Yet the college could certainly be useful for the training needs of some of these countries.

130. During the visit to Kenya and Tanzania, the mission learned of a workshop being organized in November under the auspices of the United Nations University, focusing on the management of marine living resources. And in 1979 ENDA, (Environment and Development in Africa) Dakar, organized a workshop for the Indian Ocean Island countries focusing on the protection of the marine environment. This and other similar workshops which have been convened on a regional level (and national level such as was the 1980 workshop in Kenya) have enhanced the appreciation of the complex nature of the marine environment and related problems. Further seminars and workshops would be desirable, and if possible should be extended to include senior decision makers.

131. In conclusion, the long-term economic viability of coastal and marine living resources will depend on sound policy decisions and legislation in addition to scientifically based management practices. This requires a thorough knowledge of the ecological processes governing the characteristics of the various ecosystems and the biota associated with them. The World Conservation Strategy offers a convenient reference basis for this purpose, and a common platform for conservation action by the countries of the region (see paragraph 134 (a)).

#### CONCLUSIONS AND RECOMMENDATIONS

132. The information provided in this report has been collected as a result of a field mission and supplemented by data currently available at the IUCN Conservation Monitoring Centre (CMC) in the United Kingdom. Although a significant amount of information has been compiled, this report clearly demonstrates that so far the coastal and marine zones have not received the attention they deserve and that

work at national and regional levels, to improve, monitor and strengthen the conservation of coastal and marine resources.

133. The World Conservation Strategy has been used as a conceptual framework and as practical guidance for this mission and the resulting report. The recommendations that follow are being presented as opportunities to shape development in ways that protect living resources for long-term productivity. It is hoped that the follow-up to these recommendations will be guided by the priorities identified in the World Conservation Strategy (WCS).

134. The WCS was prepared by IUCN with the advice, co-operation and financial assistance of UNEP and WWF, and in collaboration with FAO and UNESCO. The WCS is intended to stimulate a more focused approach to the management of living resources and to provide policy guidelines on how this can be carried out by three main groups:

- government policy makers and their advisers;
- conservationists and others directly concerned with living resources;
- development practitioners, including development agencies, industry and commerce and trade unions.

135. The aim of the WCS is to achieve the three main objectives of living resources conservation:

- (a) to maintain essential ecological processes and life support systems such as soil regeneration and protection, the recycling of nutrients, and the cleansing of waters on which human survival and development depend;
- (b) to preserve genetic diversity (the range of genetic material found in the world's organisms), on which depend the functioning of many of the above processes and life-support systems, the breeding programmes necessary for the protection and improvement of cultivated plants, domesticated animals and micro-organisms, and consequently much scientific and technical innovation, and the security of the many industries that use living resources;
- (c) to ensure the sustainable utilization of species and ecosystems (notably fish and other wildlife, forests and grazing lands), which support millions of rural communities as well as major industries.

#### SUMMARY OF RECOMMENDATIONS

136. The recommendations outlined in this report are initial steps towards outlining what needs to be done on a national and regional level for reinforcing and improving the conservation of coastal and marine resources and ecosystems.

137. Essential ecological processes and life support systems

Problems:

erosion-siltation, destructive fishing practices, etc.). Utilization of the coastal and marine living resources, and the resulting degradation of habitats, is often not carried out on a sustainable basis thereby leading to an impoverishment of the life-support systems with unfortunate consequences to the human communities depending on those resources.

Recommendations (on a national level):

- (a) Priority should be given to ensure that the principal management goal for estuaries, mangrove swamps and other coastal wetlands and shallows that are critical for fisheries is the maintenance of the ecological processes on which the fisheries depend.
- (b) Particular attention should be given to the formulation of a coastal and marine national living resources conservation and management strategy aimed at protecting and maintaining the support systems of critical habitats (i.e. coastal dry forest, coastal dunes, coastal flood plains, fresh and brackish water marshes, mangrove forests, reef-back lagoons, sandy beaches, etc.) and regulating the use of genetically rich areas (fisheries ponds, marine mammal feeding grounds, turtle nesting areas, nursery grounds for shrimps, coral reefs, etc.).

Recommendations (on a regional level):

- (a) Ecological and biological inventories of coastal and marine life-support systems and the assessment of ecosystem capabilities should be continued and expanded to provide detailed classification of these ecosystems and their living resources content.

138. Genetic diversity (threatened/endangered species of flora and fauna, and habitats)

Problems:

The coast and seas of the region harbour a large number of threatened or endangered coastal and marine species, including several species of marine mammals and turtles, sea-birds and migratory avifauna, crocodiles. Most of the coastal species of fauna and flora are subject to growing threats from urban and industrial development, destruction of their critical habitat (e.g. coastal wetlands and reefs), pollution, uncontrolled exploitation, incidental take in relation to various fishing operations, and from erosion.

Recommendations (on a national level):

- (a) Priority should be given to species that are endangered throughout their range and to species that are the sole representative of their family or genus.
- (b) Unique ecosystems should be protected as a matter of priority.
- (c) As a matter of urgency the Government of Madagascar should ensure the protection of coral reefs at Tuléar by, for instance, creating a marine protected area. Recommendations to this effect have already been submitted to the Central Government by the Marine Research Station at Tuléar.
- (d) Tanzania and Mozambique should consider joining the state of Madagascar.

- (e) Additional protective measures should be accorded, where identified, to marine turtles and their critical habitats. Further surveys should be carried out to inventory stocks, movements and conservation measures, such as in Seychelles where the survey under way should be strengthened and expanded to cover the entire region.

Recommendations (on a regional level):

- (a) A regional network of selected marine parks, equivalent reserves and management areas should be created with a view to affording better protection to coastal and marine ecosystems which are of vital importance as renewable food and energy resources for the people.
- (b) Regional co-operative measures should be encouraged, such as the initiative taken by the Governments of Kenya and Somalia to determine the status of the dugong, and should be reinforced to include the rest of the geographical range of this species. Tanzania and Mozambique have indicated the need for such a co-operative survey. Co-operation on a regional scale for conservation of all marine mammals and other marine resources is highly desirable.
- (c) The development of a comprehensive mapping of systems should be considered (mapping of critical coastal and marine habitats; highlighting potential conflict and compatibilities of living resources in the region).

139. Supporting measures: conservation for development

Problems:

As in other regions, environmental and conservation values and processes have not always been integrated into national development plans. Institutions to promote and implement conservation-oriented programmes are very few and often do not have the necessary requirements and facilities to carry out their tasks. This situation is particularly critical along the coastal zones where major economic development occurs or is being planned and where serious and perhaps irreversible damage to living resources has been or is being done.

Recommendations (on a national level):

- (a) Additional efforts should be made to strengthen government agencies responsible for the conservation of living resources. Where such an agency is lacking, measures should be taken to either create one or use existing infrastructure and administrative facilities to undertake the necessary action.
- (b) National seminars and workshops on environmental and living resources conservation and management should be regularly convened to bring in all levels of Government and the public. Whenever possible, such meetings should be organized to coincide with, precede or follow up, other conferences, symposia or workshops having a bearing on living resources conservation and utilization to ensure a proper flow of information and to facilitate, for instance, inter-agency contacts (i.e. Regional conference on endangered species and habitat).
- (c) Institutions studying coastal marine ecosystems and species should be encouraged and strengthened, especially by providing them with adequate

- (d) Further comparative information and analyses are needed to determine the adequacy of existing national legislations and policies concerning living resources.
- (e) Nations which have not adhered to the major global conventions dealing with the conservation and management of living resources should do so to ensure the conservation of those living resources that cannot be conserved by national legislation alone.
- (f) Where Man and Biosphere National Committees have been established, they should be strengthened and be involved in the decision-making process affecting the conservation and management of ecosystems. Where such Committees have not been established, advice should be sought from UNESCO on the feasibility of expanding Man and the Biosphere Programme network.
- (g) Where appropriate, traditional methods of living resources management should be retained or revived. This is particularly important in rural and fishing communities as one of the best methods of ensuring a sustainable use of ecosystems and species.

Recommendations (on a regional level):

- (a) Major efforts should be made in the region to promote environmental awareness and to highlight the need to develop integrated conservation plans to ensure sustainable use of coastal and marine resources.
- (b) Particular attention should be given to the establishment of a central data bank on coastal and marine resources inventories, research, conservation, management and utilization to ensure easy access to and dissemination of the available information.
- (c) Due to a pressing need for trained technicians and managers of marine national parks and reserves, a regional training programme should be formulated and implemented through the use of an existing national or regionally-oriented institution, at least in the short-term, and in the long-term, the creation of a specialized facility in this field to serve the region.
- (d) The findings and policies being developed by FAO's co-ordinated fisheries programmes in the region should be examined for potential relevance to and impact on the problems identified in this study.

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