REGIONAL SEAS

UNITED NATIONS ENVIRONMENT PROGRAMME

Management and conservation of renewable marine resources in the Eastern African region

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PREFACE

Thirteen years ago the United Nations Conference on the Human Environment (Stockholm, 5-16 June 1972) adopted the Action Plan for the Human Environment, including the General Principles for Assessment and Control of Marine Pollution. In the light of the results of the Stockholm Conference, the United Nations General Assembly decided to establish the United Nations Environment Programme (UNEP) to "serve as a focal point for environmental action and co-ordination within the United Nations system" (General Assembly resolution 2997(XXVII) of 15 December 1972). The organizations of the United Nations system were invited "to adopt the measures that may be required to undertake concerted and co-ordinated programmes with regard to international environmental problems", and the "intergovernmental and non-governmental organizations that have an interest in the field of the environment" were also invited "to lend their full support and collaboration to the United Nations with a view to achieving the largest possible degree of co-operation and co-ordination". Subsequently, the Governing Council of UNEP chose "Oceans" as one of the priority areas in which it would focus efforts to fulfil its catalytic and co-ordinating role.

The Regional Seas Programme was initiated by UNEP in 1974. At present it includes eleven 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 controlling 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 [2/].

The Regional Seas Programme has always been recognized as a global programme implemented through regional components. Interregional co-operation among the various sea areas on common problems is an important element in assuming the compatibility of the different regional components.

As a contribution to the development of the Action Plan for the South Asian Seas region supported by UNEP in the framework of the Regional Seas Programme in the Indian Ocean region, the International Union for Conservation of Nature and Natural Resources, in co-operation with UNEP, has prepared this document.

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

2/ UNEP: Achievements and planned development of UNEP's Regional Seas Programme and comparable programmes sponsored by other bodies. UNEP Regional Seas Reports and Studies No. 1. UNEP, 1982.

The document reviews the past and on-going conservation activities relevant to the Eastern African region at the regional and national levels; identifies priority concerns of the Governments bordering the region; and contains recommendations for interregional and regional projects to be undertaken to address these concerns[3/]. The assistance of the consultants, J. Kundaeli and L. Barratt, in the preparation of this document is gratefully acknowledged. In addition, the sections dealing with fishery aspects of conservation have been prepared by J. Beddington and J.A. Gulland. The report has been compiled and edited by the Tropical Marine Research Unit, University of York, UK.

3/ IUCN/UNEP: Marine and coastal conservation in the East African region. UNEP Regional Seas Reports and Studies No. 39. UNEP, 1984.

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INTRODUCTION

AREA COVERED

The Eastern African region has been provisionally defined as the marine and coastal area of the Indian Ocean within the jurisdiction of Comoros, La Reunion (France), Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia and the United Republic of Tanzania.

The total land area is about 3,540,169 km^2 (Table 1). The major rivers flowing into the Indian Ocean are shown in Figure 1. In Madagascar the rivers rise from the eastern mountain range (generally over 2,500 m above sea level) cutting across the heavily settled highland plateaux and the western livestock raising belts, both of which are experiencing extensive soil erosion. Thus, whatever land use practices and other developments in the catchment basins of rivers exist, even arising from outside the region, these will have an impact on the marine environment.

The coastal plain is negligable to almost absent on the granitic islands of the Seychelles, the volcanic-origin islands of Comoros and the Mascarenes, and almost the entire eastern coast of Madagascar. Mauritius, which is volcanically older, is less rugged with fairly flat areas along the northern coasts. Western Madagascar's extensive plains are especially associated with the major rivers and are probably the result of deposition of soil from the upland plateaux.

The mainland coastal plain lies less than 100 m above sea level and is very variable in width. It is narrowest (less than 10 km wide) along the Mozambique-Tanzania and Tanzania-Kenya borders and northern Somalia. It is widest (about 20 km) from central Somalia southwards to north of Mombasa (Kenya), central Tanzania, central and southern Mozambique.

Much of the coast, especially north of Kenya, is relatively unindented. This may be partially ascribed to the absence of large rivers and to the coastal currents which flow parallel to this coast. The result is that there are relatively few mangrove stands to be found here; a similar situation is also noted for the east coast of Madagascar where the Madagascar current flows parallel to the coast.

The continental shelf is very narrow, averaging only 15 to 25 km in width. Along the mainland it varies from as narrow as a few hundred meters off Pemba in Mozambique but extends to nearly 145 km in the Bight of Sofala (Figure 1). The shelf area for the different countries is indicated in Table 1. The shelves and banks are areas of intensive biological activity and productivity. Clearly therefore, the narrower the shelf, the less productive the sea area and as will be seen later, the West Indian Ocean is relatively fisheries-poor compared to other regions.

The sea bed drops rather sharply after the continental shelf, plunging to depths of over 2,000 m below sea level. The plunge continues to a general depth of 4,000 m except where interrupted by submerged platforms and islets associated with the island countries.

One important limestone plateau is the Seychelles Ridge which supports four major patches of continental shelf. The first supports the Seychelles islands, which are principally granitic but with limestone highs and coralline islands. The others are capped with limestone only: the Saya de

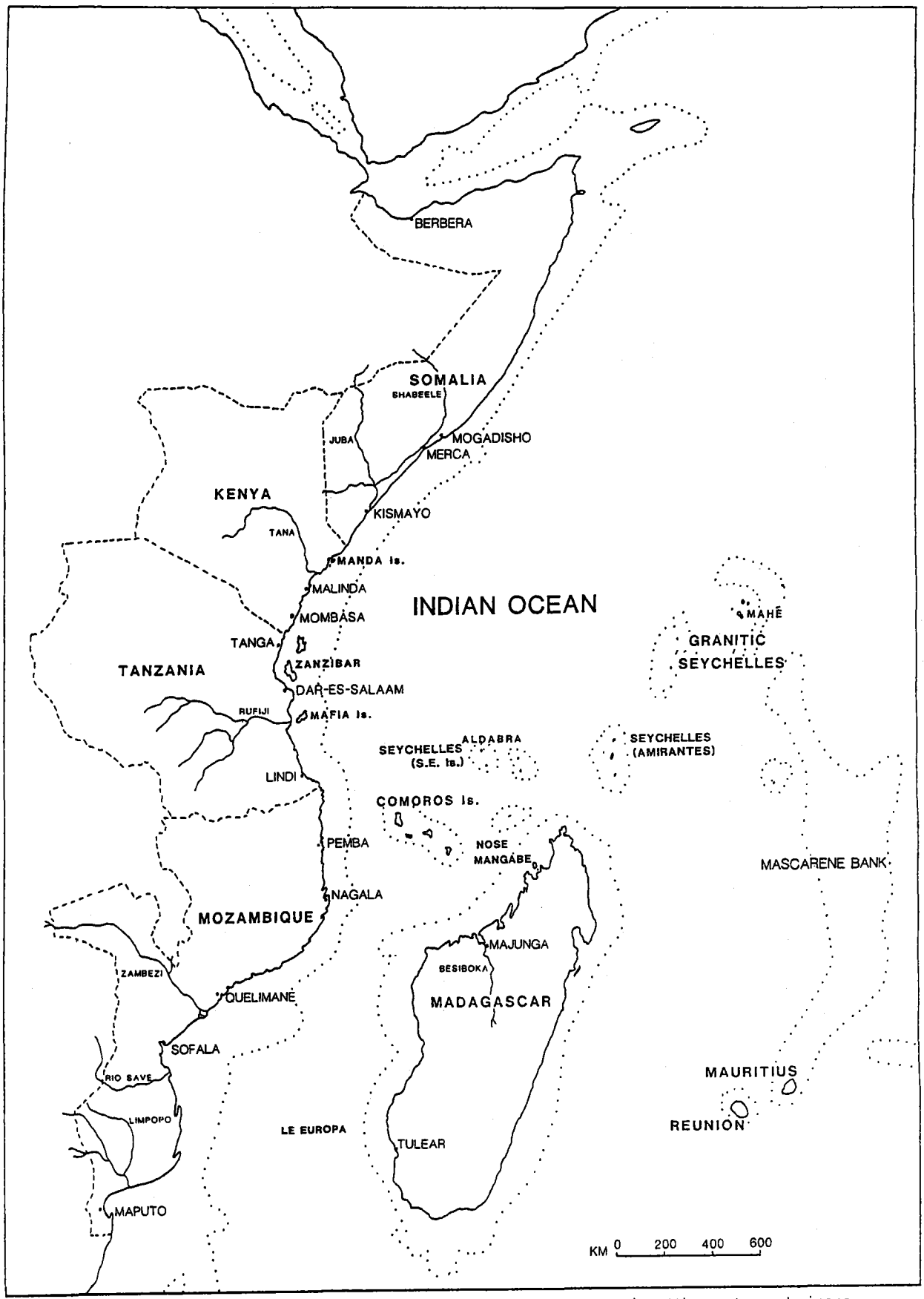


Fig.1 The Eastern African Region, showing major towns, coastal settlements and rivers

.....Represents the limits of the continental shelves and major banks in the Western Indian Ocean

(Information from Ambio 12(6), 1983. IUCN)

Table 1 - General Profile of Countries in the Eastern African Region after UN/Unesco/UNEP

Countries	Land Area (sq km)	Estimated Shelf Area Depth Range 0-200 sq km	Length of Coastline (km)	Estimated Population in 1980 (million)	Marine Fish Landing in 1980 (1,000 metric tons)	Per Capita Fish Consumption in 1980 (kg life weight)
	(1)	(2)		(3)	(3)	(4)
Comoros	2,236	900	350	0.33	4.0	12.4
France (la Réunion)	512	--------	207	0.46	-------	--------
Kenya	582,650	6,500	500	16.40	5.4	3.3 (5)
Madagascar	595,790	135,000	4,000	8.74	12.0	6.0 (5)
Mauritius	1,865	1,600	200	0.99	5.3	17.7
Mozambique	738,000	120,000	2,500	10.47	31.7	3.5
Seychelles	443	48,000	600	0.06	5.0	82.0 (6)
Somalia	637,657	32,500	3,000	3.64	11.0	0.6
Tanzania	939,703	30,000	800	17.00	49,2	10.0 (5)

(1) ANON, 1981
(2) FAO, Fishery Country Profiles and FAO/IOP, 1979
(3) FAO, 1981
(4) FAO, ICS printouts, Fish. Department, unpublished
(5) Note that freshwater fish supply exceeds marine catch
(6) Note that per capital fish consumption is subject to great variation due to comparatively small number of inhabitants and yearly variability in total supply (consumption by tourists is not separately accounted for)

N.B. Data for France (La Réunion) not available from the same sources.

Malha Bank, Nazareth Bank and Cargados Carajos shoals. Of these only the last have islands (St Brandon group) although large areas of all three lie in water of a few meters deep.

In the southwest, the Mascarene islands include La Reunion (the highest point of the Indian Ocean), its dependency Rodriguez, and Mauritius. All are separated by deep water.

The population of the region was about 62.24 million in 1981 with an average annual growth rate of about 3.0%. However, about 75.3% of the population of the region is agricultural being either cultivators, pastoralists or carrying out mixed farming. A small proportion living along the coasts, main rivers and inland lakes practice artisanal fishing. Agricultural production, and even fisheries as practiced by the local populations is essentially subsistence in nature.

It should be mentioned that population distribution on the mainland is very uneven. This uneven distribution is closely determined by soil fertility and the presence of disease vectors such as mosquito and tsetse-fly which has rendered northern Mozambique as well as a good proportion of the coastal belt of the mainland and western Madagascar uninhabitable on a large scale. The prevailing climatic situation, for example the desertic conditions in southwestern Madagascar and in Somalia from Merca northwards also govern population distribution. Another factor is, of course, the existence of economically active coastal towns, particularly those associated with import, export and processing of materials. The populations of some of the major cities and towns is shown in Table 2, which also gives estimates for the discharge of domestic sewage. At present levels - except very locally in towns without sewage treatment plants, this is considered to have a negligable impact on the marine environment.

CLIMATE

The climate of the region may be described as moderately warm tropical but with semi-desert to desert areas in most of Somalia, north and north-eastern Kenya, central Tanzania and south-western Madagascar. In the extreme south, Madagascar has a Mediterranean type climate while southern Mozambique can experience temperatures as low as 2^{o}C during the southern winter. Temperatures along the mainland coast, and generally over the islands other than Madagascar, are moderated by the sea. The high plateau and eastern mountain range of Madagascar and the mountain ranges running along the Rift Valley through to the Ethiopian mountains are cooler than on the coasts.

The mean sea surface temperatures at different times of the year are shown in the following table. (See also IMO/UNEP, 1982).

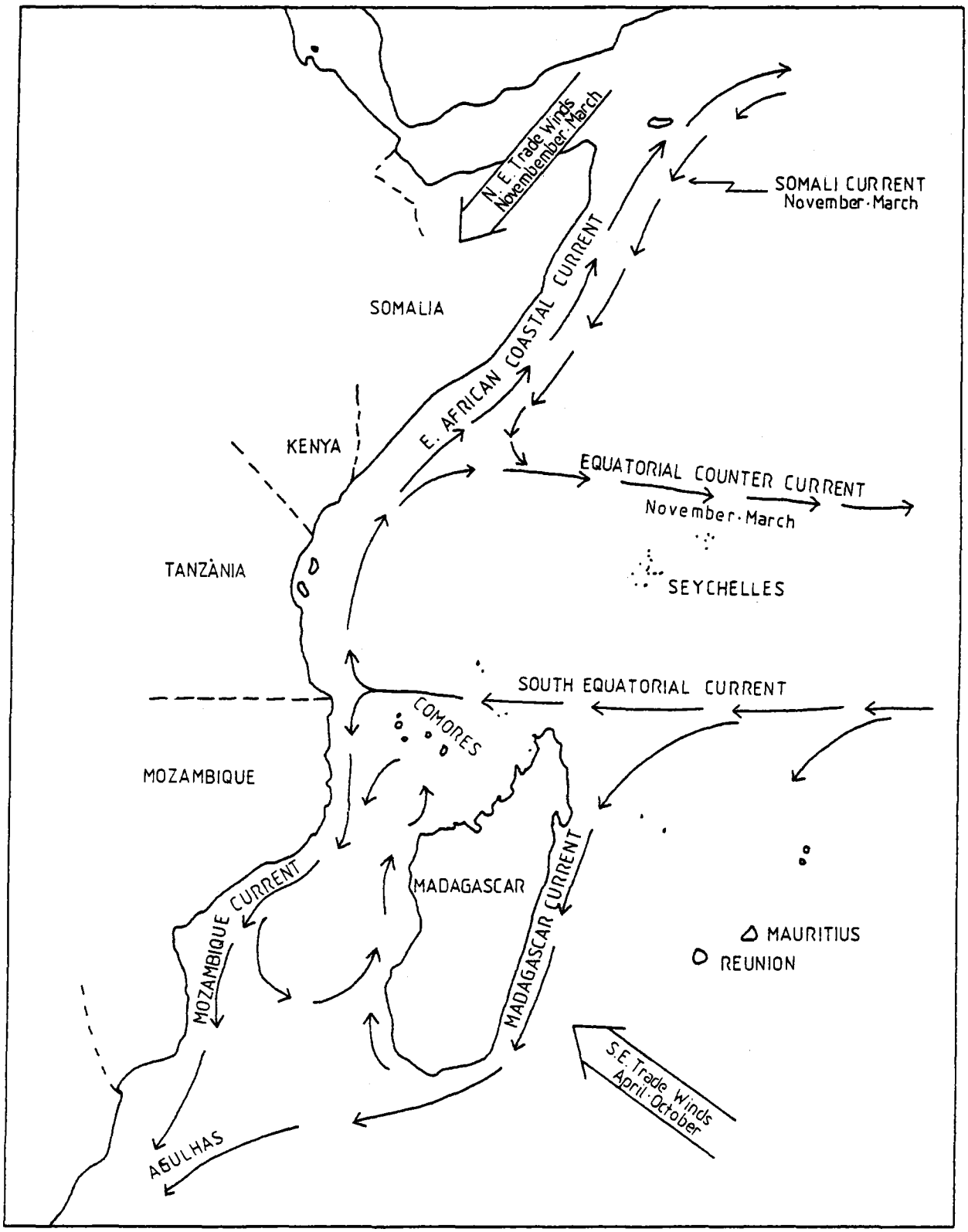


Fig. 2 Ocean currents and winds in the Eastern African Region

(After IUCN/UNEP, 1982)

LATITUDE	FEBRUARY	MAY	AUGUST	NOVEMBER
10°N-0°S	25.0-26.0	28.0-29.0	21.0-25.0	26.0-27.0
0°-10°S	26.0-28.0	28.0	24.0-26.0	27.0
10°-20°S	28.0	25.5-28.0	23.0-24.0	25.5-27.0
20°-30°S	25.0-28.0	22.0-25.5	20.0-23.0	22.0-25.5

Besides the incidental conventional precipitation frequently associated with the coast and the islands, rainfall pattern is closely tied to that of the monsoon (or Trade) winds. These winds are influenced by the low pressure Inter-tropical Convergence Zone (ICTZ) which moves north and south of the Equator, within the two tropics, according to the movement of the sun. The southeast monsoon, which blows from April to October, has the greatest impact on the region because it blows over a large body of water. Most of the water transported by the wind falls in the southern and central parts of the region and is therefore depleted of much of its moisture by the time it reaches northern Kenya and Somalia. The northeast monsoon, October to March, is principally continental in nature and therefore relatively dry except for the moisture picked up in the northern Indian Ocean and the Gulf of Arabia. Some parts of Kenya and northeastern Tanzania, as well as the Seychelles islands close to the Equator benefit from the water deposited by this wind but the land morphology over most of Somalia and north eastern Kenya is not suitable for orographic precipitation - hence the semi-desertic nature of this part of the region. Consequently, these areas close to the Equator have one long and one short rainy season, whilst those further away experience one long rainy season of some six months duration.

The annual rainfall patterns have implications on the economic activities of the region; on soil erosion; sedimentation of flood plains; paddy fields; coastal wetlands and near-shore marine habitats; and on both the quality and quantity of nutrients being washed into these habitats. It should be mentioned that mangroves do need a great amount of freshwater input for best development (Saenger et al., 1983).

A zone of high pressure is permanently located along 30°S, increasing in size and shifting north and south of this latitude according to the position of the sun. It is most extensive in July (northern summer) when its influence reaches northern Madagascar; it breaks down and shifts further south, below latitude 30°S in January (northern winter). Associated with this is a cyclonic zone which is known to cause extensive damage to the eastern region's island countries. The cyclones, hurricanes and storms associated with the air mass turbulence along this belt also give rise to strong waves which results in coastal erosion.

OCEANOGRAPHY

The principal ocean currents in the west Indian Ocean are shown in Figure 2 (Bliss-Guest, 1983). The permanently west flowing South Equatorial Current, 6°S to 20°S, is partly diverted along the eastern Madagascar coast becoming the Madagascar current. On approaching the mainland, the South Equatorial Current splits to form two coastal currents; the East African

Table 2 - Estimated Discharge of Domestic Sewage from Major Cities on the Coasts
(estimated 20 kl/capita/year)

Information from UNEP, 1982.

Country-City	Population 1980 (estimated)	Length of Coastline (km)	Population Sewered	%	BOD_5 (ton/yr)	BOD_5 km coast-line (ton/yr)
KENYA	15,300,000	500				
Mombassa	440,000		88,000	20	2,760	3.52
Malindi	14,000					
Lamu	6,000					
Regional/Total	460,000		88,000	19	1,760	3.52
TANZANIA	17,540,000	800				
Dar es Salaam	760,000		112,500	15	2,250	2.81
Tanga	100,000		10,000	10	200	0.25
Lindi	30,000					
Regional/Total	890,000		122,500	14	2,450	3.06
MOZAMBIQUE	10,200,000	2,500				
Maputo	770,000		77,000	10	1,540	0.62
Beira	220,000		55,000	25	1,100	0.44
Quelimane	100,000		10,000	10	200	0.08
Nampula	100,000		10,000	10	200	0.08
Pemba	30,000		3,000	10	60	0.02
Regional/Total	1,220,000		155,000	13	3,100	1.24
COMOROS	400,000	350				
Moroni (G. Comores)	16,000					
Moheli	4,500					
Anjouan	10,000					
Regional/Total	30,500					
MADAGASCAR	8,500,000	4,000				
Tamatave	60,000		9,000	15	180	0.05
Majunga	70,000					
Tulear	40,000					
Diego-Suarez	45,000		4,500	10	90	0.02
Regional/Total	215,000		13,500	6	270	0.07

Table 2 (Cont'd)

Country-City	Population 1980 (estimated)	Length of Coastline (km)	Population Sewered	%	BOD_5 (ton/yr)	BOD_5 km coast-line (ton/yr)
MAURITIUS	936,000	200				
Port Louis	250,000		150,000	60	3,000	15.00
Plaines Wilhems/ Curepipe	57,000		40,000	70	800	4.00
Beau-Bassin/ Rose-Hill	72,000		50,000	70	1,000	5.00
Phoenix	36,000		25,000	70	500	2.50
Regional/Total	415,000		265,000	64	5,300	26.50
SEYCHELLES	65,000	600				
Victoria	25,000		6,250	25	125	0.21
Regional/Total	25,000		6,250	25	125	0.21
SOMALIA	3,850,000	3,000				
Mogadishu	400,000					
Merca	55,000					
Kismayo	60,000					
Berbera	50,000					
Regional/Total	565,000					
GRAND TOTAL	3,820,000		650,250	17	13,005	

N.B. No data available for La Réunion

Coastal Current (EACC), which flows northwards, and the Mozambique Current which flows southwards. The latter joins the Madagascar current to form the Agulhas current.

From April to October the EACC is under the strong influence of the SE monsoon which causes it to flow north attaining mean velocities of 4 to 5 knots and occasionally reaching 7 knots. The strong current continues along the Somali coast, but the increasing offshore component of the winds north of the Equator result in the upwelling of cold water which in turn results in potentially high fisheries productivity. This is the only zone in the region with upwelling. The northeast monsoon generates the southward flowing coastal Somali current, November to March, and thus reverses the EACC down to about $2^{O}N$ where they join to generate the east flowing Equatorial Counter Current.

Some of the water mass from the Mozambique current and the Madagascar current generate internal currents within the Mozambique channel. It has been suggested that this current, which flows along the mangrove and prawn rich western coast of Madagascar, passively transports prawn larvae to the Mozambique coast. On a local basis, strong tidal currents may occur along breaks in the reef and at openings of creeks. The scouring action of the sediment transported by these currents may limit the distribution of coral in some areas.

CONSERVATION AND MANAGEMENT ACTIVITIES

The Eastern African region is not as polluted as the Mediterranean or Caribbean, nor does it suffer the environmental stresses imposed on regions such as the Kuwait Action Plan region, but it is plagued by a number of problems, most notably soil erosion, the pollution of coastal waters by untreated sewage and chemical wastes and by the rapid disappearance of wildlife habitats.

It is important to stress that wide differences exist between the countries as regards the level of perception or appreciation of the impact of the various activities on the coastal and marine environment; means at their disposal for effectively managing and developing the resources of these environments (institutional frameworks, capabilities and technical capabilities); and in competing priorities regarding social and economic development. In some, continual internal political instability has been an important factor in resource allocation and in the overall development prospects for the country. This has been further aggravated by the generally poor and worsening economic performance attributable to both internal and external factors.

A further complication arises from the multiplicity of agencies responsible for the management of the resources of the coastal and marine environments. These include urban fisheries, forestry, agriculture, harbour developments, and nature conservation authorities each of which has a specific mandate assigned to it under legislation. Fisheries interests are very likely to come into conflict with nature protection as with forestry, agriculture, and urban authorities regarding the protection of mangroves or establishment of national parks. There is clearly a need for harmonization of institutional frameworks at both national and inter-national levels. The convention, protocols and plan of action for the Eastern African region due to be concluded during the course of 1985 will be a useful step towards this end.

International Conventions

The countries mentioned below have ratified the following international conventions, where possible, the date of ratification is given in brackets at the end of the country's entry. (Information taken from FAO/UNEP, 1984).

International Convention for the Prevention of Pollution of the Sea by Oil. London. Kenya (1975); La Reunion (France) (1957, ammendments ratified 1963, 1972); Madagascar;

International Convention for the Prevention of Pollution from Ships, London. (MARPOL). Kenya (1975); La Reunion (France) (1981); Tanzania (signatory only);

International Regulations for Preventing Collisions at Sea, London. La Reunion (France) (ratified final ammendments 1981); Madagascar;

Convention on the High Seas, Geneva. Kenya (1969); Madagascar; Mauritius;

Convention on the Continental Shelf, Geneva. Kenya (1969); La Reunion (France) (1965); Madagascar; Mauritius;

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters, London. Kenya (1972); La Reunion (France) (1979); Seychelles (through adoption of convention by UK);

African Convention on the Conservation of Nature and Natural Resources, Algiers. Kenya (1969); Madagascar; Seychelles (1978); Tanzania (1974);

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) Bonn. La Reunion (France) (signed but not ratified);

Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), Washington. Kenya (1979); La Reunion (France) (1978); Madagascar; Mauritius; Seychelles (1977); Tanzania (1980);

United Nations Convention on the Law of the Sea, (UNCLOS) Kingston. Kenya (1982); Mauritius; Seychelles (1982); Somalia (signatory but not ratified); Tanzania (signatory only);

Charter of the Organisation of African Unity, Addis Ababa. Kenya (1963); Madagascar; Mauritius; Seychelles (1976); Somalia (1966);

Indian Ocean Commission 1982. Seychelles, Comoros, Madagascar and Mauritius formed themselves into an Indian Ocean Commission with a view to increasing co-operation within the region.

World Heritage Convention. Seychelles; Tanzania; Madagascar; Mozambique;

Ramsar Convention (Wetlands). No countries are party to this agreement;

Man and the Biosphere Programme, (UNESCO). Kenya, Madagascar, Mauritius and Tanzania have national MAB committees, and Kenya, Mauritius and Tanzania have biosphere reserves. In the case of Kenya two of these areas are marine, Kiunga and Malindi-Watamu (both declared parks/reserves).

It must be noted that although many of the member countries have ratified a good many international agreements, few countries have implemented any national legislation arising from accession to these conventions.

National Legislation

There is some provision in all the member countries for protection of the marine environment by prevention of oil pollution and regulation of shipping activities in territorial waters and to a lesser extent within the Exclusive Economic Zone. Shipping activities are also controlled by a number of laws and regulations relating to the operation of the ports and thus implementation of the same rests with the port authorities. In Kenya, a wider variety of pollutants are covered under legislation such as the Water Act and the Fish Industry Act, similar kinds of national legislation can be found in many other countries in the Eastern African region.

Over-exploitation of marine resources is governed by a large number of agreements which for the mostpart relate to the Fisheries Acts of a number of countries (e.g. Seychelles Fisheries Act, 1942; Mauritius Fisheries Act, 1980) which lay down general guidelines. In some cases more specificic issues are addressed, for example, the practice of dynamite fishing on coral

reefs has been outlawed by several countries, among them Tanzania, Kenya and Madagascar. Similarly, there are Acts governing the removal of sand and gravel from the sea for use as construction material in both Mauritius and the Seychelles. In some cases however, lack of suitable infrastructure has prevented the full implementation of these acts and regulations.

National Agencies

La Reunion (France) - Marine environmental affairs are largely discharged by the Ministry of the Environment under the directorates for the Prevention of Pollution, Protection of Nature and Water Quality. This body also cordinates the efforts of other Ministries with international organisations in marine environmental affairs and in educational and training methods.

Kenya - responsibility for environmental management lies with the National Environment Secretariat which is a department of the Ministry of Environment and Natural Resources. The Secretariat lays down the country's general policy on environmental management in addition to responding to specific incidents as they arise. The Inter-Ministerial Committee on Human Environment is convened by the Secretariat it discusses policy issues and makes recommendations to Government. The Anti-Marine Pollution Committee is intended to respond to oil spill incidents within territorial waters and the EEZ.

Madagascar - environmental management and pollution control falls under the remit of a number of different Ministeries, those of Transport, Defense, Agriculture, Finances and Scientific Research play particularly important roles.

Mauritius - previous Governments have entrusted matters of the environment to the Minsitry of Agriculture and Natural Resources. In more recent Governments responsibility for the environment was transferred to the Ministry of Housing, Lands and Environment.

Seychelles - several institutions exist which deal exclusively or in part with environmental and pollution control not all are regulated by legislation. The principal institution is the National Environment Commission.

Somalia - environmental management, in general, is organised by a number of different Governmental and non-governmental organisations. Management of the marine environment falls basically within the remit of the Ministry of Fisheries, although efforts appear to be concentrated more on practical utilisation of resources rather than on conservation. The National Range Agency, and the National Parks Agency were created in order to establish and maintain national parks and reserve areas. These have yet to be established in the marine environment.

Tanzania - an Inter-Ministerial Committee under the Ministry of Lands, Housing and Urban Development meets occasionally to co-ordinate and map strategy on environmental issues. There is a move to establish the National Council for the Environment which will co-ordinate all the Ministries and other bodies concerned with environmental affairs. Legislative proceedure for this Council is at the draft stage.

Protected areas

With regard to nature protection a number of countries, especially Seychelles and Mauritius, have made considerable efforts in the right direction (see Table 3). The mainland countries which have, in addition, plains areas with easily observable herds of large ungulates and associated predators have paid more attention to these at the expense of coastal and marine environments; Kenya, Mozambique and to a lesser extent Tanzania have taken some steps and the same may be said of Madagascar which is presently co-operating with IUCN and with WWF to draw up a National Conservation Strategy. It should be mentioned that both Madagascar and Tanzania are included in the IUCN-WWF Tropical Rainforest/Primates Programme. In Somalia, a project is underway to plan and develop the infrastructure for national parks and reserves as a base for tourism, several of the reserve areas suggested by Simonetta and Simonetta (1983) encompass maritime regions within their boundaries, but no specific marine reserves have been delegated.

Existing and proposed coastal and marine protected areas are indicated in Table 3. The list is a result of a survey undertaken in the region during 1983 the report of which was reviewed by a workshop of government conservation experts concerned in Mauritius in October 1983 (IUCN/UNEP, 1984). Where relevant, the important reserves, their status and purpose has been included under the appropriate headings in the main section. The table uses management categories of protected areas as defined by IUCN (1983). These categories are used in order to avoid problems caused in nomenclature between coutries, and are based on the actual management objectives of each area. It should also be noted that the areas given refer to the whole park or reserve, and not just to that part of it which contains marine or coastal habitats (for further details see IUCN/UNEP, 1984).

Endangered Species

Several coastal and marine species in the area are endangered, and most of them are of international importance, Table 4 lists these species and indicates their present conservation status in the region (information taken from IUCN/UNEP, 1984). These and others not mentioned in the report have been proposed for inclusion in the Annexes to the convention and protocols for the Eastern African region.

Table 3. Protected Areas in the Eastern African Region
(page 1)

	SOMALIA		KENYA		TANZANIA		MOZAMBIQUE		MADAGASCAR		FRANCE (LA REUNION)		MAURITIUS		COMOROS		SEYCHELLES		
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	
EXISTING MARINE PROTECTED AREAS																			
Category I	0		0		0		0		5*	?	0		0		0		1	35,000	*Reproduction of green and hawksbill turtles
Category II	0		2	3,901	0		1	8,000	0		0		0		0		4	3,031	
Category IV	0		0		0		1	?	0		0		0		0		0		
Category VI	0		2	46,309	0		0		0		4	3,000	0		0		11*	?	*Nesting seabirds, turtles and mollusc protection
Category VIII	0		0		0		0		0		0		6	8,400	1	?	0		
Category IX	0		2	79,600	0		0		0		0		0		0		0		
TOTALS	0		6	129,810	0		2	8,000+	5	?	4	3,000	6	8,400	1	?	16	38,000+	

N.B.

Category I = Strict Nature Reserve
Category II = National Park
Category IV = Managed National Reserve
Category VI = Resource Reserve
Category VIII = Multiple Use Reserve
Category IX = Biosphere Reserve

Table 3. Protected Areas in the Eastern African Region
(page 2)

	SOMALIA		KENYA		TANZANIA		MOZAMBIQUE		MADAGASCAR		FRANCE (LA REUNION)		MAURITIUS		COMOROS		SEYCHELLES		
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	
PROPOSED MARINE PROTECTED AREAS																			
Category I	0		0		0		0		0		0		3	841.2	1*	5	4	100+	*Coral reef research
Category II	0		2	35,000+	0		3	?	0		0		0		0		2	?	
Category IV	0		0		0		0		0		0		14*	?	0		1	34.4	*Nesting seabirds, turtles, coral reefs
Category VI	0		0		5	?	1	?	0		0		0		0		0		
Category VIII	0		0		0		0		0		0		2*	?	4	?	1	?	*Buffer zones for NR's
TOTALS	0		2	35,000+	5	?	4	?	0		0		19	841.2+	5	5+	8	134+	

Table 3. Protected Areas in the Eastern African Region
(page 3)

	SOMALIA		KENYA		TANZANIA		MOZAMBIQUE		MADAGASCAR		FRANCE (LA REUNION)		MAURITIUS		COMOROS		SEYCHELLES	
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)
EXISTING COASTAL PROTECTED AREAS																		
Category I	0		0		0		0		1	740	0		0		0		2	98
Category II	0		2	221,699	0		0		0		0		0		0			
Category IV	0		1	4,331	0		1	?	1	520	0		8	594	0		1	8.3
Category VI	0		0		0		4	240,000	0		0		0		0		1	25.2
Category VIII	0		0		0		0		0		0		0		0		1	3,045
TOTALS	0		3	226,030	0		5	240,000	2	1,260	0		8	594	0		5	3,176.5
PROPOSED COASTAL PROTECTED AREAS																		
Category I	0		0		0		0		0		0		0		0		3	?
Category II	0		0		0		2	?	0		0		0		0		1	?
Category IV	0		0		0		0		0		0		3	?	0		0	
Category VIII	0		0		0		0		0		0		0		0		2	469.6
Unclassified	0		0		0		0		0		2	?	0		0		0	
TOTALS	0		0		0		2	?	0		2	?	3	?	0		6	469.6+

Table 4

Source of Table

THREATENED MARINE SPECIES OF THE EASTERN AFRICAN REGION

SPECIES	SOM	KEN	TAN	MOZ	MAD	FRA (REU)	MAU	COM	SEY
MAMMALS									
Dugong *Dugong dugon*	V	V	V	V			Ex		Ex
Humpback whale *Megaptera novaeangliae*				E					
Blue whale *Balaenoptera musculus*			E	E	E				
BIRDS									
Madagascar fish eagle *Haliaeetus vociferoides*					E				
REPTILES									
Green turtle *Chelonia mydas*	E	E	E	E	E	E	E	E	E
Hawksbill turtle *Eretmochelys imbricata*	E	E	E	E	E	E	E	E	E
Olive ridley turtle *Lepidochelys olivacea*			E	E	E				
Loggerhead turtle *Caretta caretta*		V	V	V	V				
Leatherback turtle *Denmochelys coriacea*				E					E
MOLLUSCS									
Triton's trumpet *Charonia tritonis*		R	R	R	R	R	R	R	R
Commercial torchus *Trochus niloticus*					CT				

Table 4 (cond't)

Source of Table

THREATENED MARINE SPECIES OF THE EASTERN AFRICAN REGION

SPECIES	SOM	KEN	TAN	MOZ	MAD	FRA (REU)	MAU	COM	SEY
Green snail *Turbo marmoratno*	?	CT	CT	CT	CT		CT	CT	CT
Fluted giant clam *Tridacna squamosa*	?	I	I	I	?	I	I	?	I
Small giant clam *Tridacna maxima*	?	K	K	K	?	K	K	?	K
Horse's hoof clam *Hippopus hippopus*							?		
Pearl oyster *Pinctada* spp.	CT	CT	CT	CT	CT		CT	CT	CT
CRUSTACEANS									
Coconut crab *Birgnolatro*			R		?		R/Ex	R	R/Ex
Spiny lobsters *Panulirus spp.*	CT	CT	CT	CT	CT	CT	CT	CT	CT
CNIDARIANS									
Black coral *Antipathes dichoioma*	?	?	?	?	?		CT	?	CT
Whip coral *Cirrhipathes spp.*	?	?	?	?	?	CT	CT	?	CT

Table 4:

Ex = Extinct, E = Endangered, V = Vulnerable, R = Rare, I = Indeterminate, K = Insufficiently known, CT = Commercially threatened, x = Status not assigned, ? = occurrence suspected but not confirmed; areas with no symbols require further investigation.

HABITATS AND SPECIES

The coastal and marine ecosystems have been fairly adequately described by UNEP (UNEP, 1982c; IUCN/UNEP, 1984). The various habitats, occurrence and protection status are shown in Table 5.

The principal ecosystems and associated habitats with particular relevance to the Indian Ocean Sanctuary and the Indian Ocean Alliance are briefly described below.

OPEN SEA

Character and Occurrence

This is an area extending from the high tide zone to about 200 m depth at which point the sea bottom drops fairly abruptly reaching depths of over 2,000 m within a short distance of the coastline. Within the open sea there are a wide range of macro- and micro-habitats, and an equal variety of life forms (sedentary, bottom feeders, and free swimmers). The presence of channels and canyons provides easy access to this zone by the larger deep sea fauna. These channels also allow the filling and emptying of shallower protected waters which is one of the variables responsible for the diverse life forms found in this zone. The zone is therefore biologically highly active with equally high rates of energy exchange (biological, chemical and physical).

There are several areas with offshore banks in the region. These are raised sea floor platforms resembling continental type rock. The most extensive of these is within Seychelles waters (see Figure 1). Others include St. Lazarus Bank (Mozambique), and Nazareth Bank and Saya da Malha. Habitats include those associated with the continental shelf but lack the mudflats because of limited river input. Like the shelf along the mainland and the various islands, these banks have a very high fisheries potential. Unlike the nearshore shallower habitats, most of the fishes are strong swimmers and include tuna, sardines, sail fish, bill fishes, etc., and mammals such as dolphins.

Targeted Exploitation

The major fisheries resources of oceanic waters are the various stocks of large migratory pelagic fish: tunas, seerfishes and billfishes. These stocks are for the most part exploited by fleets from foreign countries, in particular, Japan, Korea and Taiwan all of whom fish by long-lining. Some European countries have also started to fish tuna in the Indian Ocean, and are now transferring parts of their fleets from the Antarctic. Table 9 lists tuna and tuna-like species catch by country from the western Indian Ocean (area 51).

Trawl potential of the continental shelf and banks is shown in Table 6 from which it will be seen that Mozambique and Mauritius have the largest trawlable area.

The open seas are also the foraging areas for dolphins and whales. The dolphins are especially vulnerable when caught in nets.

Table 5 - Protected Status of Marine and Coastal Habitats in the Eastern African Region

Environment/Habitat	SOM	KEN	TAN	MOZ	MAD	FRA (REU)	MAU	COM	SEY	REMARKS
Coastal Environments										
Sand beach	x	s	x	P	s	P	s	x	P	Generally turtle nesting sites
Rocky shore	x	s	x	s	x	x	s	x	P	Both granitic and limestone in Seychelles
Cliffed shore	x	s	x	x	x	x	s	x	x	
Bay	x	s	x	s	x	x	x	x	P	
Estuary	x	s	x	P	x	-	x	-	x	
Brackish coastal (barrier) lagoon	-	-	-	s	x	-	-	-	-	
Intertidal sand/flat	x	s	x	P	x	x	x	x	P	Good example at Aldabra but not at granitic islands of Seychelles
Delta	-	x	x	P	-	-	-	-	-	Partial protection of Zambezi River delta at Marromeu
Dune	x	x	x	P	x	-	-	-	-	
Coastal plain	x	P	x	P	x	x	x	x	s	

Table 5 (cont'd)

Environment/Habitat	SOM	KEN	TAN	MOZ	MAD	FRA (REU)	MAU	COM	SEY	REMARKS
Limestone caves	-	x	x	-	x	-	x	-	-	Protected by tradition because believed sacred in Kenya; no legal protection
Offshore Environments										
Island	x	P	x	P	P	P	P	x	P	Representative variety of protected islands
Rocky fringing reef	-	-	-	P	x	x	-	-	-	
Alluvial bar/bank	-	s	x	s	x	-	-	-	-	
Continental shelf soft bottom	x	s	x	x	x	x	x	x	x	Poor representation in protected areas
Continental shelf hard bottom	-	s	-	x	x	x	x	x	x	None protected
Continental slope	x	x	x	x	x	x	x	x	x	None protected
Submarine canyon	-	x	x	x	x	-	-	-	-	None protected
Submarine plateau/ bank	-	-	-	x	-	-	x	-	x	None protected
Abyssal plain	x	-	-	-	x	x	x	x	x	None protected
Seamount	-	-	-	x	-	-	-	-	-	Unique example not protected

Table 5 (cont'd)

Environment/Habitat	SOM	KEN	TAN	MOZ	MAD	FRA (REU)	MAU	COM	SEY	REMARKS
Ocean trench	-	-	-	-	-	x	x	-	x	None protected
Pelagic Environments										
Upwelling none protected	x	-	-	x	-	-	-	x	x	
Algal beds	x	s	x	s	x	x	x	x	s	
Seagrass	x	s	x	s	x	x	x	x	s	
Salina/saline marsh	-	x	x	P	x	-	s	-	-	
Mangrove forest	x	s	x	P	x	-	-	x	P	Good examples protected in Aldabra and Mozambique
Maritime forest-wood land	x	P	x	P	P	x	-	-	-	
Coastal swamp forest	-	-	s	s	-	-	-	-	-	
Coastal shrubland	x	x	x	s	x	s	x	x	P	
Coastal grassland	-	x	-	P	-	-	-	-	P	
Coastal palm forest	-	x	-	x	-	-	-	-	-	None protected
Living Reefs										
Reef-associated lagoon	x	P	x	s	x	x	s	P	P	
Coral atoll	-	-	-	-	-	-	-	-	P	Most valuable example protected

Table 5 (cont'd)

Environment/Habitat	SOM	KEN	TAN	MOZ	MAD	FRA (REU)	MAU	COM	SEY	REMARKS
Barrier coral reef	-	-	x	-	x	-	x	x	-	None protected
Fringing coral reef	x	P	x	P	x	s	x	x	P	Southern most African examples protected in Mozambique
Patch reef	?	s	x	s	x	x	x	x	s	Unique example protected
Sabellariid reef	-	-	-	P	-	-	-	-	-	

Taken from IUCN/UNEP, 1984

Captions

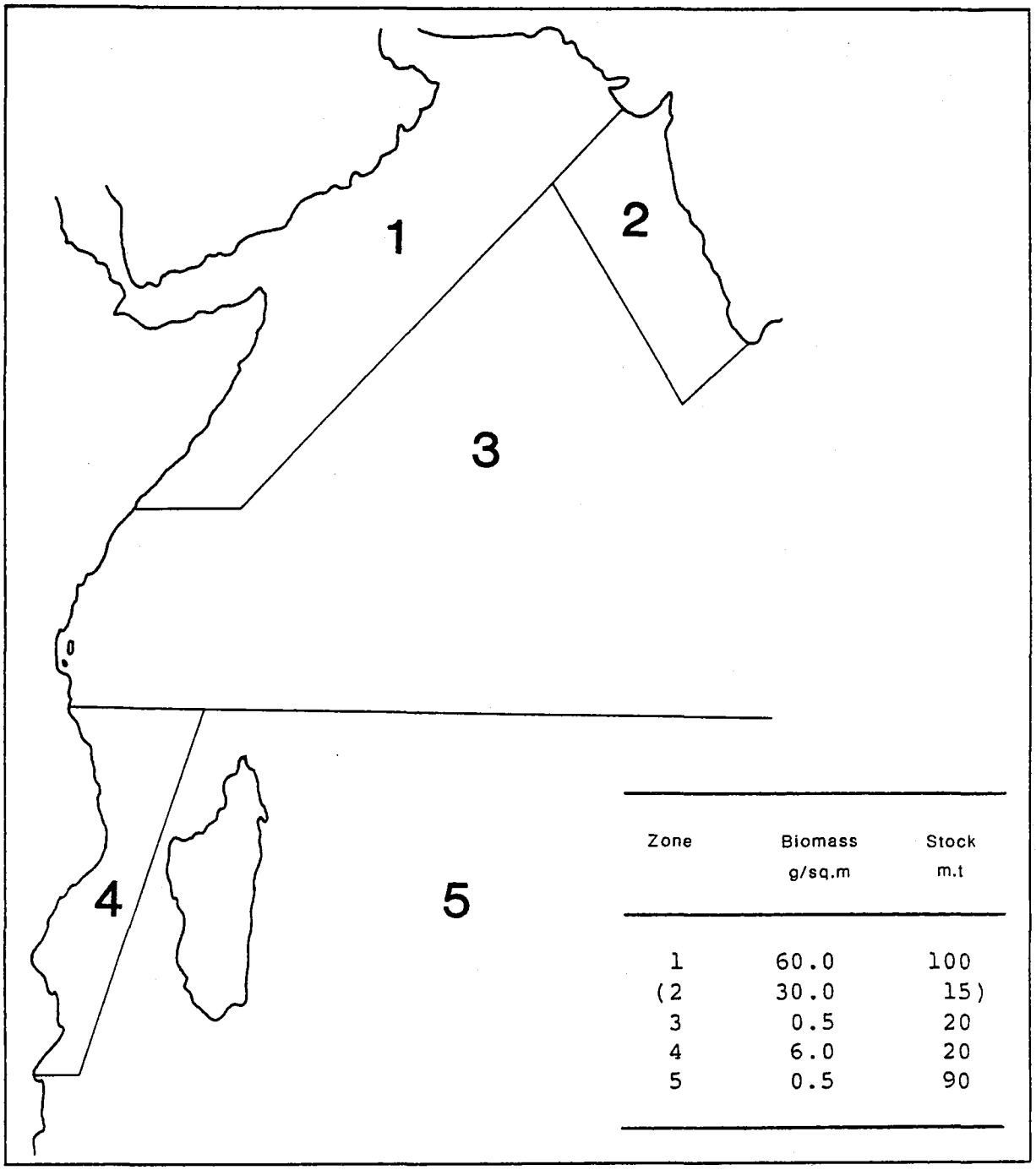
SOM = Somalia
KEN = Kenya
TAN = United Republic of Tanzania
MOZ = Mozambique
MAD = Madagascar
FRA = France (La Réunion)
MAU = Mauritius
COM = Comoros
SEY = Seychelles

P = principal reason for protection/good representative example
s = protected incidentally and of secondary interest/not necessarily good sample
x = occurs but not protected
- = does not occur
? = occurrence probable but not confirmed

Table 6 - Area of Shelf off the Mainland and Island Countries of the Eastern African Region and their Trawl Potentials
(extracted from FAO/IOP, 1979)

Country	Total Shelf Area (sq km)	Trawlable Area (sq km)	Coral (sq km)	Trawl Surveys (4) Biomas Density (t/sq km)
Somalia	n.a.	n.a.	n.a.	n.a.
Kenya	19,120	10,994	not indicated	2.12 (4)
Tanzania	18,908	0	over 2,183	1.82
Mozambique	86,090	71,592	2,500	1.33
Madagascar (1)	130,000 (2)			1.21
Comoros	900 (2)	0		
Mauritius + banks	117,102	61,625	36,073	
Seychelles (3)	48,334	14,176	20,093	2.08
TOTAL	421,154	158,387	68,859	

(1) from 0 to 400 m depth
(2) from 0 to 400 m
(3) area over 200 m negligible
(4) averages



Zone	Biomass g/sq.m	Stock m.t
1	60.0	100
(2	30.0	15)
3	0.5	20
4	6.0	20
5	0.5	90

Fig.3 Mesopelagic fisheries potential in different zones of the West Indian Ocean (from Gjosaeter and Kawaguchi, 1980)

DEEP SEA

Character and Occurrence.

Depths of over 4,000 m have frequently been recorded especially in areas of submarine canyons such as those found along the Mozambique Channel. As depth increases, a variety of environments occur, although within each stratum conditions are fairly homogeneous in terms of chemical, temperature, light, nutrients, etc.

Targeted Exploitation

Biological productivity is highest in the top 200 m where light permits a high primary productivity. It is however, a transitory habitat for migrators and associated predators, and for species common to the shelf edge. Below 200 m are the mesopelagic and bathypelagic environments down to about 1,000 m and 4,000 m respectively. Here, colder and darker environments are encountered and productivity decreases accordingly.

While fauna in the epipelagic zone is essentially made up of some of the fish associated with the continental shelves and banks, scavengers and predators dominate the deeper waters. Members of families Gonostomatidae, Myctophidae and Bregmacerotidae are well represented.

Substantial concentrations of mesopelagic fish have been found between 200 and 1000 m deep along the East African coast, particularly off the Somalian east coast (see Figure 3). From survey cruises, mean biomass in the latter area varied between 8 and 85 g/m, usually around 20 g/m (Gjosaeter & Kawaguchi, 1980). The highest concentrations were usually observed just off the shelf break. Further south, mean biomass decreases to 0.5 g/m although concentrations of 6 g/m were found in the Mozambique Channel. The dominant species is a mystephid, Benthosema pterotum: no fishery has so far exploited this fish resource.

In some areas notably the Comoros, hand-lining for large demersal fish occurs in deep waters. Perhaps the most significant catch here is for the 'living fossil', the coelocanth. These fish are taken only around the Comoros at at a rate of around 5 per year, largely for scientific use, as the fish is not considered good eating, and resists capture strenuously. The only use the coarse islanders have for the fish seems to be the use of the rough scales to abrade inner tubes prior to puncture repair. Nothing is known of the size of the coelocanth population.

Existing Management Policy/Practice.

In order to prevent the over-exploitation of the coelocanth, a law was passed in 1974 by the Comoros Government which afforded the animal complete protection and prevented it's systematic capture. Nevertheless, exceptions have been made in the case of scientific research and tourist development.

OPEN SOFT BOTTOM HABITATS

Character and Occurrence.

These are areas of extensive sandy flats which are characteristic of areas moderately exposed to strong waves and sedimentation. Sandy bottoms usually occur in clearer waters and are associated with extensive seagrass and algal plains. These are especially important to herbivores, including marine turtles and dugong (Dugong dugon). Duging populations exist in small pockets along the Somalia-Kenya border, in the Mafia channel (Tanzania), Maputo Bay close to Inhaca Island (Mozambique), and near Moheli Island (Comoros).

The granitic islands of the Seychelles have extensive lengths of shoreline without mangrove or reef. On Mahe, much of the west coast is devoid of both coral reef and mangrove, and much of it is sandy and fringed with coconut palms, creepers such as Ipomea and the shrub Scaevola (Taylor, 1968), all of which commonly dominate the sandy beaches and coral atolls as well.

Mauritius has extensive areas of very shallow water (<4 m) which extend from sandy beaches outward for several hundreds of meters around much of the island; this is due to the fact that its fringing reef is located well offshore and this creates a broad lagoon. This lagoon supports a variety of soft substrate habitats, including seagrass beds. Similar conditions appear in Rodriguez (Montaggioni & Faure, 1980). Behind fringing reefs in Reunion there are similar though narrower expanses of shallow, soft substrate.

Seagrass meadows with Cymodocea spp. dominate in sandy areas between coral rock and outcrops.

Human and Economic Value

Open soft bottom habitats are particularly important for coastal fisheries. The habitats serve as feeding and breeding grounds for a variety of locally important fish like Johnius spp., Liza macrolepis, Hilsa kellee, Polydactylus spp., Pomadasys hasta, penaeid shrimps, etc. They present much less difficulty in trawling than rocky substrates or coral reefs. Fish groups common to these soft bottom habitats are shown in Table 7.

Targeted Exploitation.

Both artisanal and industrial fishing activities make use of these habitats. The important shrimp fishing grounds in the region are located along the central and southern Mozambique coasts, western and northwestern Madagascar and the Mafia channel, Tanzania, especially in association with the Rufiji Delta. Exploitation of this habitat is confined to shrimp trawling (see shrimp fisheries).

Incidental Exploitation

Since these areas are foraging areas for marine turtles and dugong as well as dolphins, intensification of fishing activities, either by trawling or by lines, presents an imminent threat to these animals. Although no statistics are available, fishing activities in open soft bottom regions may in part be responsible for the ever-dwindling populations of dugong along

Table 7 - Fish Species Present and Approximate Distribution
(from UNEP Regional Seas Reports and Studies, No. 13)

Estuaries	Penaids
Mangroves	Penaids, mullets, crabs, oysters
Reefs	Lethrinids, scolopsis, scarids, lutjanids, caesio, carangids, panulirus
Coral-free reefs	Rays, sharks, breams, penaids
40 m	Scavengers, snappers, sharks, rays
Coral rubble & rocky bottom	Lutjanids, serranids, sharks, denticids, carangids, caesio, spiny lobsters
Smooth Sea Floor	Mullidae, nemipterus, sauridae, sparids, lutjanids, serranids, lethrinids, sand lobster, portunid crab
More than 100 m	Pristipomoides, carangids, panulirus, scuridae, polysteganus, sparids, epiniephelids, sharks
Deep ocean waters	Tuna, billfish, squids, cuttlefish, sharks, skipjack, dolphin fish, auxis, euthynnus, scomberomorus, acanthocybium, clupeoid, carangids, baraccudas
Mesopelagic/Bathypelagic	Lantern fish, gonostomidae
Others	Include red oceanic swimming crab, mantis shrimp, porcupine fish, dolphins, marine turtles.

East-West Distribution of Major Species

Pelagic	Oil sardine*, lesser sardine^{+}, other clupeoids^{+}, Bombay duck*, half beaks, gar fishes, carangids, flying fish, ribbon fish^{+}, mackeral*, seer, tunny, Indian pellona, leiognathidae
Demersal	Elasmobranchs^{+}, eels, catfish^{+}, tuna, perches, lizard fish, anchovy, red mullet, polynemids, sciaenids^{+}, silver bellies^{+}, lactarius, pomfrets, soles, prawns*, shellfish, cephalopods, crustacea, Pomadasyidae.

* dominant on the west coasts
\+ dominant on the east coasts

the mainland coast especially those north of Malindi (Kenya) and along the Mafia channel and the population in the Comoros.

Shrimp trawlers often take very large amounts of finfish by-catch, which is generally not used (see shrimp fisheries).

Waste Discharge

Although not as widespread a problem as that witnessed by other (e.g. the Mediterranean), development of textile and sugar industries do present reasons for concern in Maputo Bay, Dar-es-Salaam and around Mauritius. The volume of domestic solid and liquid wastes entering the sea is low but locally significant in relation to major coastal towns and cities.

Sedimentation

Large-scale, rural activities in upland areas outside the coastal zone have important effects on marine resources. Perhaps the most obvious effect is the tremendous increase in silt carried by major rivers to the sea. This is the result of soil erosion brought on by poor farming techniques, grazing and deforestation. Deltas have expanded and formerly sandy beaches have become dumping grounds for river sediments. Vast quantities of sediment are being deposited in estuaries and on the continental shelf. This problem is particularly evident around Madagascar due to intensive agricultural activities in the plateau. Coastal erosion has also been noted as an important factor along the Mozambique coast especially around Maputo. In some instances where the sediment load is not excessive the increased sedimentation may be beneficial in replenishing material carried away by tides and currents. Where sedimentation is excessive, the finer particles are deposited on the seagrass beds and cause a reduction in photosynthetic ability.

Huge volumes of sediment reaching the coastal plain and deltas could actually lower the coastal strip through "downpressing", resulting in a rise in the local sea level and extensive coastal erosion; this phenomenon is thought to have occurred already in the Zambezi delta (Tinley, 1971).

Silt on beaches may discourage tourism, as on the Kenyan coastline around Malindi.

Direct/Habitat Destruction

The continuing extraction of beach sand in the Comoros for making cement has severly degraded the quality of beaches and lagoons largely reducing them to mudflats fed by terrigenous sediments from eroded hillsides.

Sand extraction from beaches has occurred at various places in the Seychelles, but has now largely been brought under control through a licensing system; the government actually collects the sand in various areas such as the mouths of rivers and sells it to the licensees.

In Mauritius, sand extraction is fairly regularised and sand is mined from pits shoreward of the immediate coast and the area then recovered and planted. But these supplies cannot continue to meet the demand, and there is now a search offshore for sources of sand - the effects of dredging sand from the seabed could have an equally dramatic effect on the sublittoral

zone as it has had on the shoreline.

Sediments from the Galana River have seriously affected the beaches at Malindi, a major Kenyan tourist centre. Sand and water quality has markedly declined and there has been considerable beach accretion - reportedly as much as 500 meters over the last 10-15 years, with a notable acceleration during the last decade. As a result, fewer tourists visit the area and hotel occupancy has dropped.

Beaches and reefs at Nosy-Mangabe a tourist centre in Madagasacar, have been similarly affected.

Recreation and Tourism.

In the main island of the Seychelles, coastal land is more densely utilised and is also more scarce due to the grantitic character of the island. As a result there is considerably more restraint on its tourist development, which currently earns about two thirds of the Nation's export earnings and employs 7-8,000 people (UNEP, 1982b). On the main granitic islands there are only limited extents of beaches. High quality beaches suitable for intensive tourist development based on an analysis of overall attractiveness, sand quality, 'marine growth' and currents total only 5.6 km on Mahe, 3.5 km on Praslin and 1.7 km on La Digue. Consequently, tourist densities are already high which increases the difficulty of maintaining this desirable resource (UNEP, 1982).

Priority Concerns

The biology and ecology of these habitats has not been sufficiently studied to be able to provide management information. In particular the impact of heavy sediments around Madagascar and the Comoros and that in association with the large rivers of the mainland needs to be studied and monitored.

Priority Recommendations

a) Identification of suitable areas to be set aside as sanctuaries for dugong;

b) Biological and ecological study of the fauna and flora associated with open soft bottom habitats including the impact of sediments and wastes on the functioning of these habitats.

ENCLOSED SOFT BOTTOM HABITATS

Character and Occurrence

Muddy flats are associated with the main rivers and bays protected from strong circulating currents and waves. These are particularly noticeable off the Rufiji and Zambezi Rivers; the numerous rivers feeding into the Bight of Sofala and Maputo Bay in Mozambique; along the northern and western coasts of Madagascar; around Moheli and parts of Anjouan island in the Comoros.

These areas of mud bottoms are rich in dead organic matter and are thus good feeding grounds for prawns. Photosynthetic action is limited however, and coral growth virtually inhibited.

Conservation Status

Protection is afforded only within existing national parks and marine reserves as indicated in Table 5.

Human and Economic Value

These habitats support a wide variety of bottom feeding invertebrates which are fished locally around Madagascar, Comoros, Seychelles, Tanzania, Kenya, Mozambique and La Reunion. The seagrass meadows also provide protection, nursery, breeding and feeding grounds for coral-associated free swimmers such as the young of gobies, blennies, rockhoppers, mullets, barracuda, snappers, lethrinids and siganids. It is also noteworthy that turtle and dugong forage in these habitats.

Targeted Exploitation

Fishing in estuarine waters is largely artisanal. There is a fishery for the anadramous hilsa (Hilsa kelee), notably around Maputo (see demersal fisheries).

Exploitation of bottom feeders (crustaceans, sea cucumbers, etc.), either for food or for the curio trade is particularly noticeable in Madagascar, Mauritius, Comoros and the Seychelles. Crabs and molluscs are collected for subsistence level living in Mozambique. The collection of Beche-de-mer figures significantly in the fisheries statistics of Tanzania and Kenya (FAO, 1978).

Incidental Exploitation

Mainly marine turtles in fishing areas close to nesting beaches and areas frequented during feeding.

Oil Industry

These habitats are vulnerable to pollution from floating oil, particularly at low tides. Vulnerable too because most of the oil receiving and refining installations are located in the vicinity of these habitats. Leakages, accidental or otherwise, find their way into

these habitats and affect either free swimming organisms, for example by forming an oily film on fish gills, or bottom feeders residing in the intertidal zone. The accidental oil leak at the Dar-es-Salaam harbour in 1981 resulted in both fish and invertebrate kills.

Waste Discharge

Practically all the coastal towns empty treated or untreated domestic, municiple and industrial wastes either directly or indirectly into the nearby marine environment. Creeks and mangroves connected with the enclosed soft bottom habitats are especially subject to this abuse as they are claimed for settlements and other developments (WHO/UNEP, 1982; FAO/UNEP, 1982; UNIDO/UNEP, 1982). The poor water circulation in these enclosed habitats means that higher concentrations of chemicals derived from these wastes are introduced; these may include heavy metals. Also, fine sediments associated with the muddy flats have high nutrient absorbtion capacities (Walsh, 1967). Hence the danger of contamination of inshore mudflats from these effluents is high.

Additional input is in the form of agrochemicals which find their way into streams and rivers, and eventually into coastal waters.

Sedimentation.

In addition to inputs from agriculture and development activities on the immediate coast, large loads of sediment are carried down the major rivers which originate deeper inland. The nearshore marine environments around Madagascar are particularly at risk because sediment accumulations have led to the closure of the Majunga harbour. Tulear is equally threatened.

A similar situation has also been noted in the Comoros (Moheli Island). Heavy sedimentation is reported in Maputo Bay, northwards to the Zambezi River delta; down the Rufiji, Wami and Ruvu Rivers; and the Galana River in Kenya, have direct impact on existing closed water bodies. Sedimentation of both soft and hard bottom sediments, including coral and sand beaches due to input from the Galana River has almost ruined tourism in the area.

Salm (1978) reports sedimentation problems around the island of Mahe in the Seychelles. This island, like Grand Comoro, eastern Madagascar, La Reunion and Rodrigues, is steep sloped favouring both natural and man-induced soil erosion.

A decrease in sedimentation caused by, for example, upstream dams may likewise damage estuaries and even lead to the erosion of river deltas. Productive estuaries provide a balance between the different environments of the rivers and the sea; a sudden loss of sediment or change in flow when water is diverted upstream can disrupt the equilibrium and damage the marine life which depends on nutrients from the river.

Direct destruction.

A lack of suitable natural harbours has led to major dredging and reclamation projects, the largest being the creation of a new port area in Victoria, on Mahe, Seychelles.

Trawling activities and prospecting for oil have a destructive effect

on seagrass beds through uprooting and indirectly through increase of suspended materials.

Other impacts.

Major dams are planned or being constructed in Eastern Africa. The Bardera Dam on the Juba River in Somalia is one and additional dams are planned for Kenya, Tanzania and Mozambique. Of the several estuaries in Kenya, probably only those on the Tana and Galana Rivers will be significantly affected by damming. It has been reported that fisheries in the area actually improved after damming of the Tana, nevertheless, the possible effects of these huge hydropower schemes on the coastal and marine environments should be a cause of concern.

Existing Management Policy

No specific policy other than that associated with fisheries and, in countries such as the Seychelles and Mauritius, the extraction of sand. Measures suggested by Salm (1978) with regard to coastal zone management planning and policy sould be implemented in Seychelles waters.

Priority Concerns

Sedimentation and pollution is an even more serious problem than in open soft bottom habitats. The invertebrate fauna is known to accumulate heavy metals rather rapidly. The coastal inhabitants who fish in these waters in countries like the Seychelles, Comoros, Madagascar and to a lesser extent some communities along the mainland coast may in fact be in danger.

Heavy collection of shells in Mauritius, Comoros and Madagascar - as well as Tanzania, may be affecting some species adversely. The extent of the impact on the individual species and associated communities as a result of this form of exploitation, as well as that of collection of invertebrates for food (other than penaeid shrimps), needs to be assessed more thoroughly.

Priority Recommendations

a) In order to protect coastal artisanal fisheries, governments should give serious consideration to:

   (i) formulation of coastal zone management and development policies and plans to mininise marine pollution from wastes and sedimentation;

   (ii) the identification of key fisheries breeding, spawning and nusery grounds and their management as fisheries reserves. This is in addition to national parks and equivalent reserves.

b) Research should give special attention to the impact of sedimentation, the oil industry and wastes on communities and the functioning of soft bottom habitats.

c) The impact of fishing activities, including the collection of invertebrates for food or tourist trade should be studied with priority given to habitats found in the Seychelles, Mauritius, Reunion, Comoros and Madagascar.

MANGROVES

Character and Occurrence.

The mangrove habitat - which is a critical habitat for a wide range of marine organisms as breeding, nursery and feeding grounds particularly for crustaceans - are not as well developed as on the northern and eastern coasts of the Indian Ocean. Locally however, extensive forests and swamps occur on the western coasts of Madagascar, Mozambique, Tanzania and Kenya mainly in relation to the deltas of the main rivers like the Rufiji, Zambezi and Betsiboka (see Figure 1). The approximate area covered by mangrove habitats is just over 5144 sq km (Bliss-Guest, 1983). Associated fauna, some economically valuable, include prawns (Penaeus indicus, P. monodon, P. semisulcatus, and Metapenaeus monoceros); mangrove crab (Scylla serrata; Uca spp.; Chiromantes sp.); oysters (Brachydontes spp., Saccostrea cucullata); and cockles Donax spp. Martosubroto and Naamin (1976) have demonstrated a linear relationship between the area of mangrove and prawn production in Indonesia.

In the granitic Seychelles, several patches of mangrove exist in many of the sheltered embayments, though these are often only small remnants of former large stands which have been destroyed for fuel or for land reclamation for both industry and for human occupation (Taylor, 1968; Stoddart, 1973). On the seaward edges of the islands, Rhizophora and Bruguiera are dominant, behind which Ceriops, Sonneratia, Lumnitzera and Avicennia are found (Taylor, 1968). The Seychelles atolls usually lack mangoves, except for Aldabra Atoll which has relatively large stands fringing the shores of its large and shallow lagoon.

In all three principal islands of the Mascarenes, thin fringes of mangroves line estuaries and very enclosed bays. Rhizophora mucronata and Phragmites mauritianus dominate the flora (Montaggioni & Faure, 1980) with Bruguiera gymnorhiza common in Mauritius (Procter & Salm, 1974). Mangrove reduction especially of Bruguirea has also taken place for the same reasons, although pressures on the coastal zone of these islands is much less than it is in the Seychelles (Procter & Salm, 1974). Mangroves are also abundant in the lagoon of Europa Atoll in the Mozambique Channel (Battistini, 1966). In the Seychelles and Mauritius the mangrove is not heavily exploited for fuel or timber (UNEP, 1982).

The available data on the extent of mangrove coastline, species of mangrove and their uses is shown in Table 8.

Conservation Status

Generally poor, considering the importance of mangrove habitats to marine fisheries. Protection has only been afforded when incidental to the establishment of national parks and equivalent reserves (see Table 8). Where large tracts exist, such as the Rufiji Delta and Lamu Lagoons (Kenya), these are under the jurisdiction of forest departments but only in Kenya does there seem to be an attempt at management of mangrove forests. As a result of over-exploitation of charcoal, the Kenyan government has given blanket protection to mangrove stands, whatever the size of the area (Shuma, 1980; Mung'ala, 1980; AL & WM, 1981).

Table 8 - Importance of Common Mangroves Species, their Distribution and Uses
(from various government-sponsored study reports)

Data for Réunion

al Area in Hectares:	Somalia v. small Kismayu	Kenya 62,027 (46,184 in Lamu)	Tanzania (3,200 in Rufiji Delta)	Mozambique 84,800 (67,000 in Central Delta)	Madagascar 320,700 (McNae 1974)	Comoros v. small	Seychelles v. small	Mauritius v. small	Réunion v,small 12 sq^2 total
zophora mucronata	Possible use for local housing	Timber, fuel, bank for tanning	Timber	Locally for firewood and fuel to sugar factories	Locally for enclosures, firewood and tanning	Hardly exploited	Not exploited	Not exploited	Not exploited
lops tagal		Timber, fuelwood tanning	Timber						
viniana									
quiera gymnorrhiza	Poles	Poles							
ndrica									
enia marina									
fficinalis									
eratia molluccensis									
carpus molluccensis									
granatum									
iera littoralis									

Human value and uses.

The coastal wetlands and flood plains including mangrove habitats are used fairly extensively for cultivation of food crops, especially rice. In near urban centres these have however, been dumping grounds for domestic and industrial wastes including effluents from factories especially in creeks and streams emptying into lagoons and the sea. In some cases these areas are reclaimed for urban and industrial developments.

Mangroves trap sediments from rivers and release their nutrients at a steady pace into nearby waters. These areas can also absorb pollutants from coastal and upland sources. However, mangroves are cut down both legally and illegally, for firewood, charcoal, tannin and lumber. These areas are also cleared to make room for ports or tourist developments e.g. Africana village (Tanzania) (IUCN/UNEP, 1984). Often the result is a dramatic decline in marine populations - especially shrimp (Bliss-Guest, 1983). Areas of mangrove are used for mariculture in Kenya, Tanzania, and Mauritius, and for salt production in Tanzania, Mozambique and the Seychelles - see Table 8 (IUCN/UNEP, 1984).

Targeted Exploitation

The areas of mangrove in most of the countries of this region are small, with the exception of Madagascar. Exploitation is mostly local and at a low level. In Somalia a small area of mangrove is possibly used for local housing and firewood needs. In Kenya, where two thirds of the mangrove area is in Lamu, there is some unquantified use of mangrove for construction timber, for fuel and for tanning, as well as for fish and shellfish fisheries. In Tanzania, about 3200 ha of mangrove forest in the Rufiji delta are exploited for poles and other timber. Some 30,000 scores of poles were exported from the Rufiji Delta in 1980/81; about 2/3 of these were exported outside the country while the rest were sold in Dar-es-Salaam, Mafia and Zanzibar (AL & WM, 1981).

In Mozambique, mangrove wood is exploited locally for firewood and fuel, and there is some additional usage for charcoal and tannins, and for shellfish fisheries. Madagascar has the largest mangrove area, totalling around 330,000 ha which is exploited for firewood and tannin as well as charcoal and timber and other minor products. In Madagascar there has also been some local destruction of mangroves for plantations, salt pans and urban development. The other island states of the region have only very small mangrove areas, and very limited exploitation (Hamilton & Snedaker, 1984; Saenger et al., 1981).

Fishing is also an important form of exploitation of mangrove-associated waters. The Rufiji Delta, for example, provides more than 50% of the prawn catch in Tanzania. Liza macrolepis, Johnius sp., Hilsa kelee and Polydactylus sp. are caught in the delta channels for export mainly to Dar-es-Salaam (AL & WM, 1981).

Although not as well organised from a management point of view, exploitation of the mangrove crab Scylla serrata, and oysters Brachydontes spp. and Saccostrea cucullata for personal use and supply to local markets is significant in the island countries, especially Madagascar and Seychelles (Rabesandratana & Rabesandratana (no date); Chong Seng, 1981). In Kenya, some 29 tonnes of crab and 1 tonne of oyster (a decrease from 4 tonnes in 1975) are reported for 1977 (FAO/IOP, 1979)

Medicinal use of mangroves in Madagascar has been recorded by Rabesandratana & Rabesandratana (no date) who also report the use of mangroves for making cattle enclosures.

Incidental Exploitation.

MacNae (1974) found correlations between the prawn fisheries and mangrove areas of both Mozambique and Madagascar. He noted the dependence of Penaeus monodon and Metapenaeus spp. on mangroves in both of these areas, and also pointed out the importance of mangrove systems in the life cycles of some fish species such as Chanos and Mugil. The destruction of mangroves in Madagascar should also be noted in relation to the conservation of the endemic and vulnerable Madagascar teal (Anas bernieri) which is a mangrove associated species.

Oil Pollution.

The problem of oil spills and other petroleum discharges are particularly acute in the seas off Eastern Africa, because they serve as a major route for supertankers carrying crude oil from the Middle East to Europe and the Americas. Tankers returning to load oil in the Middle East routinely discharge large quantities of oil during operations.

Vessels and refineries routinely discharge and occasionally spill oil into harbours, which has both immediate and long term effects on the marine fauna and flora. For example, recent spills in Dar-es-Salaam and Matola have destroyed several hundred hectares of mangrove (IMO/UNEP, 1982).

Rutzler and Sterrer (1970) reported that an oil spill on the Panama coast killed Rhizophora seedlings and algal mats, an important species of the Eastern African mangrove habitats, while experiments carried out by Mathias (1976) using diesel oil on Avicennia intermedia revealed that concentrations of 10,000 ppm and above also killed seedlings. This may be happening in the mangrove habitats of the Eastern African region, particularly along the mainland coast since most surface currents are westerly.

Waste Discharge

Mangrove habitats are amongst the most immediate recipients of domestic, municipal and industrial wastes as well as of agrochemical residues. As noted earlier the fine sediments od associated mud bottoms have high absorbtion capacitie for nutrients such as nitrates and phosphates (Walsh, 1967). Concentrations of organically derived substances in these habitats can lead to very high biochemical oxygen demand (BOD) (see Table 2) consequently burrowing and mud feeding fauna are directly affected.

In Dar-es-Salaam, deprivation of oxygen due to industrial effluents has led to the development of anaerobic conditions and to the production of large quantities of sulphide in the mangroves of the Msimbazi creek (UN/UNESCO/UNEP, 1982; FAO/UNEP, 1982).

Maputo is a busy port and many industries are also based here. Wastes form the city and port drain directly into the sea as do effluents from cotton and textile factories. The ports handle hydrocarbons, minerals and general cargo. A new method of loading has led to high values of iron and

copper. In the new sedimentation process the supernatant, which is rich in iron (111.4 mg/l), copper (8.2 mg/l) and other heavy metals such as lead and nickel is dumped straight into the sea (UN/UNESCO/UNEP, 1982). Some of these are absorbed by mud in the bay and fringing mangrove habitats. Contamination of mud feeding fauna as well as penaeid shrimps is inevitable.

Sedimentation

The heavy sedimentation on the west coast of Madagascar may be leading to accelerated succession in mangrove swamps with a likely negative impact on the prawn fisheries.

In this connection care is needed with regard to the impact of water impoundments (e.g. in the Zambezi, Rufiji and Tana Rivers).

Direct Destruction.

This arises primarily from reclamation for the expansion of coastal towns, and the siting of manufacturing and other industrial factilities. Siting of tourist facilities such as hotels and access routes have also led to the reclamation of mangrove stands including those in creeks and small estuaries. In the case of islands such as the Seychelles and Mauritius which are very limited in space, such reclamations are sometimes unavoidable.

Upstream dams affect mangrove swamps by reducing the amount of water and sediment reaching them. Siltation from the rivers degrades protective reefs and exposes the shore to increased erosion, inflicting further damage on the mangroves.

Elsewhere it is more a lack of appreciation of the ecological value of these habitats and poor planning.

Other Impacts.

Many of the major rivers are under hydo development projects. These will affect the freshwater input regimes into the estuaries and deltas associated with them, including the suspended organic matter so vital to prawn productivity. Salt water is presently ascending some 80 kms up the Zambezi River primarily due to the Cabora Bassa dam. The proposed Steigler's Gorge dam on the Rufiji River will lead to a similar result and, in addition, to a possible loss of mangrove forest there due to erosion by sea and change in the chemical nature of ground water.

Existing Management Policy

This is generally covered under forestry legislation in Kenya, Tanzania, Mozambique and Madagascar, but the policies consider mainly those areas with potential for wood production (timber and poles). In Kenya, however, protection has been extended to all mangroves.

Existing Management Practice

In Kenya, the exploitation of mangrove for timber and poles is supervised by the Forest Department. The department is experimenting with

intensive management of the Lamu forest, including regeneration. This is probably the only known example in the region aimed at scientific management of mangrove forests.

In Tanzania, the only significant forest tract is that associated with the Rufiji Delta although other, not so negligable stands exist around Tanga. Again the Forest Department controls the exploitation of these although, appartently not to the same degree as in Kenya. AL & WM (1981), who evaluated the Rufiji Delta forest for the first time, recommended that a similar inventory should be undertaken for the Wami and Pagani River mouths as well as for those in Tanga.

The Madagascar mangrove forests are not being exploited for timber or poles on a commercial scale. As such there is no management nor even control of encroachment by agriculture.

Priority Concerns

Amongst the priority concerns must be the level of wastes discharged into mangrove habitats or nearby waters, including contaminants carried down rivers. This is of particular concern in large centres of population such as Mombasa, Dar-es-Salaam and Maputo where fish products constitute the main source of protein. Elsewhere health hazards are presented by the ad hoc emptying of untreated sewage into mangroves. People bathe in these waters and therfore run the risk of contracting disease through contact with harmful viruses and bacteria.

Reclamation of mangrove habitats is generally very localised but could be significant in the island countries where the mangrove area is limited. Agricultural activities especially in Madagascar, could eventually lead to large scale schemes with adverse consequences on mangrove habitats such as a decrease in area and increased levels of agrochemical residues.

Existing policies and management practices aim more at the utilisation of forest products than on the value of mangrove habitats to the developing artisanal and large scale commercial fisheries. With the probable exception of Kenya, the Seychelles and Mauritius, countries of the Eastern Africa region need to concentrate their policies in this direction.

Priority Recommendations

a) Mangrove habitats are of national and regional importance. The governments of the region should consider:

   i) reviewing policies and management practices affecting these habitats. Special attention should be given to their protection from pollution and encroachment from both marine and inland processes, especially from agriculture and reclamation activities;

   ii) giving protected status, as national parks and equivalent reserves or carefully managed forest reserves.

b) Scientific studies need to be undertaken focussing on:

   i) evaluation of the status, and extent of mangrove habitats;

   ii) functioning of the mangrove habitats and the impact of pollution and sediments on these.

SEAGRASSES.

Character and Occurrence.

One of the most comprehensive accounts of seagrasses in the Eastern African region comes from Aleem (1984). Nine seagrasses have been identified from the region and their distributions are recorded by Aleem (1984). Seven of these are common throughout the region but the distribution of Enhalus acoroides and Halophila stipulacea seems to be sporadic.

In the Seychelles, six species contribute to the occasionally dense beds. These are: Thalassia hemprichii, Syringodium isoetifolium, Cymodocea rotundata, Halophila ovata and Enhalus acoroides from the granitic islands. Also, C. ciliata occurs in Platte and Coetivy where it forms beds down to 40 m deep (Taylor, 1968). In Aldabra, seagrasses are important in the lagoon (Aleem, 1984), but are less so in the Amirantes and Farquhar Islands (Aleem, 1984).

The most important communities encountered by Aleem (1984) were a Halodule uninervis community; a Halodule - Thalassia **or** Thalassia - Cymodocea serrulata community; a Thalassia - Syringodium community; a Thalassia hemprichii community, and finally a Cymodocea ciliata community.

Thalassia and Cymodocea ciliata grow in deeper water, which in the latter case grow as deep as 40 m.

Halodule is the main pioneer species, colonising new areas of seabed, or recolonising those areas which may have been destroyed using inappropriate fishing techniques.

The main environmental factors influencing the zonation of these seagrasses are substrate type, water depth, exposure to waves and current, and tidal range. They grow where water temperatures range between 26 - 30 ^{o}C, but in littoral pools they may have to withstand temperatures of up to 38$_{o}$C for short periods.

The substrates in which these seagrasses grow range from fine sand and silt to coarse sand mixed with coral debris. Thalassia seems to be the only species which can effectively tolerate anoxic sediments, although Halodule and Syringodium can tolerate some lowering of sediment oxygen content.

Average standing stock of the main communities indicated that the least productive communities were Halophila ovalis, and the most productive communities were Cymodocea ciliata. The productivities of the other communities falls between these two extremes. There was some evidence that seagrass biomass increased from LWS to the infralittoral.

Conservation Status

Seagrass beds are not protected per se, but some degree of protection is afforded in existing national parks and equivalent reserves and in areas remote from immediate human settlements (although not by law).

Recognition needs to be given to the importance of the habitat to dugongs (Dugong dugon) and the urgency of setting aside special reserves such as that suggested by Ray (1968), south of Kilwa in Tanzania.

Human and Economic Value

Aleem (1984) makes no comment on the economic or human value of these grass beds, nor does he state whether they are under any threat due to mismanagement. However, as nursery, breeding and feeding grounds the habitat contributes to the fisheries productivity of coastal waters, particularly as nurseries for lethrinids, lutjanids, siganids and scarids and feeding grounds for the adults of these species, and even the spiny lobsters, Panulirus versicolor and P. ornatus.

Algae are associated with seagrasses. In Tanzania the brown algae Sargassum and Turbinaria and the red algae Eucheuma, Hypnea and Gracilaria are actively being exploited and Eucheuma is utilised in Zanzibar, Pemba and Mafia. In Kenya, particularly in Lamu, the brown algae (Cystoseira, Turbinaria and Sargassum), the green algae (Ulva) and the red algae (Hypnea) are used as bait. The leaves of the seagrass Enhalus acoroides are used for weaving mats and the rhizomes are used as food (Ruwa, 1981). Madagascar has also been exploiting seagrass and algae for local use and for exports.

Targeted Exploitation.

In 1971 Tanzania harvested some 135 tonnes of seagrass, exploitation rose to 204 tonnes in 1974 and declined dramatically in 1975 to 50 tonnes (FAO, 1979). This was for export rather than local consumption. No recent data are immediately available.

Inshore seagrass beds support artisanal fisheries although trawling is hazardous. The beds provide a good camoflage for traps and baskets and are used fairly extensively by individual fishermen for example in the Seychelles (Salm, 1978).

Incidental Exploitation.

Dugongs and green turtles feed primarily in seagrass beds, and accidental capture of both these species occurs at an unknown level. Dugongs in particular are threatened by incidental and possibly deliberate capture throughout this area.

Waste Discharge

Most sewage outfalls e.g. in Dar-es-Salaam, Mombasa and Port Louis in Mauritius empty some distance from the beach in lagoonal areas with seagrass beds. Otherwise, contamination arises as water circulates from the creeks and estuaries.

Sedimentation

This is serious around Madagascar and in relation to large rivers along the mainland coast. Turbidity induced by suspended sediment and the settling of fine particles on leaves and stems impairs photosynthesis and the growth of seagrasses and algal communities.

Direct Destruction

Mainly in relation to fishing and, very locally, during oil exploration

activities.

Recreation and Tourisms

Only those areas located close to tourist resorts and/or within protected areas are affected.

Existing Management Policy

There is no existing management policy.

Existing Management Practices

Essentially none on seagrasses per se. Reported commercial harvesting is based on exploitation rather than on sound management practices. Seagrass beds located within national parks and equivalent reserves are fully protected from physical destruction but not from pollutants and sedimentation whose origins are beyond the control of the park officials.

Priority Concerns

While seagrass beds evoke no urgent concern beyond that posed by sedimentation, the use of these habitats by dugong and marine turtles - all species considered threatened and/or endangered - call for special measures. On the one hand there is regulation of fishing intensity and methods and on the other the avoidance of areas known to have populations of dugong (Malindi to the southern Somali coast; off Kilawa) and probable populations in other localities (Mafia Channel south to the Mozambique border; Maputo Bay close to Inhaca Island and around Moheli Island in the Comoros).

Priority Recommendations

a) In relation to priority concerns a survey should be carried out to locate prime dugong habitats. These should be brought under immediate protection.

b) Studies initiated by Aleem (1984) should now be expanded to include the impacts of sedimentation and chemical pollution, and both local and commercial exploitation of seagrasses and associated algae.

c) Recognising their value to both commercial and endangered species, careful environmental and economic impact studies should be undertaken before seagrass areas are considered for sacrifice in the face of other developmental activities.

ROCKY SUBSTRATES AND SHORES

Character and Occurrence

Rocky shores and cliffed shores occur in the coastal zones of all the countries in the Eastern African region, although data to their extent is not yet available (IUCN/UNEP, 1984).

On the northern and eastern sides of Reunion there are rocky shores. These sublittoral rocks support corals and algae, but no reef development.

Rocky shores in southern Mozambique, western Madagascar, Mauritius and Seychelles are an important tourist resource.

Conservation Status

Shores within national parks and equivalent reserves are automatically protected from activities other than recreation. Protected areas are in the Seychelles, Mauritius and Mozambique. Cliffed shores are protected in Madagascar and Mauritius but this is incidental to other conservation activities.

Most of the sea bird rookeries in Seychelles, Mauritius and Nosy Mangabe in Madagascar are protected. Elsewhere these are either too remote or in dangerous localities such as cliffs. Therefore, they enjoy indirect protection.

The tendency in the establishment of marine parks and reserves has been to ignore the relevence of the immediate land habitats, at least with respect to the mainland countries.

Human and Economic Value.

Rocky shores have some value as tourist attractions e.g. Mauritius and the Seychelles.

In Kenya and Mauritius, this type of habitat is used for both urban and industrial development, and in Tanzania the cliffed shores are extracted and used for lime production and building (IUCN/UNEP, 1984).

Collection of guano as fertilizer has been reported from the Seychelles (Salm, 1978), although its export, particularly to Mauritius may have ceased.

Sea bird eggs are also collected from the Desnoeufs Island, Seychelles. In 1970, 1,600 cases containing 700 eggs each were landed in Mahe for sale (Procter, 1970).

Targeted Exploitation

Most offshore banks have rough, untrawlable bottoms, and are exploited mainly by hand-lines. In the Seychelles, there has been a steadily growing export trade in demersal fish. A fleet of wooden sailing schooners make trips of up to 12 days to offshore fishing grounds (Anon., 1979b). The main species groups exploited by this fishery are Lutjanus spp. Epinephalus

spp., Lethrinus sp. and Aprien sp.

The commercial bank fisheries in Mauritius, mainly on St Brandon, Nazareth and Saya de Malha banks, appear to be heavily exploiting demersal resources.

Incidental Exploitation

Latham Island off Dar-es-Salaam has been used for the installation of oil and gas prospection rigs and associated facilities. This is a very important seabird rookery (IUCN/UNEP, 1982), and green turtle nesting area.

Oil Pollution

Although no specific studies have taken place, oil and tar ball pollution which affects the other coastal habitats almost certainly affect patches of rocky and cliffed shore.

Recreation and Tourism

This is particularly important to the island countries - Seychelles and Mauritius - where tourism is a major foreign earner.

Existing Management Policy

Generally under land use or settlement policies as well as policies aimed at promoting tourism and nature conservation. With regard to the extraction of building and construction materials, policies falling under mining also apply in some countries e.g. Tanzania.

Existing Management Practices

Those under protection as national parks and reserves have full protection from physical developments. Use for recreation and tourism is also controlled by the responsible agency, normally a national park or wildlife conservation authority. Only Seychelles seems to have nade noteworthy steps in protecting beaches for recreation and turtle nesting and seabird rookeries. Mauritius has also made steps in this direction, although surveillance is wanting on such important reserves as Round Island.

Priority Concerns

A major concern is pollution both from oil and waste products. The latter could be more easily managed since it is of local origin. The former would require both local controls (at receiving harbours, wastes from garages etc.) and international co-operation. Such co-operation as anticipated under the regional convention, protocols and plan of action for the Eastern African region is only one of the key steps. Shipping companies must also be encouraged to co-operate.

Priority Recommendations

a) The governments of the region should make every effort with regard to rapidly concluding the proposed convention and accompanying protocols, followed with strengthening of measures against oil pollution.

b) Development of tourism and the siting of fishing operations should take into account the nesting requirements of marine turtles.

CORAL REEFS

Character.

Coral reefs are amongst the most important habitats of the Eastern African region, even though their diversity and general abundance is not so great as in other parts of the Indian Ocean e.g. the Philippines and Indonesia.

Fringing reefs are the main characteristic reef formation on mainland East Africa. The narrowness of the continental shelf (see fig 2.) means that all the coral reefs of the region are close to land, and are therefore strongly subject to terrestrial influences of both natural and human origin and are particularly vulnerable to changes in land use and coastal development.

The island groups of the region display a wider variety of reef formations with some outstanding examples of atoll formations e.g. Aldabra, and some well formed barrier reefs e.g. Tulear (Madagascar) and Mayotte (Comoros).

Occurrence and Extent.

Many parts of both the larger and smaller granitic islands of the Seychelles have no coral reef. Mahe and some of its closely adjacent smaller islands have been studied by Taylor (1968), Braithwaite (1971) and Rosen (1971); they show that extensive parts of the west coast have no fringing reefs. The fringing reefs of the remainder of the islands (Frazier & Polunin, 1973; Salm, 1977) have characteristic dead patches, where large expanses of broken coral are found on gently sloping sublittoral areas. By contrast, on the northern edge of the granitic Seychelles the two coral islands of Bird and Denis are reputed to have spectacular reefs. A cluster of other coral islands and atolls lie to the southeast of the Seychelles Bank lie. For the mostpart little is known about these reefs, although the most westerly group, the Aldabras, are of international repute.

Reefs of the Mascarenes diminish from east to west. Rodriguez and Mauritius have well developed fringing reefs, often located far offshore, while Reunion has fringing reefs only on its southwest coast.

There are three main types of coral reef around Mauritius, descibed by Salm (1976) as periferal fringing reefs; sheltered fringing reefs; and lagoonal coral patches. All three types generally have a rich and dense coral fauna. In addition, Fauvre (1977) desribes a barrier reef at Mahebourg. This is 400-600 m. wide and 9 km. long, lying some 3-5 km. offshore.

Europa and Bassas de India (in the Mozambique Channel) and Tromelin (in the Mascarene Basin) are atolls or low islands but little research has been done on their reefs. Those of Tromelin and Europa appear to be in good condition while those of Bassas de India have a high proportion of dead coral (Battistini, 1966; Cousteau, 1971).

There are finging reefs around the three northern islands of the Comoros group, while Mayotte has a substantial barrier reef which lies between 3-5 km. offshore and extends for some 140 km. It is broken by at least nine passages of navigable depth. The inner barrier is still growing and small lagoons are developing. Fringing reefs are occasionally found adjoining the island (Guilcher, 1965).

The reefs of Madagascar are extensive and numerous, and include good examples of almost all the main classical reef types, some of which have been well studied. Most information is taken from Battistini (1960; 1964), Clausade et al. (1971), Pichon (1978) and UN/UNESCO/UNEP (1982). Reefs of the east coast are least known, however, a chain of shallow lagoons run behind the rudimentary but extensive fringing reefs.

The main reef formations are found on the west coast of Madagascar, (Pichon, 1972) where fringing reefs are well developed along the mainland coast and around the offshore islands. Reefs in the southwest sector are the best known. Fringing reefs, barrier reefs and reefs with sand cays are all represented together with intermediate types (Clausade et al., 1971; Pichon, 1972; 1978). A series of barrier reefs and fringing reefs of particular importance are found in southwest Madagascar near Tulear.

Little detailed information exists on the reefs of Mozambique and little is known about their biological nature or condition. However, the continental shelf along much of the coastline is very narrow, and coral formations are only found fairly near the coast, extending discontinuously from the northern border south to Inhaca Island.

The narrow continental shelf continues to Tanzania, and reefs here are also restricted to close inshore, this pattern is reflected off much of East Africa (Hamilton & Brakel, 1984). Fringing reefs do occur along most of the coastline, and are broken only by large river outflows. These reefs are most extensive where the continental shelf broadens around islands such as Zanzibar and Mafia (Bwathondi, 1980). Patch reefs, often extensions of fringing reefs, arise from the sea floor on most parts of the shelf away from river mouths. A similar situation is found in Kenya.

Most of the Somali coast has either no coral reefs or only very weak reef development due mainly to the seasonal cool water upwelling (Hamilton & Brakel, 1984). A report by Scheer (1971) suggests that corals are preset but not especially abundant around Socotra, where the sublittoral is dominated by macroalgae. On the mainland coasts seagrasses are important, and corals are limited to sparse patches amongst the seagrasses, some patch reefs are noted in the Mogadishu area (Carbone & Matteucci, 1984).

Conservational Status.

In general, the conservational status of reefs in the area is good, and most countries have protected areas of reef.

Kenya. There are now four marine parks and reserves, covering a total area of approximately 50,000 ha. Some are not designated specifically for the protection of coral reefs, for example the main function of the

Kiunga Marine National Reserve (situated in the north, close to the Somali border) is to safeguard important concentrations of birds on the offshore islands but it also includes reefs which are unspoiled (Brakel, 1979; Pertet, 1982).

Tanzania. At present, no coral reefs are protected, although some are proposed (see IUCN/UNEP, 1984).

Mozambique. Some of the coastal and marine protected areas include significant reef systems (IUCN/UNEP, 1984). In the central region, Bazaruto National Park includes reefs, as does Inhaca Island Marine Reserve, which includes the most southerly reefs of the African mainland. These reserves cover an area of over 8,000 ha.

Madagascar. There is no legislation to protect reefs (Salm, 1983).

Seychelles. Several areas of the main island of Mahe and the adjacent smaller granitic islands have been declared as marine protected areas. These are: Saint Anne Marine National Park (1,423 ha.); Port Launay Marine National Park (158 ha.); Baie Ternay Marine National Park (80 ha.) and Curieuse Marine National Park (1,370 ha.). In addition Cousin Island is a nature reserve managed by the ICPB, with a resultant benefit to reefs as well. There are also four areas where mollusc collection is prohibited, (Sheppard, in prep). Aldabra atoll is a strict nature reserve and a World Heritage Site.

Mauritius. Emphasis with regard to conservation is focussed largely on terrestrial concerns. The "Wildlife Research and Conservation Programme" is currently in hand, the first phase of which: Phase I, 1984-1985, Initiation and Integration, involves a number of policies and practical activities. These include development of logistical frameworks for effective conservation measures, development of legal aspects, tourism and education, and the start of some habitat and species improvement and rescue schemes. In this phase there is no direct reef related project. Several coastal areas of Mauitius have recently been surveyed and recommended for protected status. In some cases, notably small islands, the terrestrial areas are already protected, but this does not extend to the reefs. Areas cited by Salm (1983) as proposed marine protected areas with coral reefs are:- Blue Bay /Le Chaland; Flat island / Gabriel reef complex; Baie de Arsenal / Pte aux Cannoniers; Round Island Nature Reserve; and Coin de Mire Nature Reserve. In the last two, the recommendation is for a seaward extension of the protected area to 20 m. deep. In addition to these nearly twenty other coastal sites have been proposed for protected status (UNEP, 1982b) including some smaller islands, though not all of these include reefs. Some were recommended by Scott (1973) and Robertson (1974), and are also tabulated in Procter and Salm (1974). The Ministry of Agriculture, Natural Resources and the Environment is responsible for the administration of the Crown Lands in Mauritius and, via its executive arm in the Forestry Service, manages the terrestrial nature reserves. In addition, the Ancient Monuments Board recommends areas for the creation of nature reserves to the Minister for Education.

Reunion. Reunion and its dependency Rodriguez appear to have no protected coral reefs, although laws such as the prohibition of mollusc collection give some protection. Europa is an important breeding ground for Green turtles and for their protection has been declared a reserve with apparently satisfactory control (IUCN/UNEP, 1984).

Human and Economic Value.

Food Reefs are of major economic value as a source of food both to artisanal fishermen and to commercial outlets. Over-exploitation has occured, for example in Mauritius where a 50% decline in fish catches from reef areas has been recorded over the last 30 years despite an increase in effort (Procter & Salm, 1974). The use of dynamiting and poisons for fishing are a significant cause of reef destruction.

In Madagascar, food is collected from the reefs by women and children in periods when other animal protein is scarce. Over 30 mollusc species are exploited for food, as are several species of spiny lobster (Panulirus); green mud crabs (Scylla serrata); echinoids (Tripneustes gratilla) which are all for local consumption, and the holothurians (Holothuria scabra and H. tubulosa) which are exported to Asian countries (Sheppard, in prep).

Tourism Several reefs in many countries are considered important to the developing tourist industry. Major tourist centres are in Kenya, Tanzania and the Seychelles, although in some areas damage to the reef by visitors has markedly reduced their value in all respects.

Barriers Reefs are regarded as important barriers, protecting water, communications and transport.

Curios In Madagascar currency is also obtained from the collection of bivalve molluscs Maleaguina margaritifera and the gastropods Turbo marmoratus and T. imperiales which are exported to Europe for button manufacture, and Cypraeacassis rufa which is sold to Italy for cameo. M. margaritifera is now locally extinct (Sheppard, in prep.).

Building materials In common with many other areas of the world, coral and coral sand are taken for building and for lime (Walker, 1962). As a result of mining, few beaches in the Comoros remain intact, and coral formations in Tulear (Madagascar) have been seriously affected (IUCN/UNEP, 1982).

Guano Guano mining is common in Mauritius and has an obviously deleterious effect on such small islands (Sheppard, in prep).

Targeted Exploitation.

Most of the coral reefs in this region are found very close to the shoreline, and are therefore accessible to fishermen even with redimentary vessels and gears. Exploitation of reef fishes is mostly done by lines and traps.

The table below lists fishing efforts and catches from some regions of Eastern Africa (from Gulland, 1979).

Area	Current Catch (t/km)	Catch-per-unit-Effort (kg/trap/sct)	Fishery Intensity (trap/scts /km /yr)
Mauritius	3.5	1.0 - 1.5	2800
Kenya (north)	4.9	-	-
Kenya (south)	5.6	-	-
Tanzania (north)	4.7	2.4 - 4.5	1400
Tanzania (south)	4.8	-	-
Mahe (east coast)	1.4	5.4	260
Mahe (west coast)	3.1	5.1	620

Calculation of maximum yield from coral reefs based on these figures suggest a value of 5 tons/km. The east coast of Mahe is thus lightly exploited, and Mauritius very heavily exploited.

Both Kenya and Tanzania are reported to have exported 1 tonne of coral in 1978 (Wells 1981). Exact statistics on local exploitation and sale of corals to tourists are unavailable, but this trade represents a risk to many coral reef zones in tourist areas.

In Mauritius at least 8 species of coral reef fish are exploited for the aquarium trade and are now rare or extremely rare. Their exploitation is controlled by an export permit system. In addition sea horses and porcupine fish are sold to tourists as curios. The effect that this exploitation has on the latter two groups is unknown. (IUCN unpubl. data).

Turtles are exploited in some parts of the region (see section on Turtles)

Incidental Exploitation.

Ray (1969) points out that several methods of fishing are destructive and sub-optimal. They result in the deaths of dugong, turtles and small reef fish whose capture is not intended. Dynamiting causes significant death of the smaller reef species and in the case of dugong and turtles present populations are clearly much lower than in the recent past. The dugong is now extinct from Mauritius, and turtles are occasionally seen but no longer nest on the island.

Oil Industry.

The western Indian Ocean is a major transit route for tankers carrying crude oil from the Arabian Peninsula and which use the Cape route (see figure 4), some of the tankers do however, deliver crude or processed oil to the countries of the region. The crude oil is processed for internal requirements and re-export, or re-exported crude to neighbouring countries (see Table 7).

Along with the above, practically all the countries are actively searching for oil and gas along the coastal plain and continental shelf and banks, with external assistance. Some of these countries e.g. Tanzania and Mozambique, have already discovered gas deposits. Figure 5, shows areas now under exploration as well as the location of refineries in the region.

A number of problems emerge. The transit tankers as well as those delivering crude or refined oil to the countries of the region often deballast in the open sea. The oil so released has found its way to the coastline where, like on Comoros, Kenya and Mauritius, this forms into balls or is deposited on beaches, severely affecting the tourist activities of the region. At the same time deposition on coral and other habitats such as mangroves directly affects the productivity of these habitats; free swimmers and sea birds are also affected.

Since ocean currents flow mainly towards the mainland, and around both Comoros and Madagascar, the risk of oil pollution is increased in these areas as compared to the Seychelles and Mauritius which are not as exposed to the tanker routes (see Fig). Nevertheless reefs around Victoria Port (Mahe) and Port Louis (Mauritius) are very vulnerable to major spills or accidents at receiving and distributing facilities.

Oil spills have been recorded at receiving/loading facilities on the mainland. In 1981, Dar-es-Salaam harbour witnessed a major spill and a wide range of marine life was severely affected. The discovery of a new oil field also presents certain oil spill dangers. It is evident therefore that rigorous preventative measures are undertaken at the harbours, depots, and in order to prevent tanker owners deballasting at sea. The IMO and the Eastern African harbours association are activly trying to find solutions to this problem and it is one of the major action points to be identified in the Eastern Africa region plan of action.

Waste Discharge.

Industrial development is principally argriculturally based. In Mauritius where sugar cane plantations cover a large part of the island a particularly high BOD load (4,600 lbs) is caused by wastes from some 20 mills which are allowed to flow directly into streams finally ending in the sea. This is not uncommon with regard to other countries producing sugar cane, such as Reunion, Madagascar, Mozambique, Tanzania and Kenya (UNIDO/UNEP, 1982). In the case of Mauritius, heavy mortality of fish and invertebrates has been observed. Textile mills, plastic industries and breweries sited in coastal towns are also known to allow untreated effluents into streams and creeks. The Msimbazi creek in Dar-es-Salaam is receiving dyes and chemicals used in the textile factory upstream. A similar situation occurs with a textile factory in Maputo (Mozambique).

In addition to sewage, solid wastes, oil from garages and other related sources finds its way into lagoons and creeks. In some of the major urban centres sewage treatment facilities have been installed. In many cases

solid wastes are used as material for reclamation of sites for construction (e.g. fills). Leachate from these dumps finds its way into the nearby marine ecosystem and the associated metals are accumulated by various organisms in the food chain. This can have significant consequences considering that the local inhabitants eat a wide variety of invertebrates and fish found on these shores. Thus while negligable in terms of area of the sea involved, locally, this is an important problem. Estimates of discharge from domestic sewage is shown in Table 2.

In Tanzania, sewage is of minor importance compared to direct reef destruction (UNEP, 1982b).

Sedimentation.

Corals are known to be particularly sensitive to increases in sedimentation. Materials suspended in the water are also detrimental since they cut down light penetration, reducing the photosynthesis capabilities of the symbiotic zooxanthellae and ultimately affecting coral growth. Throughout the Eastern African region a common cause of reef deterioration comes from destructive agricultural practices, which increase sediment loading in the coastal region.

Large scale sedimentation from rivers caused by deforestation projects have led to serious problems in the Comoros, where damaging siltation of lagoons and reefs is lowering fishery productivity (World Bank, 1979). In northern Madagascar, river deltas have expanded and sediments deposited on beaches and reefs, have changed lagoonal current patterns. This has potentially adverse effects on the fisheries. In response to the decrease in fishing in the lagoons, fishing efforts are increasing on some of the reefs.

Agricultural development in the granitic islands of the Seychelles has proved to be difficult due to unsuitable terrain UN/UNESCO/UNEP, 1982) and the hillsides in several areas are scarred as a result of terracing and removal of tree cover, as a result sedimentation has affected the coral reefs. This comes partly from some increased erosion from the land, but more particularly from dredging activities for land fill.

In general this loss of coral reefs results in coastal erosion, especially in areas subject to the forces of the open sea or to severe storms.

In addition to direct inputs from rivers and erosion of the coast, dredging, filling and mining of coral limestone as well as oil prospecting activities in the coral habitats and on the immediate shores contribute significantly to the sedimentation problem. In Seychelles, for example, direct destruction of coral reef communities due to dredging was reported by Vine (1972). Port expansions such as those that are underway in Mombasa, Tanga, Dar-es-Salaam and Seychelles, or the removal of sediemnt to facilitate ship entry at Tulear and Majunga in Madagascar and at Moheli in Comoros exacerbate the problem of sediementation on the coral reefs in these areas.

Sediments derived from dredging or shoreline activities are not considered to be a major threat in Tanzania (UNEP, 1982b).

Direct/Habitat Destruction.

There are numerous causes of reef destruction in the region, most of which stem from poor fishing practices e.g. dynamiting and poisoning, breakage of coral as a result of inappropriate fishing methods and the taking of certain species for the curio trade. In some parts of the region, the use of limestone for construction purposes is widespread.

The Eastern African region is an area of moderate to heavy fishing activity by the local inhabitants, although the coral growth itself presents certain difficulties. Along the coasts of Kenya, Tanzania and Mauritius, the use of explosives to kill and stun fish is widespread. Ray (1968) estimated that the reefs in Dar-es-Salaam would be almost completely destroyed within a decade from such activity. In the following decade, Bryceson (1978) showed that the continuation of dynamiting had nearly verified Ray's prediction. Productivity was at a stage so low, and the reefs so badly damaged, that fishermen had moved further up and down the Tanzanian coast to continue dynamiting fresh reefs. Bryceson (1978; 1981) notes that although this method has been declared illegal and has been the subject of a press campaign, the practice still continues.

The problem has been exacerbated by the increase in industrial fisheries, this has led to the development of a rift between the Tanzanian artisanal fishermen and the industrial fishermen. The gap continues to widen and under these circumstances, coral reef dynamiting will more than likely persist until measures taken to curb the practice are co-ordinated with plans to develop the artisanal fishing industry (Bryceson, 1978).

The status in Tanzania today appears to be :- "...of the 8 reefs sites recommended as marine parks in 1968, only two have intact reefs; these are Latham and Mafia Islands. The rest have been reduced to rubble by dynamite fishing, including some of the finest reefs in the country near Tanga" (Salm, 1983).

Dynamiting is not a major threat to the reefs in Madagascar (Sheppard, in prep.).

Other destructive fishing methods have also been implicated (Ray, 1968). These include trampling reefs by net fishermen, and siltation of reefs due to inland deforestation (see section, 8.9).

One devastating industrial activity is the direct mining of coral and beach sand for building purposes. The problem is especially severe in the Comoros (and Mauritius) where it is having adverse effects not only on the fishing industry. Inroads into the reef front have destroyed the wave breaking action of the coral, resulting in reclamation of the land by the sea.

As a result few beaches remain on any of the islands of the Comoros group, and UN/UNESCO/UNEP (1982) emphasise that this is a fairly recent development. Coral is extracted from the living reefs offshore, and then burned to recover amorphous limestone. The buring process itself consumes large quantities of indigenous wood. The result of this is that not only have the beaches been largely removed, but that former reef areas have been transformed into mud flats especially in Anjouan. Coastal erosion in Anjouan has reached a degree where it affects coastal roads. The situation is not only serious but appears to be difficult to alleviate, the present crisis situation is expected to deteriorate further (Finn, 1983).

Coral mining has been proposed in the granitic Seychelles for building

purposes (Salm, 1983).

Impacts are also felt from the marine curio trade. In Tanzania over a quarter of a million kilos of corals and shells were exported in 1974 (UNEP, 1982b), such that the reefs which remain around Dar-es-Salaam in particular are becoming seriously depleted.

In Kenya, Ray (1969) noted that the marine resources were becoming depleted at an accelerated rate, spearfishing and the collection of shells and corals were regarded as the principal causes of reef degredation, and these activities have become more serious with the increasing tourist industry.

In Mauritius, coral collecting, mollusc collecting and overfishing are blamed as causes of reef deterioration. The use of small meshed nets (coupled with the use of dynamite), and ineffective policing and controls, appears to be particularly responsible for the decline in reef condition as well as for the loss of fish for consumption.

A further, very important threat to the reefs, and a common cause of deterioration in their condition comes from the destructive agricultural practices in the interior.

Recreation and Tourism.

Coastal tourism is intensive in countries with extensive coral sand and beaches among these are Kenya, Tanzania, Mozambique, Seychelles and Mauritius. Practically all tourists to Seychelles and Mauritius are attracted by the beautiful beaches of these countries. In Kenya about one third or more of the tourist visitors are destined for the coast and in Mozambique almost all of the 291,574 tourist visitors in 1972 were attracted by its beaches. Tourist visitors to the region in 1980 is estimated as shown below (from UN\DIESA 1983):

COMOROS	N.A. -	extensive new project now underway to develop coastal tourism;
REUNION	N.A. -	fairly high;
KENYA	373,000	coastal and inland areas;
MADAGASCAR	13,000	most inland; tourism not developed;
MOZAMBIQUE	N.A. -	mainly coastal; decrease since independence present relation with South Africa may revitalize industry;
SEYCHELLES	72,000	very developed; tourism is the principal foreign exchange earner;
SOMALIA	N.A. -	very little developed;
TANZANIA	175,000	mainly inland national parks; coastal limited to Dar-es-Salaam, Zanzibar and Mafia islands.

In the Seychelles, tourism in which coral reefs and beaches are a central feature is an important industry. Considerable capital expenditure has taken place on Mahe, Praslin and La Digue to improve the infrastructure necessary for tourism, but the more remote islands, including coral islands, have not been affected by this.

In Kenya, the coral reefs in the easily accessible areas, including Malindi/Watuma National Marine Reserve are an important source of revenue for the tourist industry. Partly as a result of this industry, destruction of the reef in several areas has, in the past at least, been severe. Inadvertant trampling of reefs is cited as one important cause of shallow reef sedimentation in the Malindi area, coupled with damage from boats

(Keech et al., 1982). Over-collection of shells and corals also occurs, not only in unprotected areas of the Kenyan coast but also in the National Marine Parks where it is illegal (Anon, 1982).

Other Impacts.

In Mauritius, the reefs receive pressure from several sources which has led to a decline in their condition. In the capital Port Louis, eutrophication is choking some of the nearby reefs (Osore, 1983). As in many other areas, coral and coral sand has been taken for building and for lime and dense concentrations of the crown-of-thorns starfish, Acanthaster planci are also reducing some areas of coral (Sheppard, in prep.).

Overfishing is the attributed cause of a sea urchin plague on the east coast which has resulted in destruction of seagrass beds and of reef areas, as well as causing the silting up of once productive lagoons (Procter & Salm, 1974).

Existing Management Policy/Practice.

There are no management plans or legislative procedure specifically governing reefs in Somalia, Madagascar, Reunion and the Comoros. In other parts of the region legislation exists but is for the mostpart insufficiently enforced. Kenya appears to be the only country with an existing management procedure. For the mostpart coral reefs are given protection under fisheries or wildlife legislation.

The policies of Kenya regarding the legal protection of coral reefs and equally important, in managing them and enforcing that protection, is second to none in the Indian Ocean at the present time.

All national parks and reserves in Kenya are governed by the Wildlife (Conservation and Management) Act of 1976. The general rules and regulations of the terrestrial parks and reserves are therefore enforced in the marine counterparts. In marine national parks the flora and fauna are fully protected. Any disturbance or collection is prohibited (although not always detected), as is the introduction of animals and plants. In the marine national reserves, specified traditional methods of fishing are allowed, but collection of shells and corals is prohibited, as is the collection of fishes by the use of poisons, speargun and dynamite. Both parks and reserves are patrolled by wardens and rangers (Brakel, 1979).

Protected areas in Mozambique fall into six categories and are listed by Tinley et al., (1974). Some of the coastal protected areas include significant reef systems (IUCN/UNEP, 1984). In the central region, Bazaruti National Park includes reefs as does Ilhas da Inhaca a dos Portugueses (Inhaca Island) Marine Reserve, which includes the most southerly reef of the African mainland. Inhaca Island is a Fauna Protected Zone. Other places for which protected status has been recommended are the islands of the Quirimba group which have 'unique' fringing reefs and exceptionally clear water; and Primeira Segundo Islands where there are also very good reefs, and important turtle nesting beaches (Tinley et al., 1974). Nacala-Mossuril is also is also proposed as a marine national park (IUCN/UNEP, 1984) and includes coral reefs. Coral protection comes under the control of the Instituto Investigacao Cientifico de Mocambique, and various Port Captains.

At present Tanzania has no marine or coastal protected areas nor are

any proposed for the future. Recommendations for the establishment and subsequent management of marine parks and reserves are given by Ray (1968). In view of the present rapid deterioration of Tanzanian reefs management planning in this part of the region must represent a high priority.

Salm (1978) lists the various parts of the Seychelles legislation which relates to marine conservation. This covers Acts for the preservation and conservation of turtles, shells and for the banning of spearguns. Included also is the National Parks and Nature Conservancy Act, and the Act covering Aldabra. Several areas of the main island of Mahe and the adjacent smaller granitic islands have been declared as marine protected areas.

In addition, Cousin island is a nature reserve managed by the ICPB, with a resultant benefit for the reefs as well. There are also 4 areas where mollusc collection is prohibited, which also benefits the coral reefs generally. These are: Brulee-Point au Sel; Northeast Point, la Passe-Grosse Roche and Anse Boudin-Pointe Zanguilles.

In Mauritius, while there has been a gradual development of conservation policies on land, marine conservation has been relatively neglected. Partly as a result, overexploitation of the marine reource has occured. This is illustrated by a decline in the catch of fish from reefs by 50% in 30 years despite a six-fold increase in effort (Procter & Salm, 1974).

However, several coastal areas of Mauritius have recently been surveyed and recommended for protected areas (UNEP, 1982b) including some smaller islands, though not all of these include reefs.

Reunion and its dependency Rodriguez appear to have no protected coral reefs.

Priority Concerns.

With such a high proportion of the Region's reefs being completely or partially destroyed, and considering that these reefs have a significant, if largely indirect, bearing on the economies of the member countries, their protection must be a high level priority. Some of the more widespread problems are:-

Sedimentation
Destructive fishing techniques (dynamite, poisoning)
Removal of reef for building and construction
Removal of corals/molluscs for the curio trade
Over-collection of some food species
Pollution (probably localised)

Priority Recommendations.

a) Every effort should be made to encourage both Madagascar and Comoros to:

   i) control, or ban completely, the mining of coral rock;

   ii) establish protected status to all coral formations in their teritories under the auspices of national parks and equivalent reserves;

b) Special assisstance for Tanzania to curb or possibly eliminate the use of dynamite on reefs. The continuation of the programme proposed by Ray (1968) to establish national parks by the government should be encouraged. Opportunities for similar protected areas around Zanzibar, Pemba and Mafia islands should be explored as soon as possible.

c) Secial conservation awareness programmes aimed at all levels of the public and informal training institutions should be designed.

PELAGIC AND DEMERSAL FISHERIES

Character.

In all countries of this region, the marine fisheries are still mainly artisanal, except in the case of shrimp exploitation. The small-scale fishing activities are mostly from non-motorized small boats such as outriggers and planked pirogues, although these are now being increasingly powered with outboard motors.

In Kenya, only 10% of the 2050 artisanal fishing boats are mechanised, and as a result virtually all fishing occurs within the 12-mile limit of territorial waters (Anon, 1979). Trawling operations by medium-sized Kenyan-owned vessels are focussed on the shrimp resources mainly in Ungwana Bay. In the artisanal sector, gillnets are used extensively, as well as beach-seines and bottom-lines in the Lamu archipelago; lines and traps in Ungwana Bay and Malindi-Mambru, bottom lines on the mid-coast down to Chale Port and traps in the south coast archipelago. The regions previously named are the main fishing areas.

Marine fishing activities in Tanzania are concentrated inshore and around the islands of Zanzibar, Pemba and Mafia. Eighty to ninety percent of the marine production comes from artisanal fisheries, which use simple gears such as hooks and lines and cast-nets from non-motorised outrigger canoes (Anon, 1979c). There are some 5-10 m sailing boats equipped with gill-nets and shark nets. A sardine fishery is developing at various points along the coast but mainly at Dar-es-Salaam and Tanga (FAO, 1980a). Three large purse-seiners and some smaller wooden boats using ring-nets, both types with light attraction, are engaged in this fishery. Four fishing companies have also been established in 1980 at Kigoma, Bagamoyo, Rufiji and Mtwara along the coast (FAO, 1980a).

The main fishing grounds on the eastern coast of Somalia are found between Kismayo and the Kenya border. During the 1970's, fishing activities were affected by various re-organisation processes, including a project of nomad settlement in fishing villages (FAO,1983d). Since 1981, a policy of privatization has been pursued, resulting in a marked improvement in vessel maintenance and operation. In the industrial sector, Somalia has contracted a number of joint venture agreements mainly with Italian companies, for offshore trawling. It has also recently acquired three large freezer-trawlers.

The traditional subsistence fisheries in Madagascar are limited to coastal lagoons and shallow inshore waters protected by coral reefs (IUCN, 1984). About 80% of the 4,000 artisanal boats, mostly outrigger canoes, operate on the west coast of the island; poor weather, currents and

difficult bottom conditions limit fishing activities in other areas (FAO, 1979). Simple fishing gears are used, mainly lines and hooks, gill-nets, beach seines and barrage traps. The commercial trawlers are fishing for shrimp. Industrial tuna fishing was attempted by a foreign fleet in the mid-1970's. Although good catches once resulted from this activity, the practise has now stopped.

The coastal and deep sea resources of Mozambique were never exploited on a large scale until independence; fish was actually imported (EIU, 1984). The most developed industrial fishery presently is targeted on shrimp. Industrial fishing of demersal and pelagic fish started in 1977 with some Soviet trawlers operating under license (Anon., 1979a). Large pelagics are caught by long-lining. Fishing for Hilsa occurs in various estuaries such as in Maputo, where it is found in large quantities. This species is used for food and as bait for the handline fishery.

Most of the artisanal fishermen of Mauritius and Rodrigues work in the shallow and extensive lagoons delineated by the barrier reefs. They use planked pirogues, an increasing proportion of which are powered with outboard motors, and their main gears are basket traps, lines, drag nets and gill nets (Ardill, 1979). The deepwater shelf resource is exploited from 10 m diesel boats, using basket traps and lines. The distant water fleet, exploiting the demersal fish on St Brandon, Nazareth, and Saya de Malha banks, is operated by six Mauritian and two chartered South Korean vessels. These mother ships carry pirogues used for hand-lining (Banerji, 1976). A tuna purse-seiner owned by a Mauritian-Japanese joint venture has started in early 1980's, to provide raw material for a cannery based in Mauritius (FAO, 1979a).

In the Seychelles, the traditional fishery, using canoes 90% of which are motorized, and mainly hand-lines and basket traps, provides most of the domestic fish supplies (FAO, 1979b). A steadily growing export trade in demersal fish is serviced by a fleet of wooden sail boats (11-18 m) with auxiliary engines and carrying ice. These vessels fish on banks of the Mahe Plateau by handline (Anon, 1979b). In 1978 a major investment in a modern tuna industry started: a cold store was built and France provided four tuna fishing vessels. Although tuna exports started in 1980, the fishing methods (pole and line) proved unsatisfactory and the ships were returned to France (EIU, 1984). Recent trials by French purse-seiners have proved much more successful, and a large French tuna fleet is now using the Seychelles for a base for tuna operations.

The fisheries sector of the Comoros Islands is entirely artisanal, and mainly at a subsistence level. About 4000 outrigger canoes (100 motorized) are used for fishing within one or two miles from shore, mainly with handline methods (FAO, 1983a). The onshore infrastructure for distribution of the catch is poorly developed, with no refrigeration facilities for local catch (Faharoudine, 1979; FAO, 1983a). Ongoing French and Japanese aid programmes are aimed at training Comorian fishermen and equipping them with outboard motors.

Status.

The most important potential fisheries resource on the east coast of Somalia is the pelagic sector. In the northern part of the coast, mackerel (Scomber sp.) is the dominant group, and was found in abundance along the edge of the continental shelf by the F. Nansen surveys (Kesteven et al, 1981). This region is a spawning area for Indian oil sardine, scad (Decapterus) and round herring (Etrumeus), and both the biomass and

availability of these fishes were higher in autumn than in spring. These pelagic resources which are much the largest resource in the East African region remain untapped except for the catches by a few Roumanian vessels (FAO, 1985). In the southern region, round herring and some mackerel are found, although only in small quantities. The total biomass of pelagic fishes on the east coast is estimated at 953,000 t - 1,214,000 t, (maximum 16-14 t/nm). To date, this resource has been lightly exploited. The total estimated demersal biomass is between 392,000 t and 822,000 t (maximum 65 $\pm$ 23 t/nm). Little is known about the present catches of the recently developed trawl fishery in this country.

In Kenya and Tanzania the inshore reef areas are being heavily fished in the case of Kenya, and there appear to be localized opportunities for increasing catches in Tanzania. Offshore demersal resources and pelagic fish are only lightly exploited (Gulland, 1979). The predominant demersal group on these coasts is the Lutjanids (snappers), especially in Zanzibar Channel. Other important demersals include Leignathidae, Mullidae, barracudas, grunts, sharks, and rays (Birkett, 1979). The largest catches of carangids, (mainly round scads) and horse mackerels in survey cruises were taken off Kenya and the south Zanzibar Channel. These surveys also found locally distributed schools of Clupeidae and Engraulidae with high variations in species composition.

In Mozambique most of the exploitation occurs in Sofala Bay where good trawlable grounds are found. Demersal fish there are thus heavily exploited, and moderate catches of small pelagic and demersal species are taken as a by-catch of the shrimp fishery. (Gulland, 1979). The inshore reef areas and other rough bottoms are only lightly fished, offering a potential for line or trap fishing development. Other fishing grounds, such as in Maputo Bay, could be exploited for small pelagics (round scad and horse mackerel) and small quantities of demersal fish (Birkett, 1979).

The total available marine yield in Madagascar, excluding tuna, is estimated at around 150,000 t/year (IUCN, 1984), although a part of it is not economically exploitable. The most promising demersal groups are the Sparidae and the Lutjanidae, although their catch rates in exploratory fishing was relatively low. Anchovy and sardine shoals were more frequently found north of 16^{o}C south, and very rarely on the west side of the island south of 16^{o}C. Catches on the east coast might improve if fishing from small or medium-sized motorized vessels was developed, since exploitation is presently limited by currents and weather.

In Mauritius, fishing intensity in the lagoons and on the surrounding reefs has progressively increased over the years, accompanied by an apparent decline in catch (Banerji, 1976). Certain gears and fishing methods catch a large quantity of juveniles and destroy the coral bottoms. Despite restrictions on the number and types of gears used, this resource is still very heavily exploited (Gulland, 1979). Banks fished by Mauritian fleets mainly using handlines, include St Brandan, Nazareth, Saya de Malha and other smaller banks. Fishing on the larger banks started in the late 1920's, and fishing effort has increased continuously since then. Catch rates have decreased considerably, and some fishing companies state that it now takes twice the amount of fishing time to fill the holds of motherships (Banerji, 1976). There is some potential for exploitation of pelagic resources mainly on Saya de Malha bank, where round scad and horse mackerel (Trachurus indicus) are found in the central area, with an average density of 19 t/sq nm (Birkett, 1979). On the eastern edge of the bank, seabream (Polysteganus sp.) is dominant with densities around 33 t/sq nm.

The inshore reefs around the Seychelles are still lightly exploited,

although heavy fishing occurs locally (Gulland, 1979). On the offshore banks (Mahe Plateau), demersal resources on untrawlable grounds are moderately exploited by the line fishery; development of other methods (e.g. traps) could increaase the yield by catching species not available to the line fishery. The trawlable grounds, especially in the southern plateau region, are at present unexploited; however survey trawl hauls were usually poor, with catches of less than 200 kg/hour (Anon, 1978). The Mahe plateau is thought to be a nursery area for several pelagic species, such as Decapterus (roundscads) spp, Sardinella spp., Rastrelliger kanagurta (Indian mackerel) and Auxis thazard (frigate mackerel). Surface schools of large pelagics, mostly bonito (Euthynnus affinis) occur seasonally on the plateau.

As a result of the extreme narrowness of the Comoros shelf and the intense fishing close inshore, the shelf demersal species are quite heavily exploited. Tunas and tuna-like fishes (mostly mackerel) are only lightly fished.

Human and Economic Value.

Domestic fresh fish consumption in Somalia is limited to coastal areas because of poor communications, seasonality of supply and a traditional preference for meat. However, fishing could come to play a much larger role in meeting nutritional requirement, domestically and in surrounding countries. The substantial offshore resources have an important foreign exchange earning potential.

In Kenya and Tanzania, almost all locally produced fish is consumed domestically, and fresh fish reaches only a few miles from the production point due to poor communications (FAO, 1980). Tanzanian marine fisheries provide only about 20% of the total fish catch, and there is a clear consumer preference for freshwater fish. Little is known on the present utilization of fisheries resources in Mozambique, other than the shrimp fishery, developed for export.

The fishery industry at present makes a relatively small contribution to the economy of Madagascar although fish accounts for about 14% of local animal protein supplies. About half of the catch of the traditional marine fisheries is marketed fresh in coastal towns. Only limited amounts of smoked dried or frozen marine fish are marketed inland, and the balance of the catch is consumed by the fishing population (FAO, 1983b). A small percentage of the catch is exported to Reunion and the Comoros Islands. About 5500 fishermen are engaged in the marine sector.

In the Seychelles, the home based fish consumption is among the highest in the world (average 85 kg/capita/year) (EIU, 1984). The fish stocks of Seychelles waters are its most important natural resource. Fish exports have recently increased and account for over 20% of the value of domestic exports (FAO, 1979).

All the production of the Mauritian artisanal and bank fisheries is consumed locally, and contributes to half the domestic fish consumption (FAO, 1979a). The other half is mainly imported canned sardines and pilchards. Emphasis on development is on tuna fisheries, export earnings from this sector could come to compensate increased imports of fisheries products. About 3500 fishermen are fishing in Mauritius and adjacent banks.

In Comoros, income from fisheries activities is quite well distributed among the 8000 artisanal fishermen and is their only source of income (FAO, 1983a). This sector accounts for about 5% of total employment. Locally

caught fish represent 40% of the total animal protein supply of the island.

Targeted Exploitation.

Little is known about the levels of exploitation of marine resources on the east coast of Somalia. Total catch for the country is estimated at 10,148 t (FAO,1983), and a good part of it is landed on the north coast.

Kenyan catches have shown slow improvement in recent years, and amount to about 2,800 mt of demersal fish, taken mostly by lines and traps, 730 mt of pelagic fish, caught by gill-nets, and 70 mt of sharks and rays (FAO,1983). Most of the fish by-catch of shrimp trawling is discarded.

Recorded statistics for Tanzania show wide annual variations in catches of various fish groups, which are probably largely due to difficulties in collecting local catch data (Anon, 1979c). On the mainland, the most common pelagics are the Sardinella spp., and the demersal ones mainly snappers and groupers. In the coastal areas, there is a seasonal availability of large migratory fish: tunas, sailfish, kingfish, etc. In the landings on Zanzibar and Pemba Islands, 75% is composed of small pelagics (sardines and mackerels), and demersal species account for the remainder of the catch. In 1981 the total marine catch in Tanzania was around 32,000 mt.

No account of catch composition was available for Mozambique. There is an important estuarine fishery for Hilsa kelee, and anadromous fish. It is used mainly for food, but also as bait for handline fishing. A longline fishery catches mainly Thunnus albacores and T. alalunga, which together account for 16-56% of the catch; other species landed by this fishery are the swordfishes (9-40%), sharks (22-80%) and lancet fishes (2 - 7%) (Anon., 1979a). Total marine fish catch for Mozambique was estimated in 1981 at 23,400 mt (FAO, 1983).

Marine catches in Madagascar account for less than 20% of total production. The traditional small-scale sector is responsible for all of the finfish landings, about 8000 tons/year (FAO, 1983b), and most of the catch is composed of demersal fish.

In Mauritius, the intensive lagoon fishery has a constant production of about 2500 tons/year, despite increases in fishery effort (Ardill, 1979). Most of this catch is composed of demersal species, although a small quantity of tunas and tuna-like fishes are also landed by this fishery (Banerji, 1976). Although dynamite fishing is prohibited, this method is still used to an unknown extent around the reefs. The distant water handline fishing on the banks yields about 3000 t/year, also mostly made up of demersal fish. About 350 marlins are landed annually by the sport fishery, which is a tourist activity with very high economic returns. Another lucrative fishery is directed at aquarium fish, catching around 80,000 fish and invertebrates, each year. The effect of the latter exploitation on fish populations is unknown, but probably of much less concern than the destructive fishery methods used by small-scale fishermen.

The major inshore handline groups caught in the Seychelles are the Carangidae, mainly Carangoides fulvoguttatus, C. gymnostethus and Euthynnus affinis (Anon., 1979b). The trap fishery landings comprise up to 60% of cordonniers (Siganus spp.) (FAO, 1979), especially in October - December when spawning aggregations are found inshore. Other important groups in trap catches are the Scaridae (12%), Mullidae (10%) and Lethrinidae (8%). A shore seining fishery produces most of its catch during the north-east monsoon months, exploiting the large schools of Sardinella and Rastrelliger

then present inshore. The commercial offshore handline fishing targets on some high value species for the export trade (Lutjanus, Epinephelus, Lethrinus, ect.,). Total marine catches amount to about 5000 mt/year.

In Comoros Islands, all fishery production is marine, and exclusively from artisanal activity. About 4000 mt are landed every year. Tuna makes up about 70% of the total catch (skipjack, yellowfin, kawakawa), with mackerel accounting for a further 15% and a variety of other fish (carangids, sardines, anchovies) making up the remaining 15% (FAO, 1983a,c). Local fishermen are engaged mainly in subsistence fishing, with stationary lines or simple troll-lines (Faharoudine, 1979).

Tuna catches in the western Indian Ocean in 1982 are listed in Table 9. The main catches are taken by foreign fleets, such as Korea, Japan and Taiwan. However, France and Spain are becoming increasingly important, in the last year or two many of their large purse-seiners have switched their operations from the Atlantic to this region.

Waste Discharge.

In Tanzania, organic waste from a diversity of small industries is a major problem, especially in and around Dar-es-Salaam. These include soap factories, sisal, sugar mills, cotton seed processing plants, plastics, wood processing, super phosphate plants and textile industries, many of which discharge directly into the coastal waters. In Mauritius, discharge from sugar mills can cause total oxygen depletion in rivers and estuaries, accompanied by a sludge layer and mass mortality of fish, and invertebrates (Jehergeer, 1978). Some sugar mills in the south of the island discharge their effluents directly in the lagoons; fishermen in these regions often complain of fouling of their fishing traps by bagasse and of decrease in their catches.

Large dam construction projects on the major rivers of East Africa and Madagascar for hydroelectric power generation, irrigation, or flood control purposes, could affect their flow and sedimentation rates. Such projects include the Cabora Bassa Dam in Mozambique, the Stiegler's Gorge area project in Tanzania and the Bardera Dam project in Somalia (UN/UNESCO/UNEP, 1982). A possible consequence of dam construction is the effect of the change in freshwater flow on the spawning and growth cycle of marine organisms in the estuaries. The impact on important exploited fish species, such as Hilsa in Mozambique, is presently unknown.

Sedimentation.

A problem common to many areas along the East African coast is the siltation of coral reefs due to increase erosion of agricultural land. The long-term effect of this process could be very harmful to the local fisheries, by reducing the general productivity of coral reef environments. Many of these fisheries are targeted at demersal reef fishes and are restricted to inshore areas.

Direct Destruction.

Dynamite fishing is certainly a prominant problem in reef areas. Although it is generally prohibited by law it is still practised due mainly to low level of surveillance. The damage caused by this fishing method extends to a high fish mortality many of which are not used by the

Table 9 - Tuna Catches by Foreign Longline Fleets (1)
in the 200 mile Economic Zones of the Southwest Indian Ocean
in 1977, by Species (t)
(from Indian Ocean Fishery Commission, 1981)

Area	SO	YF	ALB	BE	SJ	SF	Mar-lins	Sail	Total	Catch Rate (2)
Comoros	0	482	65	159	0.4	3	76	1	786	1,486
French Southern Territory	136	5	38	14	0.0	1	1	0	196	1,024
Kenya	0	418	4	310	0.5	9	37	1	780	1,648
Madagascar	2	390	938	157	0.0	26	58	1	1,572	1,076
Mauritius	9	3,28	1,775	1,100	8.0	47	321	12	6,552	1,314
Mozambique	0	220	53	79	0.0	1	57	0	411	1,194
France (La Réunion)	1	207	869	84	0.0	10	48	1	1,220	1,044
Seychelles	2	14,894	212	8,444	18.0	115	475	33	24,193	1,850
Somalia	0	980	4	851	2.0	19	145	3	2,004	1,954
Tanzania	0	2,010	50	1,376	6.0	27	126	3	3,597	1,808
TOTAL	150	22,887	4,008	12,574	35.0	258	1,344	55	41,311	

SO BF = southern bluefin tuna
YF = yellowfin
ALB = albacore
BE = bigeye
SJ = skipjack
Marlins = blue and striped and black marlins
Sail = sailfish
SF = ?

(Source: IOFC/DEV/80/48)

(1) Japan, Korea and the island of Taiwan. Only a small part of this catch is landed in the area for transshipment or processing.

(2) Catch rate in kg/2,000 hooks representing daily catch for all species for comparison:

- Indian Ocean all 200-mile zones 1,535 kg/2,000 hooks
- Indian Ocean high seas 1,240 kg/2,000 hooks
- Entire Indian Ocean 1,326 kg/2,000 hooks

fishermen, and to the destruction of coral heads. Areas affected are often reduced to a rubble bottom of low productivity. Coral growth is an extremely slow process, such that the damage due to dynamite, coupled to siltation problems, might be irreversible. The lagoons are also very sensitive to environmental changes: pollution trapped in lagoons is a problem, and could be part of the cause for a recent population explosion of echinoderms in Mauritius which have overgrazed the bottoms of the lagoons and created unstable sand beds (Ardill, 1979).

Recreation and Tourism.

A targeted fishery that could be expanded under tourist developments is the sport fishery for large pelagics, especially for billfishes. The pressure of such fisheries on the stocks would not be significant, whereas economic returns for the countries would be proportionately very high.

Existing Management Policy.

For most countries of this region, the main concern is to increase the production capacity of the fishing industry. In many areas, fishermen's operations have been set up and onshore facilities (docks, ice plants, canneries, etc.) are being created in the main centres. Assistance is sought from other countries to develop new fishing technologies and to assist at the training of traditional fishermen. In some cases, such as in Madagascar, Somalia and the Seychelles, a long term development plan has been set up as an integrated framework for management. Research and fisheries management facilities and staffs are still very limited, but in many cases are also improving, with technical training overseas and co-operation in resources surveys.

Priority Concerns.

Up to the present the major concern of the countries in the region has been to increase their catches. It is now becoming recognized that this is in many cases not feasible either because the stocks are already heavily fished, or because the resources are very small, and cannot support a large commercial fishery. There is therefore increasing concern with the need to manage over-exploited resources, and to match future investment to the resource potential. A common obstacle to doing this is the lack of good assessments of the resources, particularly of coral reefs which seem to be among the most heavily exploited resources, and, in some cases, inadequate statistical and other data on which to base the assessments.

Also of concern is the rapid expansion of purse-seining for tuna. Coastal states are concerned about the possible impact on the resources, but more immediatly by lack of full information about these resources, and of the fisheries on them.

Priority Recommendations.

Action should be taken to improve the assessments of the resources in the region, especially of coral reefs, and to identify appropriate management measures for the resources.

Action should also be taken to improve the collection, computation and dissemination of statistical and other information concerning the tuna

fisheries on a regional basis.

SHRIMP FISHERIES.

Character.

The shrimp stocks are mostly exploited in shallow continental shelf areas, off major estuarine systems. Although these stocks have usually been exploited by artisanal fishermen for some time, they are now the main target of commercial trawling operations for the most part aimed at export. Compared with other tropical areas the shrimp stocks in this region are small. The largest resources are in Madagascar, with smaller stocks occuring off Kenya and Tanzania.

In Madagascar the shrimp fishery is concentrated on the north-west coast, which is bordered with extensive mangrove areas. The traditional sector exploits the shrimp resource in the intertidal zone using mainly V-shaped barrage-traps set near river mouths (Kapetsky, 1981). These fishing grounds are situated close to or within nursery areas, and consequently many shrimps caught by this method are below the commercial sizes. Beach seines are also used to a much lesser extent. Four enterprises are involved in commercial shrimp trawling, with 44 trawlers working in shallow waters (4-30 m in depth) year round (FAO, 1983b; Le Reste, 1978). They catch mainly large shrimps.

In Kenya, around 10 medium-sized trawling vessels are operating in Ungwana Bay, especially at the mouth of the Tana River (Anon., 1979).

The Tanzania Fisheries Corporation (TAFICO) was formed in 1974 and now operates 14 trawlers fishing the shrimp grounds of Bagawayo and Kisiju (Anon., 1974). The efficiency of exploitation has so far been low, due to a lack of knowledge about the prawn trawling grounds, and inexperience of the fishing crews. Fishing for shrimp on a subsistence level has been carried out for a long time, especially in the Rufiji delta and in the Bagamayo region, using stationary filter traps, stake nets and shore seines (IOP, 1979).

The industrial shrimp fleet in Mozambique operate in shallow waters off three areas : Maputo Bay, the region between Sofala and Chiloane, and the Sofala Bank area (Anon., 1979a). At present most of the trawlers are equipped with double rig systems (Anon., 1979d). They are primarily owned by foreign companies operating in joint ventures with the Mozambican government, although three local companies also exist (UN/UNESCO/UNEP, 1982). There is some small-scale fishing of shrimps for local consumption.

Status.

Several surveys have shown that shrimp stocks in north-west Madagascar are near the maximum sustainable yield (MSY) level (FAO, 1983b). A number of management measures have been introduced to protect these stocks both in the commercial and artisanal fisheries.

The Kenyan commercial exploitation of shrimps by trawling is still relatively small and could probably intensify production levels. However, the practice of fishing close inshore has created conflicts with traditional

fishermen.

In Tanzania the mangrove areas of the Rufiji Delta and the offshore banks of the Mafia Channel have a potential annual yield of shrimp of about 2,800 t (UN/UNESCO/UNEP, 1982). Shrimp exploitation in this country is still low, and concentrated mostly in the delta. There is considerable scope for expansion of this fishery.

In Mozambique, shallow water shrimp resources are predominantly located near the Sofala Bank, between Mambone and Angoche. It covers 39,000 sq km of 10 - 15 m depth and 8,360 sq km of 50 - 200 m water (Pelgrom & Sulemane, 1982). Small stocks also exist in Maputo Bay. No account of the state of this fishery is available, but there is no overall sign of over-exploitation. Deep-water shrimps have been found in the southern area, at 280 - 550 m, and could yield about 4,000 t. The predominant species is Hymenopenaeus triarthrus, the pink or knife prawn.

Human and Economic Value

In Madagascar, the entire shrimp catch of the industrial fleet and a good proportion of the artisanal catch is processed, frozen and exported. Shrimp, along with small quantities of fish, represents the third most valuable export item of this country at US$18.4 million in 1980 (FAO, 1983b).

Shrimp and other crustaceans landed by the fleet of the Tanzanian Fisheries Corporation, and collected by TAFICO from various villages, are frozen and exported to the United Kingdom, France, Belgium, and Spain. The value of the shrimp export was around US$3 million in 1978 (FAO, 1980).

Shrimp exports in Mozambique usually account for about 10% of the total export earnings, and amounted to US$70 million in 1979-80 (UN/UNESCO/UNEP, 1982).

Targeted Exploitation.

Although shrimps are found around most of the coast of Madagascar, commercial trawlers have so far operated only in the north-west, between Cap-St-Andre and Maintiano. Artisanal fishery occurs wherever there is shrimp, but is more intensive only in the north, between Port St-Louis and Nosy-Mangabe where extensive mangrove zones are found (Le Reste, 1978). Penaeus indicus makes up most of the shrimp catch (65 - 70%). Total production in Madagascar has decreased considerably in recent years, and was estimated at 2824 mt in 1981 (FAO, 1983c).

The small commercial fishery in Kenya exploits an important breeding ground for shrimp near the Tana River, and in the past averaged 7mt of shrimp per month, and about twice that amount of fish (Anon, 1979c). However, total landings have also decreased in this country, and were at 10 mt in 1981 (FAO, 1983 c).

The TAFICO trawlers in Tanzania operate mostly in shallow waters of the Rufiji delta and its production is still small compared to the artisanal fishery. Total production has recently varied between 200-300 mt per year. Vessels from Mozambique have been fishing for shrimp since 1965. Catches of shrimp are about 10,000 - 12,000 t/yr (Pelgrom & Sulemane, 1982). The most important species in the exploited shallow waters are Penaeus indicus (white shrimp), Metapenaeus monoceros (brown shrimp), P. japonicus (flower shrimp)

and P. monodon (tiger shrimp). Species composition varies within years and from year to year; the average composition is 45% white shrimp, 45% brown shrimp, 10% tiger and flower shrimp. There is presently no exploitation of the deep water shrimp stock.

Incidental Exploitation.

In this region, most of the by-catch of the commercial shrimp fisheries is discarded at sea. The existing space and processing technology on board the fleet trawlers is one of the major limiting factors to a more rational utilization of the by-catch.

In Mozambique, a preliminary survey and data from commercial vessels show that shrimp by-catch ratios range from 1:3 to 1:1 according to season, fishing gear and company (Pelgrom & Sulemare, 1982). During 1980, only 950 t of by-catch fish were landed with 7000 t of shrimp, whereas the actual by-catch production is estimated at about 20,000 t per year. Catch composition data shows that pelagic species are as abundant as demersal species in southern areas, and demersals dominated in central and northern areas (56 - 63%). Croakers, grunts, lizard fish, goatfish and catfish were the most important demersal groups, and ponyfish, anchovies, sardines, jacks and scads, the main pelagic species. Sharks and rays represent 2 - 4% and non-fish species (squid, cuttlefish and crabs), 2 - 3%.

Waste Discharge.

The reduction of freshwater inputs caused by the large damming projects on the east African coast could affect the spawning and growth of shrimp stocks concentrated at the mouths of the rivers. Fisheries officials in Mozambique are concerned about the effects of the Cabora Bassa Dam on the delta of the Zanzibar River, which provides the primary nursery grounds for the large shrimp stocks in Beira Bay (UN/UNESCO/UNEP, 1982). Increased salinity has been noticed in the agricultural region along the river. No effects on the shrimp exploitation has yet been felt.

Sedimentation.

In Kenya, damming on the Tana river has been reported to have noticeably reduced siltation at the mouth of the river, and slowed the delta formation process (UN/UNESCO/UNEP, 1982). Marine fisheries in the area seem, however, to be generally improving. Effects of damming the Juba river in Somalia are not well understood, but outside assistance has been obtained to research environmental factors, including downstream effects on the estuary area. The Juba river is known to carry a large sediment load, and there is a shrimp fishery around its mouth.

Existing Management Policy.

In Tanzania, the present TAFICO fleet, together with the 30 trawlers proposed for the 3 fishery centres established under a World Bank project, are likely to exploit the inshore prawn grounds to its known MSY (FAO, 1980).

In Mozambique, efforts are given to assess the shrimp resources of the country. It is also government policy to resolve the domestic fish shortages by trying to maximise the use of shrimp by-catch (Pelgrom &

Sulemane, 1982). At present, studies resulting in action programmes for better by-catch utilization and those that take into consideration the lack of refrigeration capacity, space and personnel on freezer trawlers have a high priority.

Several management measures have been introduced in Madagascar, since it was clear that shrimp exploitation level was close to MSY. These include a two month closed season, control of minimum mesh size and limitation of fishing effort. Seine fishing is encouraged in the traditional sector rather than coastal barrage traps on a basis of better control of mesh size with the former gear (Kapetsky, 1981).

OTHER CRUSTACEA

Extent, Occurrence and Exploitation

Exploitation of spiny lobsters in the East African countries, which is done mainly by diving amounted to the following in 1981 (in mt):

Kenya : 51

Mozambique : 240 (includes crabs)

Madagascar : 54

Mauritius : 22

Seychelles : 1

Somalia: 836

Lobsters are captured commercially by diving in Tanzania, but catch data are not available. In this country, five species of Palinuride are found, and the catch is mostly composed of Panulirus ornatus and Panulirus longipes. Exploitation by traps has been tried, but was found ineffective. Minimum legal sizes have been recommended: 70 mm carapace length for P. ornatus and 65 mm for P. longipes (Anon., 1979c). A large lobster, Linuparus somniosus, is dominant in about 250m of water in the south Zanzibar Channel and the north Mafia shelf. Catch rates of 15-25 kg/hour are common, with a maximum of 45 kg/hour.

Spiny lobster stocks in inshore areas of Mauritius are already heavily exploited. In gear trial cruises, catch rates of Puerulus carinatus up to 200 kg/hour were noted on Saya de Malha Bank (Ardill, 1979).

In Mozambique, fishing areas of Palinurus gilchristi delagoae extends from the southern border to Bazaruto Island, at depths of 100 - 400 m (Anon., 1979a). Commercial lobster fishing restarted in 1977. Catch rates for this species are generally of 10 kg/hour, although some hauls yield more than 100 kg/hour.

In Ungama Bay, Kenya, Puerulus carinatus is common at depths of 200-250m. Catch rates usually vary between 20-60 kg/hour (Birkett, 1979). Slipper lobster (mainly Thenus orientalis) are widespread along the East

African coast, but particularly off Kenya.

Somalia has acquired a fleet of three large freezer trawlers supplied by Italy for offshore operations. The catch from this sector is probably now averaging about 10,000 t/year of fish and 1500 t of lobsters (FAO, 1983).

Existing Management Policy.

No management policies for lobster stocks are knwon to exist at present.

Priority Concerns

Lobster populations are extremely sensitive to over-exploitation, due to their life history characteristics and their relatively restricted capacity for dispersion. Without appropriate management policies and surveillance, depletion of local stocks is possible.

Priority Recommendations

Studies on stocks productions are needed throughout the region to assess potential yields and possible depletion of local stocks. Restriction on catches should also be imposed, maybe in the form of quotas. Surveillance would be necessary for a proper enforcement, especially in inshore areas.

MARINE MAMMALS

Character.

The marine mammal fauna of the East African region is not well known and very few records exist for the area as a whole. Best (1971) summarises information on cetaceans for the region to date. Racey and Nicoll (1984) provide a review of aquatic mammals found in the Seychelles.

The dugong (Dugong dugon) is known to persist in some areas of the East African coast. Nishiwaki et al (1981) report that dugongs were formerly abundant along the entire African coast in this region, but that they have been hunted for a long time and are now drastically reduced.

Racey and Nicoll (1984) report some records from the last century of unknown marine mammals in the Seychelles, which they postulate might have been elephant seals, stragglers from the southern ocean. This is the only record of pinnipeds in the region.

The cetacean fauna of East Africa is well known. Best (1971) records delphtnid species from the region: Orcinus orca the killer whale, Tursiops truncatus and Stenella attenuata the bottlenose and the spotted dolphins are all recorded from the Seychelles as well as South Africa, while Pseudorca crassidens the false killer whale has been found at Zanzibar, Steno bredanensis the common dolphin off Madagascar and Lagenorhynchus obscurus the dusky dolphin also off Madagascar. Best also records Mesoplodon

densirostris from the Seychelles, and states that sperm, right, humpback minke, sei, blue and fin whales are probably distributed throughout the Indian Ocean. Certainly, Townsend's (1935) whaling maps show dense clusters of sperm whales caught off Madagascar and off Zanzibar, and humpback whales off Mozambique and Madagascar.

In addition, Racey and Nicoll (1984) record Feresa attenuata from the Seychelles, and Peponacephala electra from Aldabra, and Keller et al. (1982) reported Ziphius cavirostris, Globicephala macrorhynchus and Grampus griseus from waters around the Seychelles. Azzaroli (1968) found one of only 2 known specimens of the beaked whale Mesoplodon pacificus in Somalia, Howell and Pearson (1975) reported Stenella longirostris from Tanzania, and Watson (1981) reports Stenella coeruleoalba from around the Seychelles. Other species which may occur in the area include Sousa chinensis, and Neophocaena phocaenoides. The type specimen of this latter species was recorded from South Africa, but no others have been recorded so far west in the Indian Ocean, and doubt surrounds the authenticity of the origin of the type specimens (Best, 1971).

Status.

The status of the dugong in this area has been described as desperate (Nishiwaki et al., 1981). There are no population estimates available, but the population is clearly drastically reduced, and very few are reported. Records of 3 sightings of dugongs (2 and 1) in 1970 and 1976 at Aldabra (Racey & Nicoll, 1984) may indicate a relic population in that area.

The status of none of the cetacean populations is known but sperm whales and humpbacks have both been extensively hunted in former years in this area. If any of the stocks of large baleen or sperm whales in this area are the same as those which have been hunted in Antarctic waters, then it is fair to say they are severely depleted.

Human and Economic Value.

Marine mammals are apparently of no commercial value in this region at present. However, some reports (Nishiwaki et al., 1981) indicate that there may still be some local exploitation of dugongs as a food source, and small cetaceans are also probably of some value locally as a food source for some people, as Racey and Nicoll's (1984) report of bottlenose dolphin harpooning in the Seychelles might suggest.

The aesthetic value of marine mammals, here as elsewhere, cannot be overlooked. Severely reduced population of dugongs, and breeding populations of some baleen whales may be regarded as of particular aesthetic value, due in part to their rarity.

Targeted Exploitation.

Low level exploitation of dugongs in some areas has already been mentioned. No statistics are available in such catches, but any exploitation of the critically reduced population here is bound to speed its disapperance from the East African region.

Racey and Nicoll (1984) report that bottlenose dolphins have been harpooned by islanders in the Seychelles for food. Other records indicate that coastal fishermen in South Africa may deliberately take small cetaceans. It seems probable that in a protein-poor area where there are

marine mammals available for taking, some local exploitation is likely to continue. There are, however, no recent records of this in the area.

Incidental Exploitation.

Martin (1981) refers to incidental capture of dugongs in Kenya, and Howell and Pearson (1975) to that of striped dolphins in Tanzania. Again it seems likely that such captures are not at all as infrequent as these two records might suggest.

It has been reported (Leatherwood et al., 1983) that fishermen around the Seychelles take tuna from under 'spinning' dolphins. In recent years French and Spanish tuna seining operations have opened up in the Indian Ocean, and it remains to be seen whether these will exploit the association between tuna and dolphins, as has been done in the eastern tropical Pacific, with a resultant high incidental mortality of dolphins.

Recreation and Tourism.

Both Humpback and Right whales breed in shallow, generally coastal waters, and both of these species occur in waters of Mozambique and Madagascar. In the USA Mexico and Argentina tourists travel large distances for a chance to see baleen whales at close quarters, and the possibility of developing a whale watching industry around Right whale or Humpback whale breeding sites is one possible way of exploiting these species in a non-consumptive way.

Existing Management Practice.

The Indian Ocean Whale Sanctuary should safeguard at least the larger species of cetacean. Here as elsewhere in the Indian Ocean, protective legislation can do little to prevent marine mammal entanglements in fishing gear, or even some deliberate killing of marine mammals for food.

Priority Concern.

The dugong in this area is critically reduced and may even be beyond aid. In helping depleted whale stocks to recover, one concern should be to protect vulnerable coastal breeding sites of Humpback and Right Whales from intentional or accidental disturbance. Humpbacks are known to breed in coastal water (Wray & Martin, 1983) of Madagascar, but precise breeding sites are not recorded. Most Right whale catches were made further south than Madagascar, notably around the Crozet Archipelago. However, Right whales have also been recorded around South Africa (Leatherhead & Reeves, 1983), and the possibility that they breed in the East African region should not be completely discounted. The possibility of tuna seining operations expanding onto dolphin associated tuna schools should also give some cause for concern.

Priority Recommendations.

Identify breeding sites of humpback whales, and possibly Right whales and ensure their protection, along the lines of the Argentinian Right whale Sanctuary off the Chubut Peninsular.

TURTLES

Character

The region includes some of the world's most famous territories for marine turtles. All five of the pantropical species are recorded (Green, Chelonia mydas; Hawksbill, Eretmochelys imbricata; Loggerhead, Caretta caretta; Olive Ridley, Lepidochelys olivacea; and the Leathery turtle Dermochelys coriacea), but only Chelonia and Eretmochelys are common. These two species are found in localised nesting colonies throughout the region.

Distribution and Occurrence

Nesting activities in certain parts of the region are widespread e.g. Seychelles, and in other parts more localised e.g. on Moheli (Comoros) where although 33 beaches have Chelonia nesting, 81% of the total occurs on only six beaches - this makes the population more susceptible to habitat destruction.

The highest nesting densities of Chelonia occur on Aldabra Atoll (Seychelles) where 1,980 - 2,420 females/yr (Mortimer, 1983); Europa Island (La Reunion) 10,000 females/yr (IUCN, pers. comm.); and Tromelin Island, where between 1,000 and 10,000 turtles nest per year. Lower densities of around 100 - 1,000 nesting females/yr occur in a number of locations on the Granitic Islands and South East Islands of Seychelles, the west coast of Madagascar and in several island locations in the Mozambique Channel (Frazier, 1979; Mortimer, 1983). All the mainland countries of the region are known to have Chelonia nesting beaches, although none are recorded from the monsoon belt of northern Somalia. A total of 2,000 nesting females/yr for Somalia and 1,900 females/yr for the Comoros is given by Frazier (1981). The total population of Seychelles is given as 3,535 - 4,750 females/yr by Mortimer (1983).

Nesting densities of Eretmochelys are generally lower throughout the region and the largest populations are found on the Amirantes and Granitic Islands of Seychelles. According to Mortimer (1983) these appear to be the largest nesting populations in the western Indian Ocean. The total nesting population in Seychelles group is estimated to be between 1,230 - 1,740 females/yr, about half of which occurs on the Granitic Islands (Mortimer, 1983). Nesting populations of less than 100 females/yr/site can be found in the South East Islands, some island locations in the Mozambique Channel, and to a lesser extent on the mainland coasts of Mozambique - at the extreme northeast tip of the island - although nesting is suspected along most of the northern coastline. Similar nesting densities have been recorded, or are suspected along much of the mainland coast but to date there are no records of Hawksbill nesting in Somalia.

There is some evidence that the other three species, Lepidochelys, Caretta and Dermochelys, also nest in the region (see Table below), although their numbers are very much smaller.

		SOM	KEN	TAN	MOZ	MAD	REU	MAU	COM	SEY
Chelonia	"O"	Y	Y	Y	Y	Y	Y	Y	Y	Y
	"B"	Y	Y	Y	Y	Y	Y	Y	Y	Y
Eretmochelys	"O"	Y	Y	Y	Y	Y	Y	Y	Y	Y
	"B"	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lepidochelys	"O"	x	Y	Y	Y	Y	x	x	x	x
	"B"		?	Y	Y	Y				
Caretta	"O"	x	Y	Y	Y	Y	x	x	x	Y
	"B"		x	x	Y	Y				x
Dermochelys	"O"	x	Y	Y	Y	x	x	x	x	Y
	"B"		x	*	Y					**

Where "O" = Occurence
"B" = Breeding
* = previously recorded on Zanzibar
** = very rarely
x = absent
y = present
? = not recorded but suspected

Records of the occurrence and breeding of the five species of turtle known from the Eastern African region (after IUCN/UNEP, 1984)

Certain areas of the region provide valuable non-breeding habitats for migratory species. Tagging experiments of Caretta in the Zanzibar area have shown the territory to be important for Caretta that nest in Natal. Similarly, Dermochelys in Kenya are thought to occur regularly in migrations to the Natal rookery (Frazier, 1981).

Conservation status.

Accurate information on the occurence and status of the species in the region is unavailable. However, Greens, Hawksbills, Olive Ridley and Leathery turtles are considered to be endangered species throughout the region, although in areas where exploitation is at the moment minimal their status is unlikely to alter. In countries where these species have a history of exploitation their future rests on the establishment of reserve area such as Aldabra.

The exception to this categorisation is the Loggerhead turtle Caretta, which is known from the mainland countries of Kenya, Tanzania and Mozambique and from the island of Madagascar, its status is 'vulnerable'.

Kenya, Tanzania, Mozambique, Madagascar, La Reunion, Mauritius and Seychelles are all signatories to CITES and all the species of turtle found in these waters are subject to CITES listing. It would appear however, that most species are not honoured by the majority of countries under the CITES regulations (IUCN/UNEP, 1984). Local trading and export of Hawksbill scutes particularly by Seychelles and Kenya is in direct contravention of CITES agreements.

A limited degree of protection is afforded to the nesting/breeding sites and feeding grounds but these are small or within existing reserve areas e.g. Aldabra. These areas do not include some of the more important

and critical habitats for turtles in the region e.g. Poivre and Coetivy in Seychelles are both very important and are still not protected.

In Mozambique there are:- the Bazaruto National Park and one managed reserve; in Madagascar there are 5 strict nature reserves specifically designed to protect Green and Hawksbill turtle reproduction, but these appear to lack any management or control (IUCN/UNEP, 1984).

In 1978, the Seychelles government set aside protected areas for female Hawksbills at Aride, Cousin, Cousine, Curieuse and South East Islands. This was extended in 1979 to include the St Anne national park and Aldabra Atoll. Although legislation effectively bans the killing of both male and female turtles in the reserve areas, poaching still continues. The problem is exacerbated by the continued exploitation of turtles outside the reserve areas, coupled with the maintenance of high prices for turtle products on world markets. Despite the considerable poaching, Mortimer (1983) concludes that protective measures are begining to be successful. During the late 1960's early 1970's population estimates for Aldabra were put around 1,000 nesting females/yr (Hirth & Carr, 1970; Frazier, 1975). Mortimer's own studies indicate that the population had doubled by 1983 (Mortimer, 1983).

Protection for some of the more critical areas in Kenya, Tanzania and Mozambique is proposed.

In most countries the adults, young and eggs are either protected or there is some kind of proposed protection scheme, the exceptions here are Somalia and Tanzania. The major problem occurs when trying to enforce the regulations, and although Seychelles is the only country to have some kind of mechanism for enforcement, even here it is partial and does not cover the outer islands (IUCN/UNEP, 1984).

In some countries e.g. Mauritius, only the females are protected by legislation and the males continue to be hunted.

A programme of research for Chelonia is underway on Cousin Island in Seychelles and La Reunion with respect to the hatchery. Eretmochelys is very poorly studied and research in Seychelles is concentrated on Cousin Island (Frazier, 1984).

Human and Economic Value.

Two separate turtle fisheries exist in the region. The Hawksbill fishery is based mainly on it's value in the curio trade, producing "tortoise shell". This is both crafted locally for sale to the tourists or sold directly to the international trade, for most countries this represents a direct contravention of CITES regulations. A variety of products are obtained from the Green turtle fishery; live animals, meat, dried meat, flippers and cartilage or calipee, which is the single most important product, - in the Seychelles at least - and is almost exclusively for export to Europe (Frazier, 1984).

Targeted Exploitation.

Frazier (1980; 1981a) and more recently Mortimer (1983) have reviewed the exploitation of turtles in the western Indian Ocean. He has pointed out the cultural and economic importance which turtles have traditionally had in the area, and how progressive commercialisation of the turtle hunting

industry has eroded both the resource, and its value to local people. The following is a summary of Frazier's account of the situation in the countries of this region in 1980.

All five species are hunted or fished throughout the region, with the possible exception of Reunion where Chelonia mydas is ranch reared for the international trade. The majority of exploitation is for export, although some species are taken for local consumption.

Turtle shell consuming countries report that substantial quantities of products are being imported from Kenya (at least 2,540 kg in 1984), Seychelles (at least 629 kg in 1984), and Tanzania (at least 540 kg in 1984) - the trade in shell is almost certainly of Eretmochelys imbricata (IUCN, pers. comm.).

Turtles are either netted or speared on the feeding grounds or the females are taken when they haul themselves ashore to breed, female turtles are frequently "turned" during nesting activities (Frazier, 1984).

The eggs of all the species are taken in most areas, but the exploitation of Chelonia eggs is by far the most severe. The harvest of eggs and adults is largely uncontrolled, with the possible exception of Chelonia in Reunion.

In Mozambique there was some exploitation during the early 1970's at least, for local meat consumption although the market was small, and also some trade in stuffed turtles (Chelonia) and in "tortoise shell" (Eretmochelys) for the local curio trade. Nesting females are said to be killed whenever encountered and their eggs dug up, but populations on the mainland, are thought to be low, and possibly "doomed" due to over-exploitation.

Numerous tribes in Madagascar still hunt turtles by harpoon and by net, and thousands of tons of meat are consumed locally every year. In addition, the annual value of tortoise shell and stuffed Hawksbills has been estimated around $100,000. Exploitation in Mauritius is heavy, although the population is small.

Similarly in Seychelles and Mayotte, exploitation is heavy, although production in Seychelles has declined due to over-exploitation. Mortimer (1983) suggests that there has also been a decline in Hawksbills and exploitation in Seychelles is still more or less uncontrolled.

The annual crop of turtles in Tanzania may not exceed 500, and in 1979 an estimated 3621 kg of tortoise shell were exported or re-exported from Zanzibar.

Somalia exports "tortoise shell" for the international trade, and turtles are also killed for food when encountered. The Bajun of Somalia are a people with traditional turtle hunting skills, they continue to consume turtles locally.

Incidental Exploitation.

There are no specific data on incidental catches, but Frazier confirms these do occur, apparently at a low level. The main causes of indirect exploitation would appear to be from animals being accidentally caught in fishing nets. In Tanzania particularly they are also killed incidentally by dynamite fishing.

In Mozambique at least, the fishermen are required to return incidental catches to the sea if still alive.

Habitat destruction.

Habitat disturbance is widespread throughout the region. Sandy beaches are particularly susceptible to domestic and oil pollution. However, unless these are severe, they are unlikely to cause considerable damage to turtle poulations. Beach erosion has been recorded in Kenya, Tanzania, La Reunion, Mauritius, Comoros and Seychelles (IUCN/UNEP, 1984), principally as a result of coastal developments, clearing of sand-binding vegetation from beaches and dunes, and removal of sand for construction purposes.

Considerable damage to reproduction capabilities has been done by increasing disturbances to beaches and breeding sites through increases in local populations and tourism. In some cases feral dogs cause extensive destruction by destroying nests and by eating eggs and hatchlings (Moheli, Comoros).

Destruction of suitable feeding areas for Chelonia in the region as a whole may have some effect on turtle densities at other sites. Green turtles are known to travel far from the nesting areas in search of food, principally, seagrass and algae in the adult phase. The problem of habitat destruction therefore crosses international boudaries and effects the entire region. There is little information cited in the literature concerning turtle feeding grounds but potential areas are certainly being affected by inappropriate fishing techniques and increased sediment loads brought down by major rivers - this latter problem is particularly acute in Madagascar.

Oil Industry

There are no records available on the effect of oil on turtles in the region. However, beach tar pollution may hamper the juveniles on their way to the sea, tarball pollution is concentrated on the mainland coasts.

Waste Discharge

This type of pollution affects turtles mainly through the food chain, particularly those feeding on crustaceans and coelenterates e.g. Eretmochelys, Caretta, Dermochelys and Chelonia juveniles (IUCN/UNEP, 1982).

Feeding areas e.g. seagrass and algal beds in shallow waters close to the main urban centres may well be affected.

Recreation and Tourism

The sale of polished and stuffed specimens of Eretmochelys and Chelonia to the local tourist trade is common throughout the region, more particularly in those countries where tourism is well developed e.g. Kenya and Seychelles, and less so in Comoros, Madagascar and Mauritius.

Disturbance of nesting beaches by tourist facilities cannot be overlooked.

Existing Management Practices

Seychelles has made some effort towards managing the exploitation of Green and Hawksbill turtles, but even here, legislation is difficult to enforce and the exploitation of both species remains largely uncontrolled.

There is some management of Green turtles in La Reunion through the establishment of the turtle ranch.

Mauritius allows the capture of males only. Elsewhere legislative proceedure is not enforced - other than the protection of nests in Kenya.

Priority Concerns

Since marine turtles are migratory, travelling between feeding and breeding grounds, they may be considered as "shared species", requiring co-operation in management and protection between all the countries of the region.

Priority Recommendations

a) A co-operative turtle management programme should be drawn up and implemented. Such a programme should include breeding programmes for the more threatened or commercially valuable species. It should also include a research and monitoring component.

b) Implementation of national legislation and international agreements relevant to marine turtles is recommended, there is an urgent need to provide physical protection of known nesting and feeding areas.

c) Major feeding grounds of the turtles, particularly Chelonia, should be identified. Efforts should be made to protect habitats critical to marine turtles.

BIRDS

Character and Occurrence

The region is host to a wide range of typically marine and maritime avifauna. The common seabirds include terns (Sterna fuscata, Anous stolidus, A. tenuirostris, and Gygis alba), tropic birds (Phaeton lepturus and P. rubicauda) and the boobies (Sula dactylatra, S. leucogaster and S. rubipes). Shore and coastal habitat species include many genera, the most important of which are given in a recent report by IUCN/UNEP (1984), which includes species endemic to the region, many of which are threatened with possible extinction (e.g. the Madagascar fish eagle Haliaeetus vociferoides.

Conservation Status

Many of the island rookeries in Seychelles (Aldabra Atoll, Bird Island, Aride, Frigate and La Digue) and in Mauritius now afford protection to their seabird colonies. In Madagascar only Nosy Mangabe offers good protection to

seabirds. Elsewhere, this has been incidental to the establishment of marine parks and reserves.

In Mauritius the seabird population on Round Island (a reserve area) is threatened not only by the collection of eggs and the killing of nesting birds (which are taken for consumption by visiting fishermen) but introduced rabbits are also destroying the habitats. In Seychelles destruction of indigenous forest through coconut plantations and human predation has almost eliminated Abbot's booby (Sula abbotti) (IUCN.UNEP, 1984). In Seychelles, Salm (1978) reports that the young of shearwaters are collected and eaten and that egg collection for sale in Mahe has been going on for some time.

Competition with man in heavily fished waters such as along the Tanzania coast and in Mauritius may be affecting seabirds foraging in inshore waters.

Human and Economic Value

As food and for the production of guano (Seychelles) (Salm, 1978; IUCN/UNEP, 1982). Their functional relationship with the marine fisheries of the region may be inferred from the food chain and possible maintenance of equilibrium between desirable (commercial) and undesirable fish species.

Targeted Exploitation.

Feare (1984) has noted that human predation is largely confined to those species which breed synchronously in large colonies. In general, this applies to island nesting seabirds only. Feare states that only Puffinus pacificus, Anous stolidus and Sterna fuscata have been commercially exploited in the Seychelles. Of these, the shearwater (P. pacificus) has been exploited for its chicks, and the other species for their eggs. In former years, as many as 10,000 shearwater chicks may have been taken from Cousin Island alone, but this cottage industry is now apparently in decline, and on Cousin and Aride the birds are now protected. Of the other species, egg collection of Sterna fuscata has probably contributed to their decline, but otherwise, current levels of exploitation are thought unlikely to affect the species populations (Feare, 1984). Both Salm (1978) and Feare state that, although no data are available, the collection of eggs of easily disturbed species such as crested and black naped terns (S. bergii and S. sumatrana) may have reduced their numbers too.

Incidental Exploitation.

In the Seychelles, the use of bird nesting sites in a number of islands for the construction of airports may have affected seabird numbers. In Madagascar, the vulnerable teal (Anas bernieri) is associated with mangrove habitats which are also being destroyed (Hamilton & Snedaker, 1984). No records of incidental capture of birds in fishing gear have been found.

Oil Industry

Those species which feed in intertidal habitats and on beaches susceptable to oil pollution are the most vulnerable. Floating oil from slicks and deballasting present evident danger to birds following fish shoals. Long stretches of floating oil have been observed between Grand Comoro and Moheli. Accidental spills, such as the recent one in Dar-es-

Salaam (Pathmarajah, 1982; IMO/UNEP, 1982) in which oil spread on beaches and lagoons may have affected seabirds in the vicinity

Oil prospecting activities also present a threat to seabirds. The important bird island off Dar-es-Salaam, Latham Island, is presently undergoing oil exploration activities. It is feared that man's presence and the modifications necessary for installation of the equipment may eventually lead to abandonment by the seabirds.

Waste Discharge

Pricipally affects near shore species and waders using estuaries and lagoons which are subject to pollution from domestic, municipal and industrial wastes. Beaches in Comoro and Tulear are used to deposit raw human sewage. The effect upon the seabirds is mainly through the food chain, especially for birds feeding on crustacea and other invertebrates occurring in shallow or exposed habitats and those feeding on lagoon or esturine fishes.

Sedimentation

Only applicable in so far as sedimentation affects the food chain.

Recreation and Tourism

Mainly in relation to protected areas. In Seychelles, for example, Cousin Island is regularly visited by both bird watchers and general tourists; numbers of visitors are not immediately available. In Mauritius local inhabitants and visitors enjoy watching tropic birds which use the Black River in the Machabe Forest Reserve. Some of the areas are however too distant to attract the regular tourist e.g. Aldabra Atoll in Seychelles and Flat and Round Islands in Mauritius.

Existing Management Policy

A blanket protection under national nature conservation legislations but more so through the national policies directed at the establishment of parks and reserves.

Existing Management Practices

Mainly through the establishment of protected areas. In Seychelles attempts have been made to regulate the collection of eggs. The island of Desnoeufs seems to be the only one in which collection is allowed and the island has been divided into two management sections - one a reserve and the other for collection of eggs (Salm, 1978). Elsewhere in Seychelles, Mauritius, and probably Madagascar and La Reunion there is no management policy and the collection of eggs and the hunting of adult birds may be taking place, there is no managemnet policy. It seems the mainland communities are not interested in eggs or adult birds.

Seabirds use mangroves as a habitat extensively throughout the region, and sometimes intensively. The mismanagement of mangroves must therefore ultimately affect seabirds populations. The Seychelles magpie robin (Copsychus seychellarum), Abbot's booby and the Madagascan fish eagle are

partially or wholly victims of land mismanagement.

Priority Concerns

a) Important seabird concentrations or habitats as yet unprotected must be identified and brought under protected status.

b) Bird populations using areas where oil pollution is a potential problem e.g. Latham Island, should be given special attention.

c) The use of pesticides and other agrochemicals should be carefully controlled. Research should concentrate on the potential impact of agrochemicals and waste discharges on the coastal and marine avifauna of the region.

CONCLUSIONS AND RECOMMENDATIONS

In addition to conservation measures taken by individual countries or collectively, and by UNEP, IUCN and the World Wildlife Fund (WWF), there are a number of other international organiSations which have been active in the region over a long period of time. These include, the Food and Agriculture Organization of the United Nations (FAO) primarily on resource management; the United Nations Educational, Scientific and Cultural Organization (UNESCO) on research, the Man and the Biosphere (MAB) programme and the World Heritage Convention; the World Health Organization (WHO) from a human health point of view; the International Maritime Organization (IMO) on shipping and oil pollution; and the International Council for Bird Protection (ICBP) which has been collaborating very closely with IUCN and WWF with regard to the protection of the avifauna of the region especially in Mauritius and Seychelles. The United Nations Development Programme (UNDP), the World Bank, and a number of bilateral development agencies have been a main source of finance needed for the development of the various resources, while the non-governmental organisations mentioned as well as UNEP have concentrated their efforts on environmental resources protection measures.

At the regional level the East African Harbours Association - an association of the port authorities of these countries can be credited for sounding out the need to protect the region from oil pollution.

Priority Concerns - National and Regional

Several activities under varying degrees of management or control are underway on both land and sea. Some reference to some of these has already been made in the preceding sections.

On land the main activities include:

- cultivation of food and cash crops;
- settlements including urban expansions;
- industries including facilities for receiving and processing fish products, agricultural products;
- communications, including harbour expansions;
- tourism development;
- oil prospecting on both coastal plain and the continental shelf and banks; and
- development of hydrological resources for the purposes of irrigation or electric energy production.

Although the data are not immediately available for all areas along the coast, the use of agrochemicals is common particularly as fertilizers, insecticides and fungicides in coffee, wheat, sugar and a number of other commercial crops. Present levels are however not significant enough to cause concern insofar as marine environments are concerned.

Industrial development is principally agriculturally based. In Mauritius where sugar cane plantations cover a large part of the island a particularly high BOD load (4,600 lbs) is caused by wastes from some 20 mills which are allowed to flow directly into streams finally ending in the sea. This is not uncommon with regard to other countries producing sugar cane such as La Reunion, Madagascar, Mozambique, Tanzania and Kenya. In the case of Mauritius heavy mortality of fish and invertebrates has been observed. Textile mills, plastic industries and breweries sited in coastal towns are also known to allow untreated effluents into streams and creeks. The Msimbazi Creek in Dar-es-Salaam is receiving dyes and chemicals used in a textile factory up-stream as is the case with another factory in Maputo (Mozambique).

In addition to sewage, solid wastes, oil from garages and other related sources finds it's way into lagoons and creeks. In some of the major urban centres sewage treatment facilities have been installed; others have yet to install them or to get the system working properly. In many cases solid wastes are used as materials for reclamation of sites for construction (e.g. fills). Leachate from these dumps finds its way into the nearby marine ecosystem and the associated metals etc. enter the food chain. This is significant considering that the local inhabitants eat a wide variety of invertebrates found on these shores, including fish. Thus, while negligable in terms of the area of the sea involved, locally this is an important problem. Estimates of discharge from domestic sewage has been shown previously in Table 2.

Recreation and tourism

The summary of tourists in the region (see data in Coral Reef section) indicates that the region received well over 748,000 in 1980 with well over one third of these destined to the coasts. For Kenya, Seychelles, Mauritius and soon Comoros this is a very important foreign exchange earner. Consequently there have been, in some cases, intensive developments of tourist facilities (hotels, roads, airports, etc.,) along the edge of the coastlines as well as the use of beaches and coral reefs for recreation. Activities have included snorkelling, sailing, spearfishing (which is now banned in a number of countries) and sports fishing. Along with this however, has been the destruction of marine life, such as coral heads, shells etc., taken for sale in the curio trade. This is particularly serious in Comoros, Madagascar and Mauritius; the other countries have introduced measures to protect corals although these are not as strict for shells.

In addition to the need to reduce to a minimum this kind of destruction, there is also a need for the countries to cooperate in developing the tourism potential of the region. In doing so particular attention must be given to critical habitat needs of marine turtles.

Mining and Dynamiting Coral Rock

The problem is particularly serious in Comoros and Madagascar (mining), and Mauritius, Kenya and Tanzania (dynamiting for fish). Serious beach and coastal erosion has now been observed. The tourist complexes along the Kunduchi beach north of Dar-es-Salaam are threatened by imminent sea encroachment, the coastline of Moheli island in Comoros is being eaten away slowly and some houses have already been flooded with sea water. Curative measures will be expensive and for, control, measures are required at the soonest opportunity. The destruction of coral habitats has also led to

serious impoverishment of the fisheries of these areas; the local fisheries around the Dar-es-Salaam coast northwards to Tanga are finding it harder to fill their catch. The result is intensified dynamiting and inescapable unemployment.

In the sea the main activities include:

- fishing (subsistence and artisanal, large scale, and sports);
- shipping, including oil destined to the individual countries of the region or in transit;
- oil prospecting;
- recreation; and
- coral rock mining.

Oil Industry

The western Indian Ocean is a major transit route for tankers carrying crude oil from the Arabian Peninsula and which use the Cape route (see Figure 4). Some of the tankers do however, deliver crude oil or processed oil to most of the countries of the region. The crude oil is processed for internal use and re-export, or re-exported crude to neighbouring countries (Table 10).

Practically all the countries are actively searching for gas along the coastal plain, continental shelf and banks, with assistance from other countries.. Some of these countries e.g. Tanzania and Mozambique, have already discovered gas deposits. Figure 5 shows areas now under exploration as well as the location of refineries in the region.

A number of problems emerge. The transit tankers, as well as those delivering crude or refined oil often deballast in the open sea. The oil so released finds its way to the coastline, where, as on Comoros, Somalia, Kenya and Mauritius it forms into tar balls or is deposited on beaches and on coral heads, thus severely affecting the natural resources and tourist activities of the region. At the same time deposition on coral and other habitats such as mangrove directly affects the associated species; free swimmers and seabirds are also affected.

There have also been oil spills at receiving and loading facilities. Dar-es-Salaam harbour witnessed this in 1981 and a wide range of marine life was severely affected. The discovery of new oil fields also presents certain oil spill dangers. It is evident therefore that rigorous preventative measures are taken at harbours and depots in order to prevent tanker owners deballasting their vessels at sea. It is worth noting in this context, that currents flow towards the mainland coast. The IMO and East African Harbours Association are actively trying to find solutions to this problem and it is one of the major action points to be identified in the Eastern African region.

Table 10 - Refineries, 1981
(from UNEP Regional Seas Reports and Studies, No. 10)

Location	Name of Refinery	Yearly Amount	Size of Tanker	Discharge Arrange-ments	Supply to Other Countries
Mogadishu	Iraqsoma	0.30	30,000	Alongside	------
Mombasa	East African Oil Refinery	3.00	80,000	Alongside	(refined)
Dar es Salaam	Tanzanian Italian Petroleum Refinery "T.I.P.E.R."	1.60	100,000	S.M. Buoy and under water pipeline	Zambia (crude)
Matola		1.00*	50,000	Alongside	Zimbabwe crude through Beira from 1982
Tamatave	Solitany Malagasy Raffinerie de "SOLIMA"	0.65	50,000	Under water pipe to berth	Comoros La Réunion (refined)

* Estimated

Recommendations for Action

Draft Action Plan for the Protection and Development of the Marine and Coastal Environment of the Eastern African Region

Eastern African Governments are soon expected to adopt their Action Plan along with a convention and two protocols. One is to cover cooperation in pollution emergencies, the other specially protected areas and endangered species.

Although the Eastern African coast is rich in a variety of marine life forms (see previous section), a UNEP mission to the region discovered damaged coral reefs, oil pollution, erosion, pollution from fertilizers and threats to endangered species.

A recent meeting of experts selected by their governments (Seychelles, 1982) prepared the first draft of the Action Plan, and invited UNEP to help in solving some of the problems identifies by the meeting without formal adoption of the action plan.

The workshop named 10 first priority regional projects (see later) which UNEP and United Nations agencies were asked to initiate during 1983. They include work on developing a network of environmental pollution laboratories, on providing training facilities for environmental control technicians, and on developing a network of oil pollution monitoring centres. Two other priority projects are concerned with assessment of the environmental impact of economic and social developments and a regional environmental education programme.

Experts nominated by their governments repared country reports on the status of natural resources and conservation, environmental legislation and socio-economic activities.

All components of the action plan are interdependent, and provide a framework for comprehensive action which should contribute to both the protection and the continued development of the region. No component is an end to itself. Each activity is intended to help the Governments of the region to strengthen the process through which environmental management policies are formulated.

The general goals and objectives in this action plan for the protection and development of the marine and coastal environments are:-

- to promote the sustainable development and sound management of regional marine and coastal resources;

- to establish general policies and to promote appropriate legislation for the protection and development of the marine and coastal environment on a national and regional level;

- to prevent pollution of the marine and coastal environment within the region originating from activities within the States of the region or from operations primarily subject to the jurisdiction of extra-regional States;

- to provide for the protection and national development of the living resources of the region, which are a natural heritage with important economic and social values and potential, through the preservation of habitats, the protection of species, and the careful planning and management of human activities that affect them;

- to strengthen and encourage, through increased regional collaboration, the activities of institutions within the region involved in the study of marine and coastal resources and systems;

- to improve training and assistance at all levels and in all fields relating to the protection and development of the marine and coastal environment; and

- to stimulate the growth of public awareness, at all levels of society, of the value, interest and vulnerability of the region's marine and coastal environment.

More specifically, the activities of the action plan should result in:-

- assessment and evaluation of the causes, magnitude and consequences of environmental problems, in particular assessment of marine pollution and study of coastal and marine activities and social and economic factors that may influence, or be influenced by environmental degredation;

- promotion of methods and practices for the management of socio-economic development activities that safeguard environmental quality and utilize resources wisely and on a sustainable basis;

- adoption of regional legal agreements and strengthening of national legislation for the protection and development of the marine and coastal environment; and

- establishment of institutional machinery and adoption of financial arrangements required for the successful implementation of the action plan.

A general description of the main components of the action plan is given below. These components and the related activities are not listed in order of priority.

Environmental Assessment

Assessment of the environmental processes of the region is incomplete. Because sound action requires an understanding of the intricate links between development and the environment, there exists a need for continuing systematic assessment of the main factors influencing environmental quality. Among the tasks that should be performed are:

- assessment of national and subregional capabilities to investigate and manage environmental processes, including scientific and administrative institutions, manpower, research facilities and equipment, together with identification of institutions with potential to serve as "regional activity centres" in particular disciplines, and as regional or subregional activity centres co-ordinating specific inter-state projects;

- encouragement of collaboration among regional scientists and technicians and their institutions through the establishment of a co-ordinated regional marine pollution monitoring programme, based on intercomparable methods, for the assessment of the sources and levels of pollutants and their effects on marine life and human health;

- strengthening capabilities in marine science and for monitoring and assessing the state of the marine and coastal environment and the conditions of the living resources, including the training of scientists and technicians from the region in methods and techniques related to the assessment and evaluation of marine pollution;

- compilation of an inventory of the sources and amount of pollutants reaching coastal waters of the region from land based and maritime sources;

- collection, analysis and dissemination of data on resource potential, resource utilization and coastal habitats of the region;

- analysis of the data on competing demands for resource utilization; and

- survey and assessment of present socio-economic activities; including development projects, that may have an impact on the quality of the marine and coastal environment.

Environmental Management

The key to sustainable, environmentally sound development is wise management of the resource base. Such management should take into account the assimilative capacity of the environment, the goals of the development as defined by national authorities, and the economic feasibility of their implementation. The following activities may be undertaken to strengthen the ability of governments to adopt appropriate environmental management policies:

- strengthening or expansion of relevant ongoing development activities that demonstrate sound environmental management practices;

- cooperation on preparedness for pollution emergencies and measures to mitigate their consequences;

- cooperation on application of existing international measures to reduce and control pollution by hydrocarbons;

- formulation of regional and locally applicable guidelines and standards for management and control of domestic, agricultural and industrial wastes, including the development of principles governing the treatment and discharge of such wastes;

- harmonization of policies on the management of wildlife, genetic resources and natural habitats;

- cooperation in the establishment and management of protected coastal and marine habitats, such as wetlands, nurseries and breeding grounds, coral reefs and mangroves, including training of technical personnel and managers in the conservation of wildlife and habitats, and mapping of critical coastal and marine habitats;

- cooperation in devising alternative land-use practices and development patterns appropriate for conditions in the region, including improvement of national capabilities to assess the environmental impact of development proposals;

- cooperation in the exploration and utilisation of fisheries to achieve the most rational utilization on a sustainable basis; and

- studies of the environmental, social and cultural effects of tourism, and elaboration of alternative strategies for tourism development. Particular attention should be given to the health aspects of tourism installations in coastal resort areas, including drinking water quality, sanitation and food safety.

Environmental Legislation

National legislation and regulations pertaining to the protection and development of the marine and coastal environment should be reviewed and where necessary expanded, updated or strengthened. The enforcement of national regulations related to marine and coastal resources should be improved, e.g. with respect to prevention of pollution of the marine environment and protection of marine species.

National legislation and regulations on the protection and development of marine and coastal resources should be harmonised whenever regional uniformity is required to meet the objectives of such legislation, e.g. on the protection and management of migratory marine species within the region.

An up-to-date compilation of national laws of the states of the region related to the protection of the marine and coastal environments should be maintained.

A regional convention for the protection and development of the marine and coastal environment of the Eastern African region should be developed and adopted. It should be supplemented by protocols prescribing agreed measures, procedures and standards to prevent, reduce and control pollution from all sources and to promote environmental management objectives.

Technical assistance and advice on the drafting of national legislation for the effective implementation of the regional convention and its protocols and other relevant international agreements should be provided by appropriate international organisations upon request.

Institutional and Financial Arrangements

In carrying out the action plan, the national capabilities available in the region and the capabilities of regional and international organisations and co-ordinating bodies, as well as their existing regional programmes, should be used to the greatest possible extent.

The agreed programme should be executed primarily through existing national institutions. Where necessary, they should be strengthened so that they may participate actively and effectivly in the various projects. For some of the projects, in the initial phase, the assistance of experts from outside the region may be requested.

To ensure the harmonious and integrated evolution of each of the components a small central co-ordination unit should be established in the region to oversee the implementation of the action plan. This unit should benefit as fully as possible from technical co-operation with existing international, national and regional organisations and co-ordinating bodies. A national focal point should be designated by each government to facilitate the work of, and communicate with, the central co-ordination unit, and to co-ordinate the activities of an inter-disciplinary programme at the national level.

The activities agreed upon as part of the implementation of the action plan should be financed separately through contributions from governments, international organisations and non-governmental organisations. Initially, support may be provided by the United Nations system on the assumption that this financial contribution will progressively decrease as the governments themselves assume financial responsibility for the programme.

The ultimate aim should be to make the proposed regional programme self-supporting, not only by developing institutional capabilities to perform the required tasks, but also by supporting the provision of training, equipment and other forms of assistance from within the region.

Supporting Measures

As support for the activities of the regional co-operative programme, intensive training programmes should be formulated for personnel from the region. These programmes should be carried out through existing national, regional or international institutions ready to offer their facilities.

Campaigns should be instituted on a national basis to create public awareness of national and regional issues relating to the protection and development of marine and coastal resources.

Education in the principles of protection and development of marine and coastal resources should be provided as part of the ordinary educational curricula at primary, secondary and university levels, through training of special instructors or specialised training of general educators, and through seminars and courses offered to the general public.

PROJECT PROPOSALS

Projects of Regional Importance

Priority Rating - 1

i) Inventory of ecosystem in the region, in particular mangroves, lagoons and coral reefs, and harmonization of national legislation with respect to mangroves, lagoons and coral reefs.

ii) Regional inventory and documentation of all existing protected areas, with proposals for new ones and for harmonisation of management policies.

iii) Regional inventory and documentation of all endangered species, with descriptions of critical habitats and proposals for preserving them.

iv) Development of a network of environmental pollution control laboratories.

v) Provision of a facility within the region for training of environmental pollution control technicians to staff the laboratories.

vi) Development of a network of oil pollution monitoring and control centres.

vii) Assessment of socio-economic activities that may have an impact on the marine and coastal environment and development of suitable planning and management techniques to prevent adverse consequences of such activities on the marine and coastal environment.

viii) Elaboration of oil pollution contingency plans. Designation, as appropriate, of oil pollution emergency centres and provision of training and equipment and other material necessary for intervention in pollution incidents up to a scale of major disasters. Training should also be provided that takes into account the provisions of MARPOL 73/78 and other IMO conventions relevant to the Eastern African region.

ix) Development and adoption of a regional convention for the protection and development of the marine and coastal environment of the Eastern African region and protocols concerning:

- co-operation in combating pollution in cases of emergency

- specially protected areas and endangered species.

x) Preparation and application of a regional environmental programme, with particular reference to the development of teaching materials, including the publication of school text books and public information campaigns, geared to increasing environmental awareness.

Priority Rating - 2

i) Network for the surveillance and control of foreign vessels carrying out illegal fishing activities in the region.

ii) Training of scientists and technicians in marine sciences.

iii) Assessment of the continuous spread of sand dunes along the coastal areas and the effects of coastal sand and lime extraction for construction purposes and study of the means to control them.

iv) Training in methods of establishment of environmental quality criteria and waste discharge regulations.

v) Study of alternative forestry activities to replace the use of mangroves for the production of firewood.

vi) Provision, where appropriate, of reception facilities in the region for shore based discharge of oily ballast and other pollutants in preparation for the declaration of the region as a discharge-free zone.

vii) Training of staff in the management and supervision of marine and coastal national parks.

viii) Assistance in the enactment and harmonization of environmental legislation concerning coastal and marine areas.

Priority Rating -3

i) Regional study to improve fish handling, distribution and quality control.

ii) Assessment of origin and magnitude of pollution from industrial and agricultural activities.

iii) Study of the oceanic and coastal circulation relevant to the transport of oil pollution in the region.

Projects of Sub-regional Importance

Priority Rating -1

i) Study of ciguatera poisoning and heavy metal, organochlorine and radioactive contamination in fish.

ii) Assessment of the impact of dynamite fishing and coral destruction on the coastal and marine habitats and their socio-economic effects on the coastal populations.

iii) Study of the green turtles, harmonization of national legislation and co-operation on protection measures.

Priority Rating -2

i) Assistance in species identification of shrimps and spiny lobsters, as well as related stock assessment programmes, and establishment of a regional tuna stock identification system using biochemical, genetic and other related analytical techniques.

ii) Preparation of a survey on and assistance in improving present sewage disposal systems.

iii) Short television films and publications of material on ciguatera and fish quality control.

iv) Study of the behaviour and movement of sharks in the region, particularly where the tourist industry is affected.

Regional Conservation Strategy

The main recommendations which emerged from the Mauritius Workshop are as follows:-

Training:

- comprehensive assessments should be made of training needs for management of resources;
- immediate consideration should be given to the creation of an academic programme;
- resource management training should include technical level personnel; and
- additional training of existing personnel should be undertaken.

Technical Consultations:

- regional coordinating mechanisms for technical consultations should be expanded.

Education Programmes should:

- increase the awareness of the general public on coastal and marine resources;
- ensure efforts are directed at the relevant policy-makers to encourage sound management of coastal and marine resources; and
- ensure that curricular materials are developed and disseminated for use in schools at all levels.

Special Management Areas:

These should be established in a limited number in order to:-

- demonstrate the feasibility of biological resource conservation and sound resource management and development;
- demonstrate the effective conservation of critical habitats;
- produce an effective balance between development and protection of marine resources; and
- identify and fill the gaps concerning the distribution of various habitats in the region.

Regional Scientific Capabilities:

- review and update of the regional research facilities;
- review of existing baseline data, and additional data requirements; and
- establishment of a regional network of scientific facilities and long term monitoring programmes

Prevention of Collection and Commercial Exploitation of Specimens of Rare, Threatened or Endangered Species:

Action should be taken to ensure that:

- rare or endangered species are listed in the annexes of the International Convention on Trade in Endangered Species of Flora and Fauna (CITES);
- there is rigorous enforcement of laws prohibiting the transfer of restricted biological or physical specimens;
- there is control of the collection of and trade in specimens of rare or endangered species;
- alternative employment opportunities are found for persons engaged in collection and trade of these species; and
- an educational programme to stress the value of these species.

Sewage and Industrial Pollution Monitoring:

States should monitor the extent and impacts of sewage and industrial pollution (e.g. on coral reefs), in order to assess the feasibility of construction of additional treatment. Alternative treatment should be considered, including those linked to natural processes reducing contaminants, or the production of useful substances.

Oil Spill Contingency Plan:

Oil Pollution Assessment:

Big Game Fishing Assessment.

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