

# Environmental Stress in the East African Region

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*The East African Region is not as polluted as the Mediterranean or the Caribbean, but it is plagued by a number of environmental problems, most notably soil erosion, the pollution of coastal waters by untreated sewage and chemical wastes, and the rapid disappearance of wildlife habitats. All of these are engendered by pell mell growth with little or no concern for environmental consequences. The Region's worst enemy is lack of planning. It is hoped that the East African Regional Seas Program will provide a framework for sound development based on mutual cooperation and the rational use of natural resources.*

Figure 1. Coastal cities and towns in the East African Region. Source: UNEP.

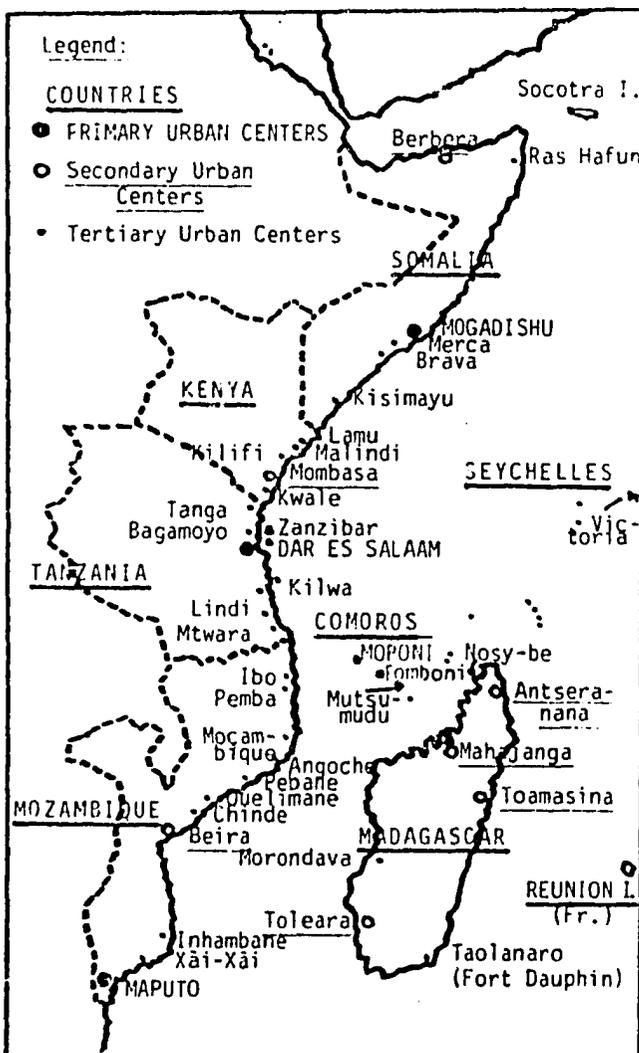


Figure 2. The general current pattern in January. Source: UNEP.

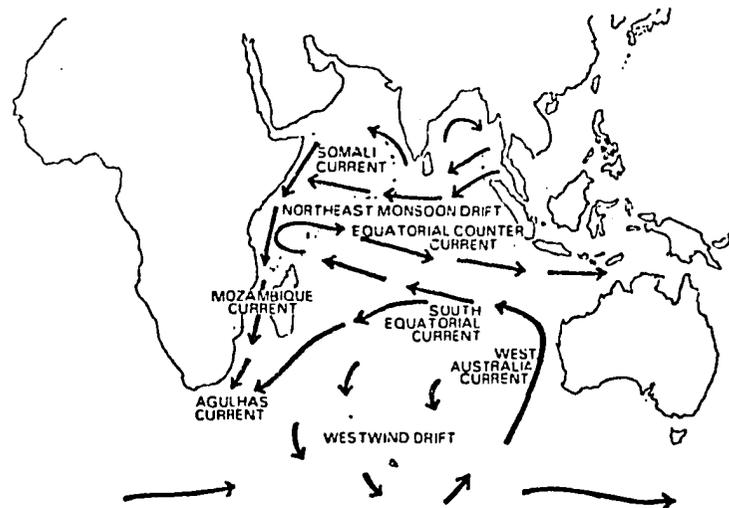
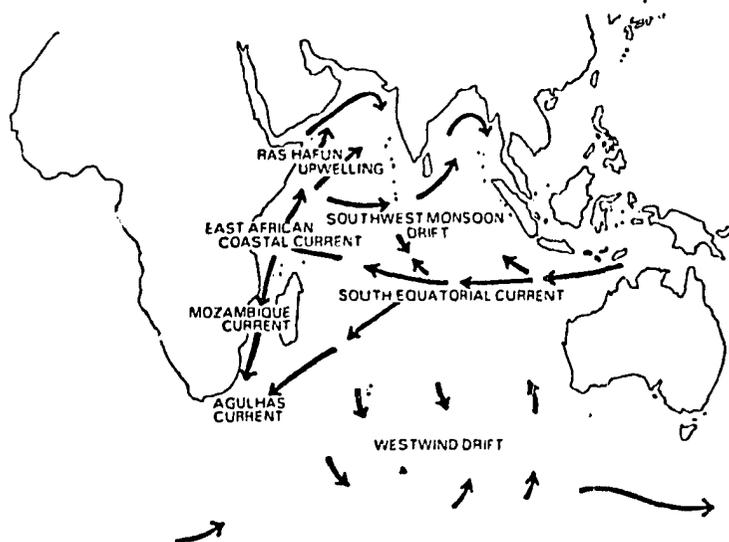


Figure 3. The general current pattern in July. Source: UNEP.



not been a high priority in economic and social planning. As a result, pollution is claiming the region's waters, erosion its lands, and the destruction of habitats its wildlife.

Concerned with the course of environmental degradation in the East African Region, the Governing Council of the United Nations Environment Program in May 1980 urged UNEP to start working on a plan to protect and develop the marine and coastal areas of the Region. The first step was a multi-disciplinary mission to the Region in October and November 1981 to assess its problems. The UNEP Secretariat compiled an overview of the situation based on reports from the six mission members (1).

Among the findings of the mission members was the fact that the governments of the area have generally not shouldered the tasks of preventing haphazard development, managing the use of natural resources in a sustainable manner, or intercepting and treating wastes before they are deposited in the sea.

mainland states of Kenya, Mozambique, Somalia and Tanzania, and Madagascar (which, though an island, is large enough to be similar geographically to the continent), and the small island states of Comoros, Mauritius and Seychelles (Figure 1). Many of the environmental problems discussed are common to all or a majority of the states (2).

## THE REGION'S CHARACTERISTICS

### Winds and currents

Tropical waters dominate, with warm surface layers and only slight temperature variations throughout the year. The hydrography of the Indian Ocean is strongly influenced by seasonal variations of the monsoon winds. There are three hydrographic zones in the region: Somali upwelling zone on the northeast Somali coast; monsoonal current zone affecting Tanzania, Kenya and Seychelles; and the Agulhas and Mozambique current zone in Mauritius, Madagascar, Comoros and Mozambique. The southern zone's flow

ures 2-5) (3).

### Continental shelves

The continental shelf off the coast is extremely narrow, though the width does vary (see Table 1). On most headlands and straight stretches of coastline along the East African littoral, there is virtually no shelf, and steep drops begin only a few kilometers out to sea. The shelf's sediments are generally sandy, especially in shallow areas, changing to mud in deeper areas and near river mouths and estuaries. Coral grows extensively in shallow sections, where there are also numerous rocky outcrops.

The shelf surrounding Madagascar varies greatly, with a narrower shelf and steeper drop on the east coast than those on the continent, broader on the west side and broader still to the northwest.

Comoros and the island of Mauritius are surrounded by deep waters that begin a few hundred meters to several kilometers offshore. There are some shallow banks around the island of Rodriguez and other

Figure 4. The vector-mean currents for January. Source: UNEP.

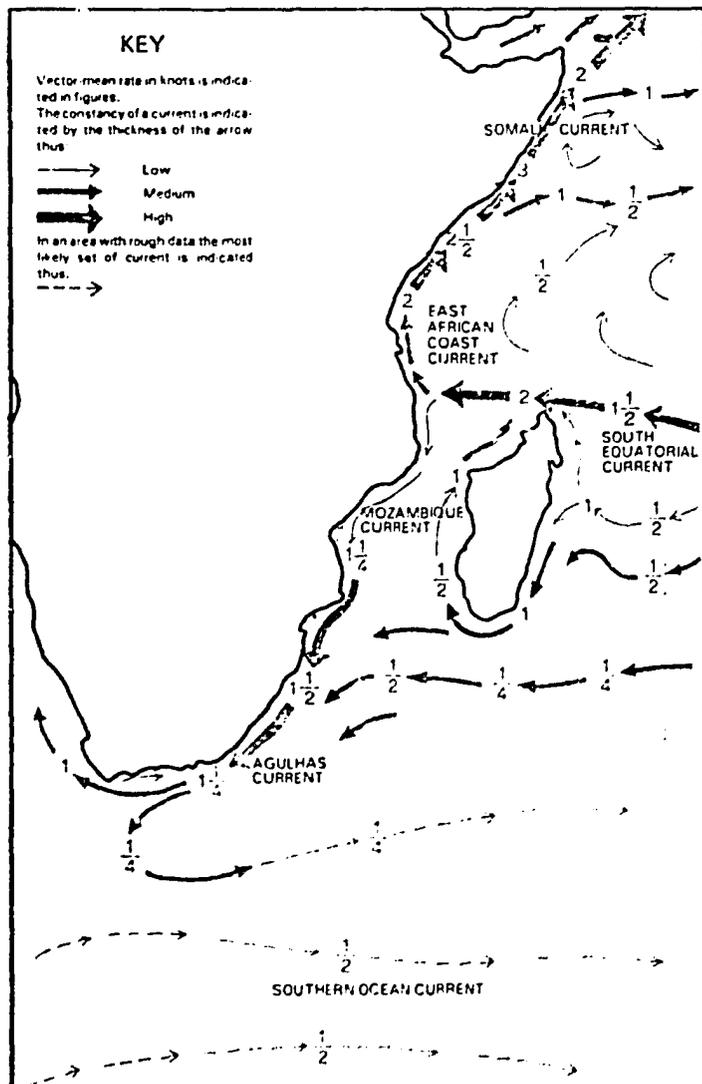
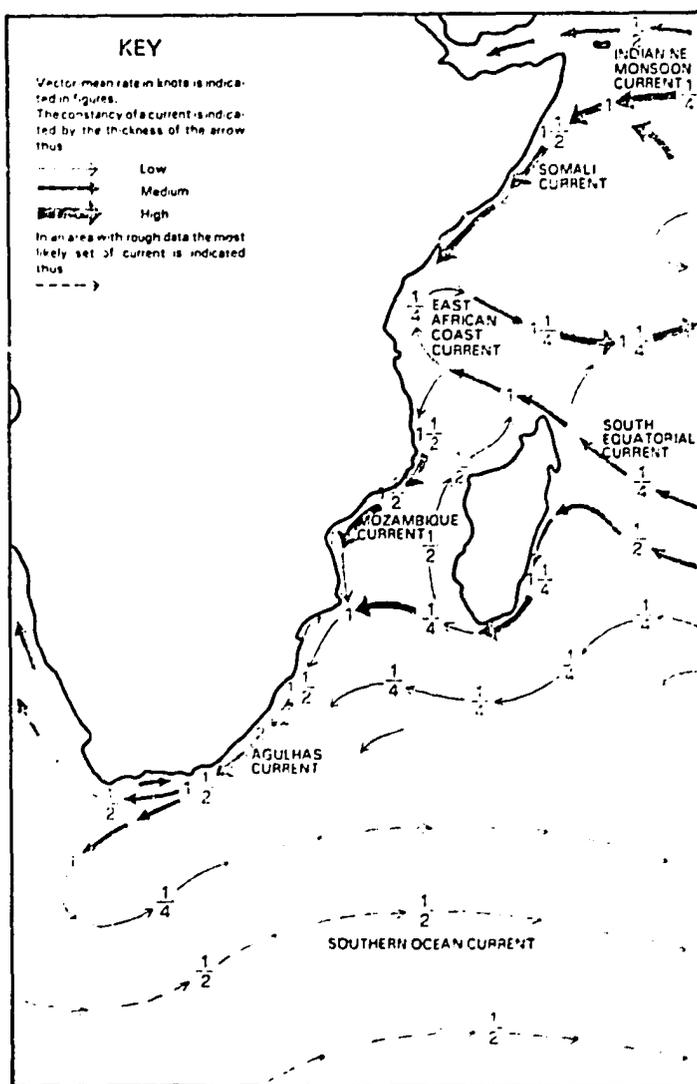


Figure 5. The vector-mean currents for July. Source: UNEP.



dependencies of Mauritius, while the coral islands under Seychelles jurisdiction are characterized by the absence of extensive shelves. The central, granitic islands of the Seychelles group, though, are surrounded by an extensive shelf (see Figure 6).

#### The coastal zone

The coast of East Africa is characterized by a coastal plain some 15 to 20 km wide, which rises to upland savannahs and plateaus. The plain widens towards the south, where there are valleys and floodplains of large rivers, such as the Juba and Shebelle in Somalia, the Tana in Kenya, the Rufiji in Tanzania and the Zambezi in Mozambique. About 10 to 15 percent of the populations of most of the continental states live in this narrow coastal plain; the exception is Mozambique, with 75 percent of its population concentrated along the coast. A similar situation exists in Madagascar (4).

The farms and pastures which cover much of the coastal plain use little irrigation, relying instead on river flooding for mixed cropping and paddy rice, and on rainfall for cassava and maize as well as for the cashews, coconut, coffee, cotton, pineapple, sugar cane and spices for export. Drier areas are used for pasturage, causing considerable soil destabilization on coastal bluffs, dunes and plains (4).

The small islands in their entirety can be considered as coastal zones, because man's activities anywhere on the islands are likely to affect the marine environment. The dilemma of where to locate development projects on the islands is, therefore, an important question in planning. The primary problems in the islands are protecting and managing the immediate shorelines, the planning of urban and other economic growth so they do not strain limited resources, and the prevention of local damage to the marine environment caused by onshore activities (4).

#### MAN'S USE OF RESOURCES

Economic and social development in the Region has tended to deplete resources and to place added stress on the environment. Yet, national development plans have not always considered these factors. Governments in some of the states in the Region have only recently created agencies responsible for protecting the environment and natural resource base. Physical planning to coordinate development with available resources, by and large, has been confined to major cities. But even there, it has been limited to planning infrastructure and has been unable to prevent haphazard development.

The situation is especially evident in the case of coastal development. The absence of planning and management in coastal areas, despite the lower level of development in them than elsewhere, has led to some serious, and perhaps irreversible, trends.

#### Impact of Inland Activities

Large-scale, rural activities in upland areas outside of the coastal zone have important effects on marine resources. Perhaps the

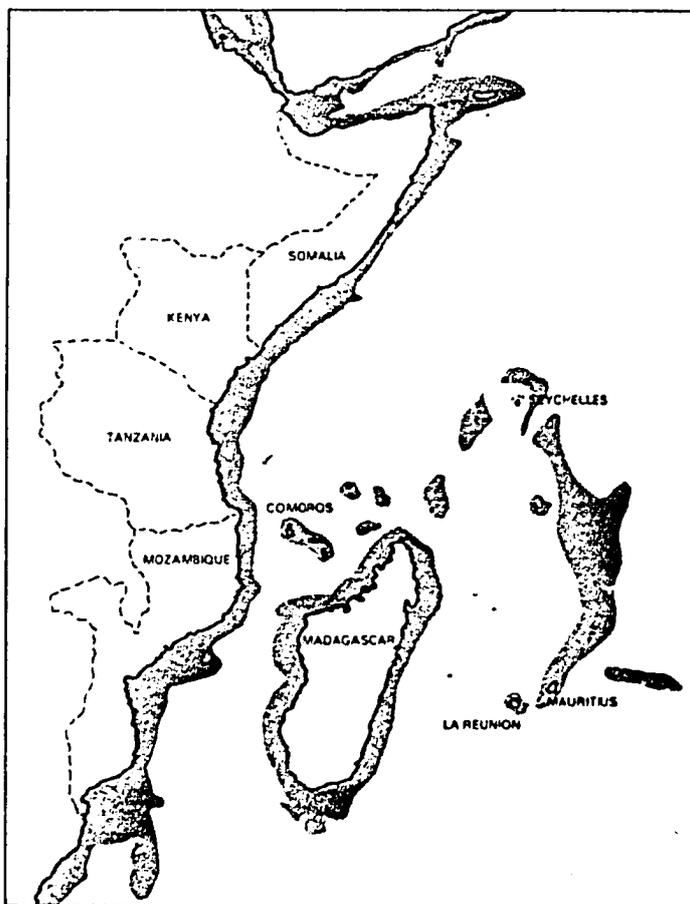


Figure 6. Continental shelves in the Southwest Indian Ocean.

crease in silt carried by major rivers to the sea. This is the result of soil erosion brought on by poor farming practices, 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.

Such large-scale sedimentation from rivers can have a variety of effects on the marine and coastal environment. Silt on

beaches may discourage tourism, as on the Kenyan coastline around Malindi, where the Galana-Sabaki River brings silt. Ports may become difficult to maintain or even unusable, such as in Mahajanga, Madagascar, where 100 million cubic meters of sediment have accumulated over the last 25 years, making its port inoperable (4).

Coral reefs fringing coastlines are smothered or killed in turbid waters. This loss of coral reefs often results in coastal erosion, especially in areas subject to the

Table 1. General profile of countries in the East African Region. Source: UNEP.

| Countries  | Land area (km <sup>2</sup> ) (1) | Estimated shelf area—depth range 0–200 (km <sup>2</sup> ) (2) | Length of coastline (km) | Estimated population 1980 (million) (3) | Marine fish landings 1980 (1 000 metric tons) (3) | Per capita fish consumption 1980 (kg live weight) (4) |
|------------|----------------------------------|---|--------------------------|---|---|---|
| Comoros    | 2 236                            | 900   | 350                      | 0.33                                    | 4.0   | 12.4  |
| 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 | 738 030                          | 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. Dept. unpubl.

(5) Freshwater fish supply exceeds marine catch

(6) Per capita fish consumption is subject to great variation due to comparatively small number of

Once productive sea-grass beds in lagoons face the risk of being turned into mudflats.

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

Major dams planned or being constructed in East Africa are: the Bardera Dam on the Juba River in Somalia; the dams planned, in addition to those already in operation, on the Tana River in Kenya; the dam at Stiegler's Gorge on the Rufiji River in Tanzania; and the Cabora Bassa dam on the Zambezi River, which is one of several planned in Mozambique. The possible effects of these huge hydropower schemes on the coastal and marine environments should be a cause of concern.

#### Urban development

Coastal areas have been attracting urban development, commerce and industry, which have relied on coastal waters to disperse and dilute their wastes (4). The effects of coastal area development need to be assessed and managed if the resource base and natural advantages of the area are to be maintained.

#### Tourism

Some states in the region are turning to tourism as a means to augment foreign exchange and revenues, and for fostering commercial development. Developing a tourist industry can be made a part of overall development plans, but its success depends on the quality of the coastal and marine environment. However, tourism can also degrade the coastal resources on which it relies by causing pollution, blocking access to the sea or encouraging widespread collection of marine life. It can also have undesirable effects on local economic and social life.

### POLLUTION IN THE REGION

#### Oil pollution

Oil spills and other petroleum discharges pose a major threat to marine ecosystems. The problem is particularly acute in the

a major route for supertankers carrying crude oil from the Middle East to Europe and the Americas. Moreover, because the waters are calm and unmonitored by national governments, tankers returning to load oil in the Middle East routinely discharge oily ballast. Local tankers also discharge large quantities of oil during routine operations (see article "Oil on Troubled Waters" by J Ferrari, this issue). (5).

Vessels and refineries routinely discharge and occasionally spill oil into harbors, which has both immediate and long-term effects on marine life. For example, recent spills in Dar es Salaam, Tanzania, and Matola, Mozambique, have destroyed several hundred hectares of mangroves (5).

Among the effects of oil spills and discharges on the coastal and marine environments are oily patches that can adversely affect marine life, and tar balls and other residues on beaches. Significant spills can smother marine fauna and flora, damage shallow reefs, and blanket lagoons, intertidal areas and beaches. Spills of refined petroleum products near marine habitats, such as coral reefs and wetlands, can have extremely toxic effects on marine life.

The offshore exploration for hydrocarbons being carried out in the Region poses other threats to the environment. These range from the discharge of potentially dangerous drilling fluids (muds), cuttings, and formation waters during the drilling phase to serious spills resulting from blow-outs or the accidental ramming of production platforms by vessels. Systematic discharges of oil-contaminated water and occasional small spills can surely be expected.

Combating oil pollution caused by serious spills calls for contingency planning and the right equipment at both the national and regional levels. However, only Kenya has a national contingency plan for oil spills, and Mombasa (Kenya) and Port Victoria (Seychelles) are the only ports with operational equipment. Dar es Salaam has a limited stock of equipment and several ports have small amounts of dispersants (5).

#### Industrial pollution

The industrial sector in the Region is not large, mainly processing agricultural products. Yet, this results in large amounts of organic matter which must be disposed of. Regardless of whether the wastes are suspended solids, larger particles, sludges or dissolved substances, they all contribute to the biochemical oxygen demand (BOD), which, at high enough levels, can strain the natural tolerance of rivers, bays, wetlands and other bodies of water (6).

Manufacturing tends to be located in major urban areas and the pollution from this sector—especially synthetic chemicals—could severely affect marine life and human health.

In deciding where to locate industries, their wastes and the impact they may have on the environment must be considered. Different bodies of water have different physical, chemical and biological make-ups determining how well they can absorb sewage. Waste recovery and treatment

ment, reduce biochemical oxygen demand and toxicity, easing their effects on the marine and coastal environments.

#### Pollution from domestic sources

Two-thirds of the coastal urban population discharge their wastes directly into the sea. Sewage systems serve only between 10 and 25 percent of the Region's overall population. Mauritius and Seychelles have extensive sewage services, but such systems operate in few mainland coastal settlements. Comoros, Somalia and Madagascar have no sewage systems, relying on pit latrines and septic tanks.

Since what sewage treatment exists is limited to the removal of coarse suspended solids, organic substances, nitrogenous compounds, phosphates and other inorganic salts are released into the ocean. The coastal water organisms usually decompose the sewage quite rapidly and with no damage to the marine environment (7). The effects can also be unsightly near outfall pipes, due to intensified biological action and oxygen depletion (7).

The major problem with sewage is bacteria and, when sewage is discharged near coastal recreation or shellfish areas, pathogens can reach the population—either directly or through the food chain—and harm public health.

#### Agrochemical pollution

Chemicals, when used heavily in agriculture, are carried to the ocean by surface run-off during the rainy season, and more so where there is soil erosion. In East Africa for example, DDT and similar compounds are sprayed on cotton and sugar cane fields to control disease vectors and to disinfect (8). Organochlorine compounds used in agriculture reach the coast either directly via surface run-off or, in most cases, via creeks and rivers that flow into the sea (8).

### CONSERVATION OF LIVING RESOURCES

#### Coastal and marine habitats

The uncontrolled collection of raw materials may threaten the Region's animal habitats. The mangrove areas of western Madagascar and on the mainland south of Somalia, for example, are home to the fry of marine fish and crustaceans. They also provide nursery grounds for shrimp, an important economic resource for several states. 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 resorts (see Table 2).

Often the result is a drastic decline in marine populations, especially shrimp.

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 damage on mangroves as well.

Table 2. Available data on mangroves, the extent and length of mangrove coastline in the East African Region. Source: MacNae 1974; Saenger et al, 1981.

| Country    | Mangrove Area km <sup>2</sup> | Mangrove Coastline, km | % Total Coastline |
|------------|-------------------------------|------------------------|-------------------|
| Comoros    | a/                            | b/                     |                   |
| Kenya      | 58/                           | b/                     |                   |
| Madagascar | 3207                          | 1150                   | 28.7              |
| Mauritius  | a/                            | b/                     |                   |
| Mozambique | 850                           | 1194                   | 48.3              |
| Seychelles | a/                            | b/                     |                   |
| Somalia    | a/                            | b/                     | 28.7              |
| Tanzania   | 500 (820)*                    | b/                     |                   |

a/ No data available; amount negligible  
b/ No data available

Among the dangers facing coral reefs are low-level, but chronic, oil pollution, siltation, turbid waters from construction, and even the collection of coral and other marine life for tourist souvenirs. Poor fishing practices also take their toll, be it by overfishing certain species and thus affecting the balance of marine life in the ecosystems, or by dynamiting and poisoning.

Human encroachment likewise threatens such habitats as coastal dry forests, coastal dunes, coastal floodplains, fresh and brackish water marshes, reef-back lagoons, sandy beaches and sea bird rookeries (9).

Human encroachment likewise threatens the coast and seas of the region are home to a number of threatened and endangered species: several species of marine turtle species; hawksbill and olive ridley; the dugong; the Nile crocodile; sea and migratory birds; and several species of indigenous birds and mammals. Large schools of dolphins and porpoises are often seen and

## Industry's Unwanted Byproducts



Effluents from a textile mill flow untreated into the Mozambique River, Kundu.

Although industry in the Region is not well developed, there are local "hot spots" of pollution caused by industrial and agricultural activities.

In Somalia, industry is negligible and does not constitute a major source of pollution. However, the slaughterhouses situated along the coast at Marka and Mogadishu discharge their wastes directly into the sea, attracting large pelagic sharks to near-shore waters.

In Kenya, industrial wastes from Nairobi drain into a river which in turn flows into the Athi River that eventually empties into the Indian Ocean. The Athi River carries effluents from slaughterhouses, tanneries, and cement and coffee factories situated in the industrial sector in the Kiambu District (outside Nairobi). Wastes from dairy processing plants and slaughterhouses are discharged directly into the sea from the port cities of Mombasa and Kisumu. Tanneries at

Table 1. Annual use of fertilizers (in thousands of metric tons).

| Country    | Nitrogenous fertilizer | Phosphates fertilizer (N) | Phosphates (H <sub>2</sub> PO <sub>4</sub> ) | Potash (K <sub>2</sub> O) | Combined Fertilizers |
|------------|------------------------|---------------------------|--|---------------------------|----------------------|
| Kenya      | -                      | 22.4                      | 27.3   | 4.2                       | -                    |
| Madagascar | 6.9                    | 11.5                      | 3.0  | 14.3                      | -                    |
| Mauritius  | 4.7                    | 6.7                       | 2.9  | 1.6                       | -                    |
| Mozambique | 5.5                    | 8.7                       | 14.5   | 10.9                      | 4.3                  |
| Tanzania   | -                      | -                         | -  | -                         | -                    |

Source: United Nations Statistical Yearbook (1977).

Kisumu discharge large amounts of chrome salts and solids which contribute from pulp and paper mills (the black liquor). Other effluents include cyanide to increased Biological Oxygen Demand (BOD). Other effluents include cyanide from mining and smelting operations, heavy loads of organic wastes from coffee and sisal processing and toxic wastes from pulp and paper mills (the black liquor). Pollution by heavy metals is a potential problem arising from the use of zinc to coat iron sheets used for roofing. Another threat is mercury. About 25,000

coastal species suffer from human interference through habitat loss or deliberate collection, such as the harvesting of turtles and their eggs. Dugongs, dolphins and porpoises are sometimes caught by fishermen.

Some animal protection programs stand

and rear young when they are on land, and Seychelles' efforts to protect wildlife on outlying islands are important measures. In most cases, though, work in this area has been minimal, studies inadequate and regulations ineffective. Regional cooperation on protecting animal life has

metric tons per year of mercury compounds are used in Kenya as seed dressing.

In Tanzania organic waste from a diversity of small industries is the main problem, especially in and around Dar es Salaam. These include soap factories (Mwanza and Dar es Salaam), sisal (Tanga), sugar mills (Bukoba), cotton seed processing plant (Mwanza), plastics (Dar es Salaam), wood processing and superphosphate plants. Textile and fishnet industries at Dar es Salaam discharge directly into the Indian Ocean. Waste effluents from several industries, for example breweries at Ilala and industries in Ubungo, are discharged into the Msibazi Valley Estuary. The water is very alkaline, with pH values of 11 or above, and has a soapy texture. The dissolved oxygen concentration is near zero and wastes are mainly from dyes and chemicals used in textile processing. Effluent from the breweries is acidic with 1-5 percent solid waste, which is mostly organic in nature.

In Maputo, capital of Mozambique, wastes from the city's cotton and textile factories drain directly into the Lourenço Marques Bay. High values of iron and copper are dumped into the Bay (111.4 µg/l iron and 8.2 µg/l copper). A large part of the tide flows back to the inner bay on tide reversal and therefore not much of the water is renewed.

In Madagascar, wastes from industries similar to those found in Kenya could affect the shrimp fisheries on the southern and western coasts. Examples of these are sisal and sugar cane at Nossi Bé, Port Dauphin and the Narudrari River. Near Tananarive, effluents from tanneries, plastics, textiles and paper industries have already been fingered as the causes of local pollution problems.

In Mauritius, a particularly high BOD load is caused by wastes from the 20 sugar mills found on the island. Effluent containing bagasse (crushed cane fibers), ash, soot and molasses can cause total oxygen depletion up to 3-4 km downstream, accompanied by a sludge layer and mass mortalities of fish and invertebrates. Parts of the south coast beach are blackened and local fishermen complain of a decrease in catches and fouling of fish traps by bagasse. In addition there is a major industrial drain from Port Louis which carries effluent from the industrial estate at Carmandel.

Effluent from industries in Seychelles is negligible. Discharges consist of caustic soda from the cleaning of vats in the local brewery and sawdust from the two furniture companies, which are released

untreated into the sea. Despite fairly heavy discharges, no faunal damage is seen.

Most countries in the Southwest Indian Ocean are predominantly agricultural. These countries use appreciable quantities of insecticides, fertilizers and pesticides such as DDT, aldrin and endrin (see Table 1). They constitute an important source of pollution from factories as well as drainage and run-off from land via the rivers to the sea. Being fairly stable and non-biodegradable they persist in the sea and often lead to areas of eutrophication. In developing countries, the use of organo-chlorine pesticides in agriculture is inevitable in order to sustain a food supply for the expanding population. Demands for DDT in the agricultural and anti-malarial programs of the tropical countries are unlikely to decrease in the near future. In Kenya the use of pesticides has increased 10-fold since 1966. The Athi River carries pesticides and insecticide waste drained away from the extensive agricultural land in the Kiambu district. Tanzania's economy is largely dependant on agriculture, in which coffee, sisal and cotton are predominant. In Tanzania and Somalia, pesticides are used increasingly on cotton fields.

In Mozambique, the Incomati, Maputo and Umbeluzi Rivers carry large quantities of phosphorus into the Lourenço Marques Bay causing localized eutrophication. On Madagascar, about 20 000 metric tons per year of pesticides—notably DDT, HCB, phosphoric and sulfuric compounds are used for agricultural purposes (ie on the sugar-cane farms). DDT and endrin are used regularly for spraying houses against insects. In 1977, 1160 metric tons of pesticides were being used on Mauritius, increasing the concern that toxic residues would drain into the sea via the rivers. In Seychelles, agricultural production is minimal and hence there is little pollution from fertilizers. However, disease control is fairly extensive and pesticides and insecticides are used freely.

In the Indian Ocean as a whole, most pollution problems arise in the vicinity of the Indian sub-continent especially around the Indian coastline. The marine pollution problems of the Region vary in nature and magnitude from country to country. Although there are signs of industrial pollution along the East African coastline, they are still at a relatively low level and tend to be fairly localized in the river outfall regions or surrounding coastal towns.

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While most of the region's environmental needs can best be met by the individual states, major strides can be made through regional cooperation. The states can work together to alleviate regional environmental problems and compare experience on the domestic ones they have in common. States with few resources should be able to seek assistance from others, both within and outside the Region. The possibilities here are numerous: international consultations, joint research projects, and linking key government agencies, to mention a few. National policies for environmental protection and development must be clearly formulated and should be strengthened through regional activities.

UNEP is doing its part in the East African Region by laying the groundwork for an environmental action plan. Such a plan would improve each state's ability to effectively manage its natural resources and promote development in a way that maintains the viability of the Region's marine and coastal environment.

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