

Protected areas serve a number of vital functions:

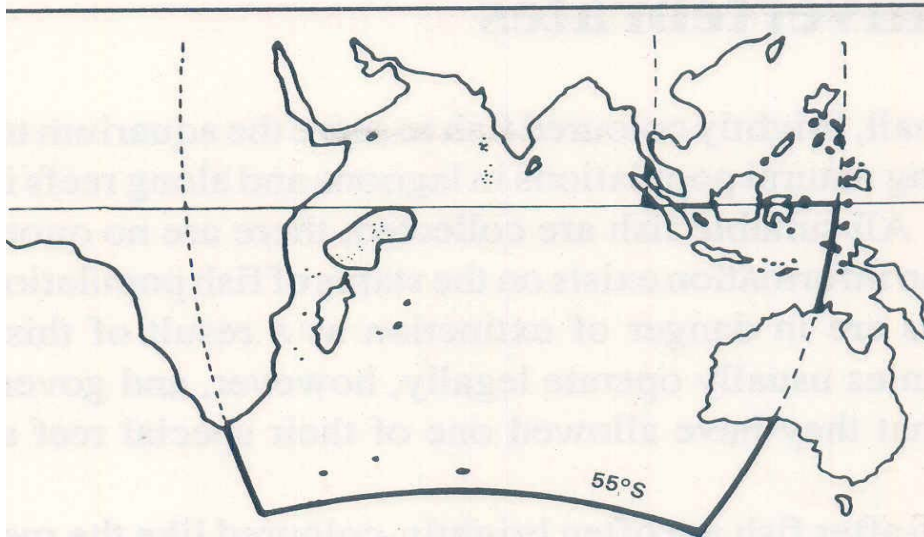
- They can serve to restock areas under exploitation. For example, fish living within a protected area will move to and restock adjacent fishing grounds.
- They can protect critical habitats for feeding and breeding of organisms vulnerable to over-exploitation.
- They serve as a base line against which degradation effects in other areas can be compared.
- They can provide opportunities for research and education without the interference of artisanal exploitation of the area.

One special feature of the region is the immense wealth of biological diversity resulting from the early isolation of oceanic islands from the African mainland. Some islands in the region were never a part of the mainland, and island populations have evolved in isolation to their present unique forms.

Rare and exotic life forms of the region include the elegant lemurs of Madagascar whose survival is increasingly threatened by deforestation. To date fourteen species have become extinct, including the giant lemur, which was almost five feet high and occupied an ecological niche similar to the mainland apes. Among the many species endemic to the Seychelles are the colourful Seychelles fruit pigeon, the Seychelles tiger chameleon, an orange breasted flying fox, and many species of palms and screw pines.

A second unique feature is the presence of two very special protected areas within the region-the Indian Ocean Sanctuary, encompassing the entire mainland coast and island states in the region, and the Aldabra Atoll, which became a World Heritage Site in 1982. Part of but remote from the Republic of the Seychelles, this island has the world's largest population of the giant land tortoise, as well as the largest nesting population of green turtles in the Indian Ocean. In addition, it has many distinct species of birds and many flowering plants found only on Aldabra.

The vast Indian Ocean Sanctuary, which was established on the initiative of the Seychelles government in 1979, is valuable, not only for the species it protects, like bluefin, humpback and sperm whales, but also to show what international co-operation can achieve for conservation. For a period of 3 years, no whaling vessels could operate within the boundaries of the sanctuary and it is hoped that the International Whaling Commission and the countries concerned will continue this achievement, when the status and jurisdiction of the



*The Indian Ocean Whale Sanctuary protects Blue, Sperm, Humpback and other large whales.*

Sanctuary come up for review in 1992 and that they will consider extending the protection it affords to all marine mammals in the zone, including small cetaceans and dugong.

The Islands of Aride and Cousin in the Seychelles are sanctuaries for birds and turtles and the Praslin National Park, now an important tourist attraction, encompasses the famous Vallee de Mai Nature Reserve whose palm species include the famous coco-de-mer. The park is also a sanctuary for the Praslin black parrot and other birds.

Collection of shells and corals is not allowed in the Seychelles islands, and spear fishing is banned. A visitor's spear gun will be politely confiscated on his arrival and returned to him when he departs.

Outstanding achievements in conservation and protection are not confined to the Seychelles, however. Kenya has gazetted a number of marine national parks and reserves designed mainly to protect inshore ecosystems like coral reefs. In the north, the Kiunga National Reserve is a biosphere reserve under Unesco's Man and the Biosphere (MAB) programme. The extensive Malindi- Watamu National Park protects some fine areas of coral and the Kisite Marine Park in the South encompasses islands, mangrove areas and coral reef. The Dodori National Reserve has both a terrestrial section and a marine area. This is in a wild, remote and beautiful area of Kenya's mainland, north of the island of Lamu, where you can see elephant and coral fish within the same reserve. The recently opened Mombasa Marine Reserve protects an area of the coast which has had a lot of pressure from tourists. Plans are moving to open another protected area at Tenewi, south of Lamu, to protect dugongs, turtles and sea birds.

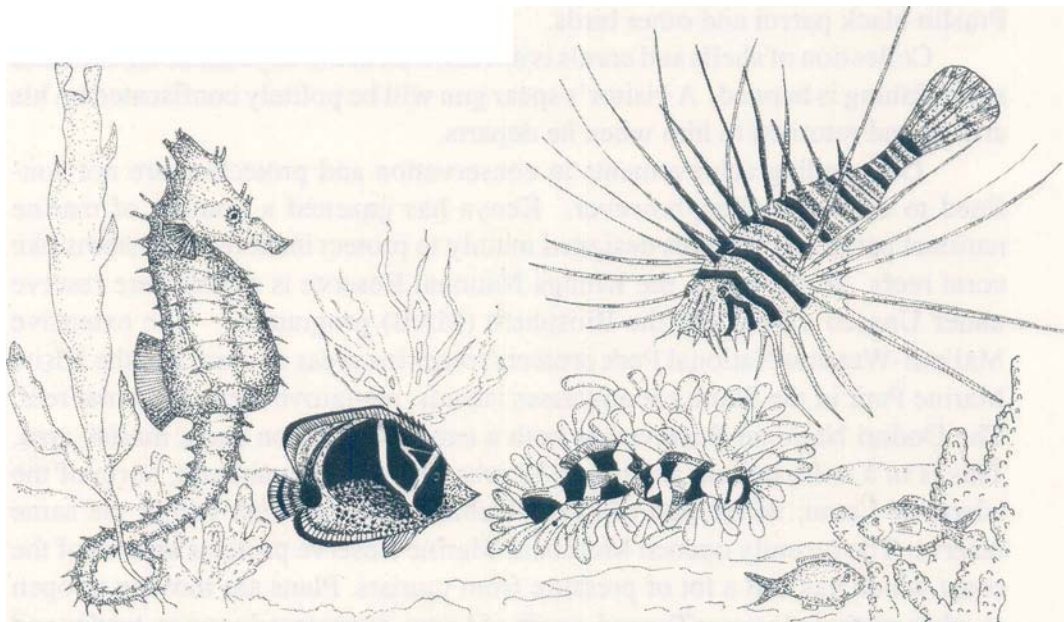
## Fish and invertebrates

The capture of small, brightly coloured fish to serve the aquarium trade overseas is rapidly depleting natural populations in lagoons and along reefs in the Eastern African Region. All suitable fish are collected; there are no quotas; many die in transit. Since no information exists on the status of fish populations, it is likely that some species are in danger of extinction as a result of this trade. Fish exporting companies usually operate legally, however, and governments may realise too late that they have allowed one of their special reef attractions to disappear.

The sought-after fish are often brightly-coloured like the members of the wrasse family, or of unusual shape like the box fish, the long-nosed puffer fish, and the clown fish that lives within the tentacles of sea anemones.

Many fish have very specialised feeding habits. Box fish feed on lagoon algae and the long-nosed puffer fish selects small lagoon urchins. How do they fare when offered unnatural aquarium foods? Each species is also adapted to a specific range of salinities, temperatures and oxygen content of water. Can they cope with aquarium conditions? Moreover, each species plays its part in the transfer of energy within the lagoon. It is a link in the complex food relationships of inshore waters. If one link of the chain is removed, the whole ecosystem suffers.

Species suitable for aquarium life should be bred in the countries that have a market for them. This would prevent depletion of natural stocks and the impoverishment of natural ecosystems.



*Many brightly-coloured and attractive fish of coral reefs and lagoons are collected and exported for the aquarium trade.*

## The trophy trade

*Fabby K J Nielsen*



*Shells and other trophies are collected to be sold to tourists. This is degrading ecosystems in many parts of the region.*

Most of the trophy trade centres on molluscs which are insufficiently protected through most of the region. People who have no fishing skills collect molluscs along the reef at low tide to supply this trade.

Consequently, the survival of the largest and some of the environmentally most important shells is threatened. The triton shell whose elegant white trumpet may grow to half a metre or more in length is now so rare in Kenya that those for sale there are said to come from neighbouring countries.

This mollusc is one of few predators of the coral-feeding crown-of-thorns starfish, whose plagues have caused severe damage to coral reefs in Australia, Oceania and the Red Sea. No doubt many factors contribute to these unnatural explosions, but the whole scale removal of a natural predator must be significant.

Similarly, many lagoons in Eastern Africa are now marred by plagues of unattractive, stinging, long spined sea urchins which disturb swimmers, snorkellers and fishermen. Doubtless many factors are at work to produce these urchin plagues, but again, the removal of their predators must contribute. The longspined black urchins are preyed upon by some of the molluscs in high demand for the shell trade, like the red helmet shell, whose heavy shell crushes the urchin's protective spines. Urchins are controlled by these, and other carnivorous molluscs.

Shells are collected at each tide from reefs in many parts of the region but those offered for sale to tourists represent the tip of the iceberg of this trade. The vast majority of shells are shipped directly overseas.

Corals, collected both for local sale and export, are equally threatened in some Eastern African countries. Black corals are allegedly being poached by tourists in Mauritius, where all corals are under threat, while bright red starfish are disembowelled for sale to tourists in Tanzania and Kenya.

All organisms that form part of the trophy trade are thus being prevented from playing their part in contributing to the richness of lagoons and reefs. Corals are food to other organisms, provide shelter and protection or anchorage to others, and contribute to the building of the reef. Starfish provide food for fish and birds, as do shells and urchins. If one type of animal is selectively removed, as happens for the trophy trade, the productivity of inshore ecosystems is impaired, and an ecological imbalance results.

Nor can the trophy trade be justified on humanitarian grounds as the person who does the hard or dangerous work of collecting obtains little reward for his pains. Profits go to the middleman, the shopkeeper or the exporter. The resource-poor fisherman or shell collector gets but a small percentage of the final price.

## **Turtles**

Global populations of sea turtle are plummeting fast not least in the Eastern African Region, where five of the world's seven species occur-the green turtle, the leathery, the hawksbill, the Pacific Ridley and the loggerhead.

All turtle stocks are under ever-increasing pressures from humans seeking food and economically valuable products like shells and leather. Both eggs and hatchlings are eaten in many parts of the region and the adult turtle provides succulent meat and valuable oils. The green turtle is particularly sought after for soup while the Hawksbill's shell is much admired for its beautiful reddish, yellowish and brownish markings. In some parts of the region, such as the Seychelles Islands, whole turtle shells and trinkets such as combs, ornaments, and bracelets of "tortoise shell", are sold to visitors, who may be unable to import these products into their own countries because of stringent international regulations. Unfortunately not even the increasing sophistication of the plastics industry has taken pressure off the Hawksbill turtle as "real" tortoise shell products have continued to stay in vogue

Other hazards beset this unfortunate reptile. Both wild animals and dogs dig up and eat its eggs. Sea birds and shore crabs catch and eat the hatchlings as they make their perilous journey from the nesting site to the edge of the sea, where again, many will be consumed by predatory fish, like sharks. Despite the

large number of eggs laid (up to 1,000 per female, per season) very few survive to maturity.

Most adult turtles are killed on beaches, as females climb the shore to lay their eggs. This is doubly destructive; it prevents the female from laying her eggs and selectively destroys the biologically important female turtle.

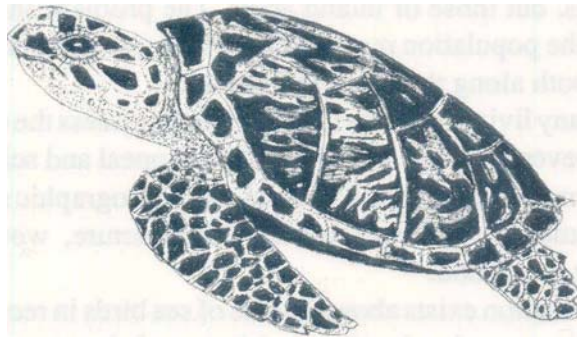
Both adult and juvenile turtles are also caught at sea, by nylon nets which are almost invisible in water. Lost or discarded nets floating around the ocean are an increasingly serious problem for marine species. They trap fish, sea mammals and turtles, until they finally sink through the weight of their tragic load.

Because all young turtles and all the adults in the region except the green turtle feed on jellyfish they can mistakenly ingest floating plastic waste like polythene bags, which look very much like jellyfish in water, with fatal consequences. The leatherback turtle, in particular, selects the jelly fish as its food.

The green turtle is a reptile of immense economic importance. It is utilized for turtle soup, a gourmet delight, and, as a herbivore, it converts seagrasses into palatable meat. Its critical habitats are seagrass meadows for feeding and sandy beaches for egg laying-both abundant in the Eastern African Region. With better management, the green turtle could be a significant economic asset to the area.

Moreover, turtle conservation must be made a regional priority if these valuable reptiles and the resources they offer are not to be lost. And effective conservation must cover all critical habitats, including feeding and nesting grounds, and involve international co-operation as these species migrate to different territories.

Turtles have been a highly successful life form for 90 million years. Are they to be exterminated in our own lifetime?



*A Hawksbill turtle---endangered by the demand for its shell.*

## Birds

The avian history of the East African Region is marred by the extinction of some of the most spectacular birds the world has ever known. In Madagascar and parts of Southern Africa lived the giant ostrich, or elephant bird, a huge three-metre high flightless creature whose 11 known species have long been extinct. Their mummified bodies and gigantic eggs have been found in Madagascar swamps. Their demise was probably caused by man.

Another large, flightless bird, the Dodo, which lived on the island of Mauritius, was wiped out by meat-starved sailors in the seventeenth century.

The threat to birds by humans seeking food and eggs for collection continues. In the 1970's the Kenya coast was known to have 8,000 breeding pairs of Roseate terns. A count in 1987 revealed that the population had plummeted to only 3,000 as a result of egg collection.

There are comparable problems on the Seychelles islands. Eggs of sooty and noddy terns are collected on some islands for sale in Mahé and young chicks are taken from the nest before they can fly, to be killed, salted and eaten.

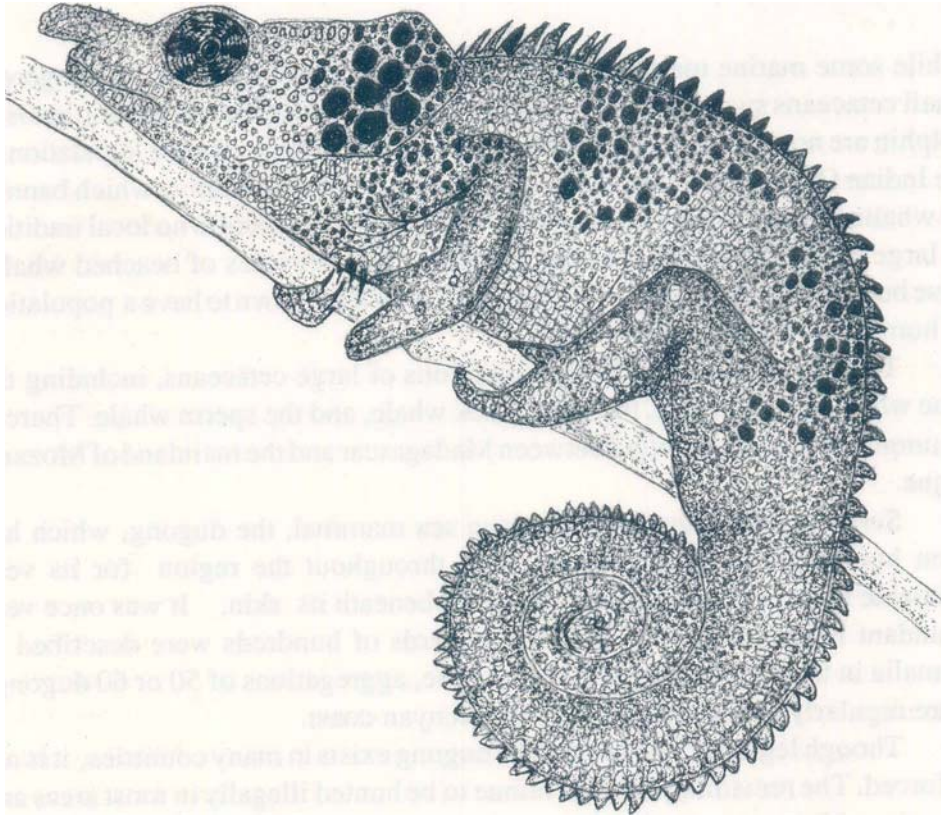
Adult tropic birds and gadfly petrels suffer a similar fate on Round Island, Mauritius. Though legislation exists to protect them it is not enforced, despite the fact that Round Island is classified as a Managed Nature Reserve.

Regional bird populations, particularly on the offshore islands, are affected by other human activities such as clearing forests, removing mangroves, draining swamps, and the proliferation of agricultural chemicals, which destroy or pollute the habitat of both resident and migrant birds.

In the meantime, serious management mistakes must be rectified. One concerns the European barn owl which was introduced to the Seychelles to control rats but found it easier to prey on native birds and now has a price on its head. Another concerns the Indian house crow whose population in Mombasa, Kenya has reached plague proportions, threatening not only indigenous coastal birds, but those of inland areas. The problem should have been dealt with before the population reached its present size and before it started its insidious spread both along the coast and inland.

As with many living resources, it is difficult to assess the economic value of sea birds. However, because of their aesthetic appeal and scientific interest, bird-related tourism, based on ornithological and photographic safaris, coupled with the development of a better tourist infrastructure, would provide an incentive for their protection.

Little information exists about the role of sea birds in recycling nutrients but their contribution must be significant. Mining of nitrogen-rich guano takes place in some of the Seychelles islands both for local use and for export.



*Much of the unique fauna of Madagascar is threatened by widespread deforestation. More than half the world's species of chameleon are found in Madagascar including this short horned chameleon. Mammal species, including this tiny tenrec, and the rare lemus, are similarly threatened.*



## Mammals

While some marine mammals in the Eastern African Region are endangered, small cetaceans such as the Indo-Pacific humpback dolphin and the bottlenosed dolphin are not. Large cetaceans are protected in the region by the legislation of the Indian Ocean Sanctuary, a remarkable conservation initiative which banned all whaling in the Indian Ocean north of latitude 55°S. There is no local tradition of large whale exploitation in the region but the carcasses of beached whales have been utilized occasionally in Somalia, which is known to have a population of humpback whales in the north.

The region has interesting populations of large cetaceans, including the blue whale, the fin whale, the humpback whale, and the sperm whale. There is a humpback breeding ground between Madagascar and the mainland of Mozambique.

Seriously endangered is a unique sea mammal, the dugong, which has been hunted to the brink of extinction throughout the region for its very palatable meat and the rich supplies of fat beneath its skin. It was once very abundant in many parts of the region. Herds of hundreds were described in Somalia in the 1960's, and at the same time, aggregations of 50 or 60 dugongs were regularly sighted off parts of the Kenyan coast.

Though legislation to protect the dugong exists in many countries, it is not enforced. The remaining herds continue to be hunted illegally in most areas and face the additional hazard of being trapped and drowned in fishing nets.

This animal is a unique resource. As the world's only herbivorous mammal that is totally marine, it converts sea grasses into very palatable meat. The Eastern African Region has vast meadows of seagrasses, and suitable critical habitats like sheltered bays and mangrove areas for calving. The potential of this animal as a food source in protein-hungry coastal lands has not been fully appreciated and the insufficient protection it has been accorded is unlikely to prevent its extinction in the near future.

Of the region's terrestrial mammals, several primate species, including the Zanzibar red colobus monkey, and the unique lemurs of Madagascar are threatened by deforestation and habitat destruction, while hunting for food has seriously reduced populations of the flying foxes of Mauritius and Rodrigues.



*on stamps in Kenya and Tanzania*

*The dugong, a highly endangered marine mammal, has been shown*

# Land use practices

The growth of coastal towns and industries, ecologically unwise fanning and livestock rearing practices, together with expanding agriculture and tourism in the area, are having undesirable effects on coastal zone and marine habitats of the Eastern African Region. These effects are becoming more and more apparent as pollution increases and ecosystems deteriorate.

Several capitals, like Victoria, Mahe (Seychelles), Mogadishu (Somalia), Maputo (Mozambique) and Antananarivo (Malagasy Republic), are on the coast, and major ports like Dar es Salaam in Tanzania and Kenya's Mombasa are large centres of population and industry. The recent proposal to transfer the capital of Tanzania from Dar es Salaam to the inland city of Dodoma was an attempt to take pressure off the densely populated coastal region.

Among the area's island nations, building land is in short supply and its availability governs the distribution of population. Agriculture is important but poor cultivation practices cause problems. For example, cultivation of rice on the steep mountain slopes of the Comores Islands is eroding the fragile volcanic soil. In the Seychelles and in the Malagasy Republic up to 300 tonnes of silt per hectare are lost annually to soil erosion. In contrast, the islands of Reunion and Mauritius, which grow sugar cane, a soil conserving crop, on more than half their land, do not have a serious erosion problem.

Livestock husbandry, particularly in Somalia, Tanzania and the Malagasy Republic, where herds are large, is another significant cause of soil erosion in the region.

*Sara Ellington*



*Overgrazing by livestock like goats can destroy vegetation and increase soil erosion.*

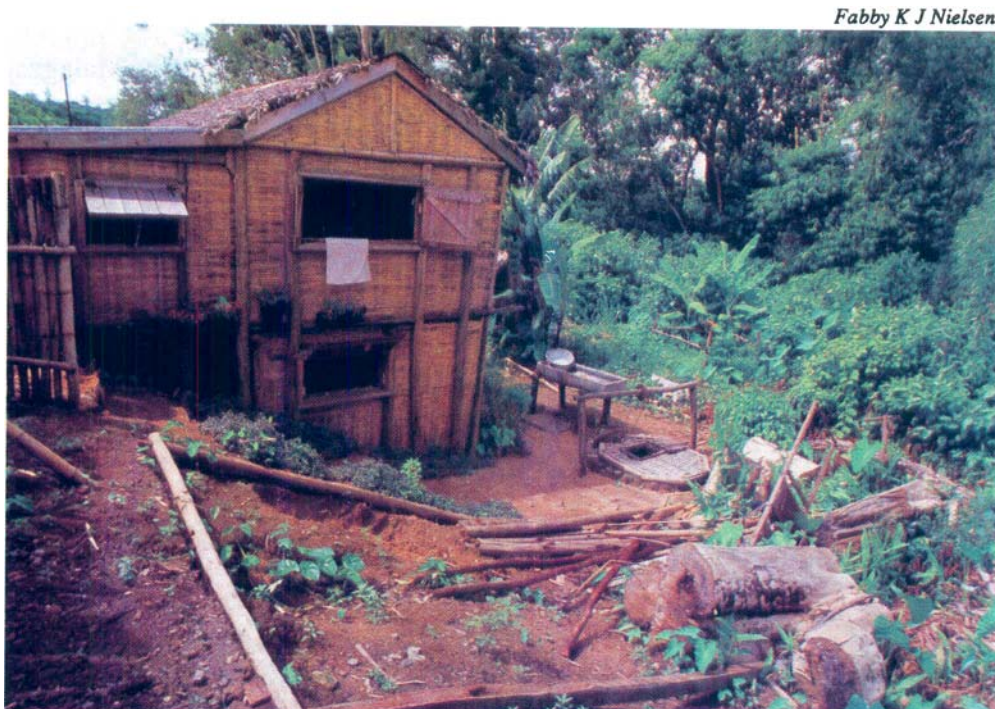
## Siltation

Soil erosion related to deforestation and unwise agricultural practices causes another form of pollution in the region-silt-with serious implications for both the people and the economies of the countries concerned.

In Kenya for example, silt from the Tana river is affecting catches of both fin fish and prawns in Ungwana Bay, and silt carried by the Galana-Sabaki River down to the sea at Malindi is smothering coral reefs and sullyng beaches, with serious consequences for fishing and tourism. Similar problems are evident elsewhere, particularly on the island of Madagascar where one million hectares of soil are lost each year through rampant deforestation and uncontrolled bush fires. Eroded soil carried by rivers to the sea has affected many parts of the coast. Mahajanga Harbor is badly silted and coastal shipping is paralysed, fish catches are down drastically and coral reefs and their associated communities are smothered, as at Toliava (Tulear) and Antseranana. When the coral polyps cannot clean themselves fast enough, they die.

Siltation is also affecting coral reefs in the Comoros, harbours and estuaries in the Seychelles and in south east Mauritius.

## Pollution caused by agriculture



*Fabby K J Nielsen*

*Unwise agricultural practices on smallholdings in Madagascar are resulting in massive soil erosion and siltation of marine ecosystems there.*

Agriculture, in which 90 per cent of the population of the East African Region is engaged, is an economic priority. All countries in the region are striving for self sufficiency in food crops and for increased productivity in cash crops like cotton, sugar, tea and coffee. As a result, pesticides and fertilizers are being used increasingly but their deployment has not been accompanied by sufficient environmental awareness.

Many areas of intensive agriculture are inland, and most pollutants from this source are carried by rivers down to the sea, thereby affecting highly productive and fragile coastal waters. Ecologically harmful organic pesticides that are used throughout the region include DDT, dieldrin, lindane and toxophene.

Herbicides, like 2,4-D and 2,4,5-T, which contain the highly toxic compound dioxin are used to spray sugar plantations in Mauritius, Kenya and the Malagasy Republic, and poisonous mercury compounds, now banned in Europe, are still used as fungicides in the region.

DDT is also used in all the mainland countries as an aerial spray to control tse-tse fly, and tourist beaches in the Seychelles are regularly sprayed with the insecticide Diazinon.

The effects of pesticide pollution on marine life are now becoming apparent in Mauritius, whose Ministry of Agriculture attributes the current fish decline to pesticide runoff, and in Mozambique, where fish have been found dead in the Limpopo River after aerial spraying with parathion.

In general, pesticides are not biodegradable; they persist for a long time in the environment, are absorbed into living organisms and accumulate along food chains. The health of humans is threatened by these toxins reaching them through the fish and shellfish they eat.

For its part, fertilizer runoff transported to the ocean by rivers increases the supply of nutrients in lagoons and estuaries, causing algae to bloom artificially, die off and decay, using up oxygen needed by fish and other organisms.

## **Urban pollution**

Very little effort is made to deal with the problem of urban trash in coastal towns, where about one twentieth of the region's population lives. This is augmented by an influ.x of tourists in some areas. Domestic rubbish from the city of Mombasa, for example, is dumped at a site at the edge of one of the inland creeks. The town of Lamu deposits its urban trash at the edge of the sea where donkeys and marabou storks feed on it Occasional attempts to burn it have little effect, and most is dispersed by the tides.



*Urban trash is dumped on shore for dispersal by the sea in many parts of the region. This scene at Lamu in Kenya is typical of many coast towns.*

Primary sewage treatment facilities are few in the region. Most sewage is discharged raw and untreated into streams and rivers or directly into the sea, for dilution and dispersion. Generally, the marine outfalls are not distant enough from the coast or sufficiently submerged to prevent pollution of some beaches and swimming areas. There is partial treatment of sewage in Mombasa, Dar es Salaam and at Victoria on the island of Mah6, in the Seychelles.

While sewage is currently a local pollution problem, it could pose a serious threat to human health if it were to contaminate marine food sources like fish and shellfish, and spread to recreational areas.

When the antiquated sewage system of Dar es Salaam, Tanzania, collapsed some years ago a master plan for the town's sewage and sanitation system was developed which was designed to be completed in phases until the year 2010. If implemented it will do much to improve the disposal of liquid and solid waste in Dar es Salaam.

# Industrial pollution

Industrialization of the countries of the Eastern African Region is increasing, and with it, the rate of increase of pollution from industrial sources.

Industries tend to be concentrated along the coast at particular sites. Mombasa is a major industrial site on the Kenya coast, while Dar es Salaam houses most of Tanzania's industries. Most of Mozambique's industries are located in Maputo and Beira.

Some industries are common to several countries, particularly those which produce important materials for local use, like textile mills, slaughter houses, sawmills and breweries.

Agriculture and livestock breeding, the mainstay of the region, are an important source of raw materials for local industries that fashion farm products into marketable items. The region has both primary processing industries like milk pasteurization and meat production, and secondary industries such as soap, leather and textiles.

Both the disposal of organic waste, and of noxious oils and chemicals after processing, can be sources of serious local pollution. Dar es Salaam harbour, for example, is badly polluted and Maputo Bay can no longer be used for swimming or fishing.

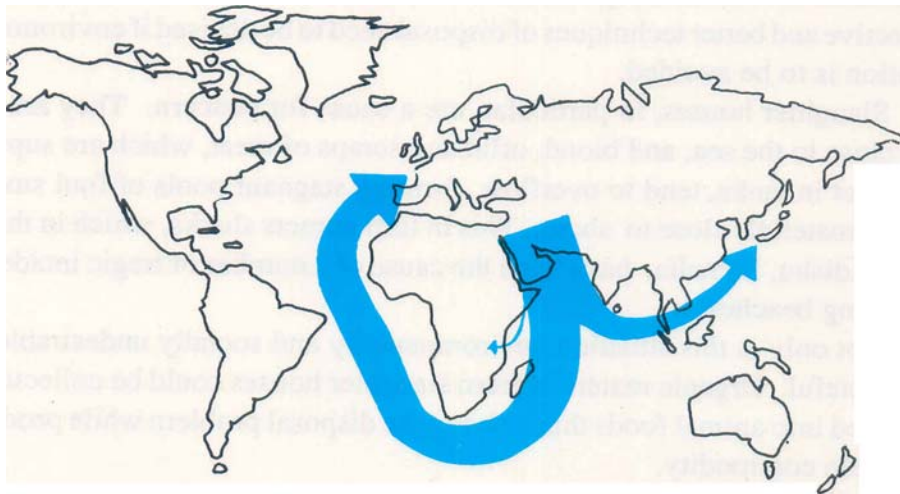
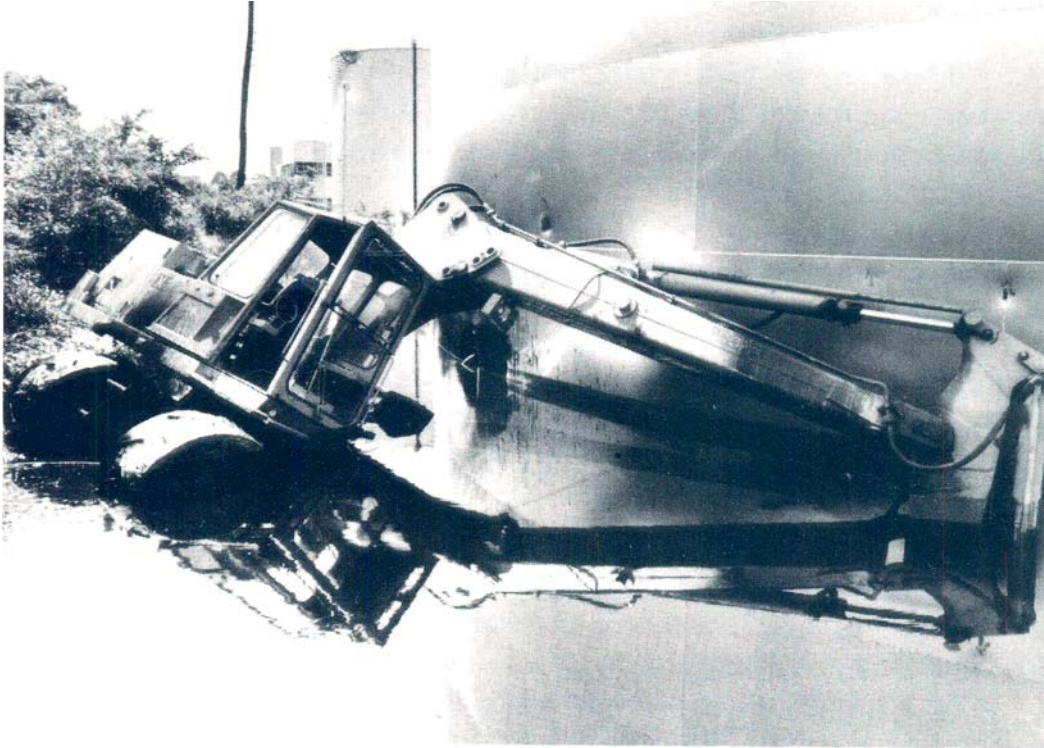
Textile mills use caustic soda and other chemicals such as acids, dyes, detergents and starch. Treatment involves passing the effluent into sedimentation tanks from which sludge is removed and burnt. Generally, the treatment is ineffective and better techniques of disposal need to be devised if environmental pollution is to be avoided.

Slaughter houses, in particular, are a cause for concern. They are often sited close to the sea, and blood, offal and scraps of meat, which are supposed to collect in tanks, tend to overflow, forming stagnant pools of foul smelling organic materials close to shore. This in turn attracts sharks, which in the area of Mogadishu, Somalia, have been the cause of a number of tragic incidents at swimming beaches.

Not only is this situation environmentally and socially undesirable, it is also wasteful. Organic materials from slaughter houses could be collected and processed into animal foods thus solving the disposal problem while producing a valuable commodity.

Sawmills, for their part, should stop using arsenic compounds for wood processing, as these highly toxic substances are likely to be discharged into the sea with other effluents,

In general, a lot more thought needs to be given to environmentally sound disposal of industrial effluents, and to appropriate siting of industries.



*ABOVE: The accidental puncturing of this oil tank by a crane caused serious oil pollution at Mombasa in 1988.*

*BELOW: Most of the worlds oil is shipped through the East African Region. This map shows oil transport routes in 1980.*

## **Oil pollution - the reality and the threat**

It has been calculated that, on any one day, about 225 tankers move through the waters of the Eastern African Region, one of the busiest oil tanker routes in the world. There are two main transport patterns: one route, served mainly by medium sized tankers of 20,000 - 100,000 tonnes, is from the Middle East to the oil refineries of Eastern and Southern Africa, providing them with a total of 22 million tons of crude oil annually. A few tankers travel to the Comoros, the Seychelles and Mauritius, which import refined oil from the Middle East. After the tankers deliver their oil, they return to the Middle East in ballast, and it is likely that their tanks are cleaned out on the return journey.

The second route is via the Cape of Good Hope to Europe and America, using very large crude carriers of more than 200,000 tonnes. This trade is over 500 million tonnes a year.

The possibility of an oil spill from one of these huge tankers is the biggest single threat to the marine environment of the Eastern African Region. Spills also occur accidentally during loading or discharging operations in a port, as happened at Dar es Salaam in January 1981, when up to 100 tonnes of crude oil destroyed an area of mangrove forest, and at Mombasa in July 1988, when 4,800 tonnes of heavy fuel were lost when a fuel tank was accidentally pierced by a crane close to the Mombasa Oil Refinery.

Oil threatens the marine environment in many ways. Oil slicks can poison marine mammals, turtles and fish, and smother bottom-living corals and other organisms. As oil breaks down, its chemical components, like aromatic hydrocarbons, affect feeding and reproduction of many organisms, including crustacea, molluscs and fish. Chemical dispersants, used to break down oil slicks, can create another form of pollution.

Liquid oil is found on Comoran beaches every day, probably discharged as ballast or through tank washing activities. But tar balls on beaches are the most visible form of oil pollution in the area. Though they vary in size, most balls weigh about one kilogram.

Oil refineries also contribute to pollution. Of the five in the region-at Mogadishu, Mombasa, Dar es Salaam, Matola near Maputo, and Tanatave (Malagasy)-the largest, at Mombasa, handles about three million tonnes of crude oil a year and Matala processes one million.

Commercial deposits of gas have already been discovered at Songo Songo Island off the Tanzanian coast, and exploration for oil continues in many countries of the region. If some is discovered, a likelihood in the near future, pollution from oil drilling machinery, and possible spills from wells will pose an additional hazard to the marine environment.