



UNITED NATIONS ENVIRONMENT PROGRAMME

*Environmental problems of the
South Asian Seas region: An overview*

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PREFACE

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

The Regional Seas Programme at present includes ten regions^{1/} and has over 120 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to 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/}.

In May 1982 the UNEP Governing Council adopted decision 10/20 requesting the Executive Director of UNEP "to enter into consultations with the concerned States of the South Asia Co-operative Environment Programme (SACEP) to ascertain their views regarding the conduct of a regional seas programme in the South Asia Seas".

In response to that request the Executive Director appointed a high level consultant to undertake a mission to the coastal States of SACEP in October/November 1982 and February 1983. The report of the consultant on his mission was transmitted to the Governments of the South Asian Seas region in May 1983, and the recommendations of the Executive Director were submitted to the Governing Council at its eleventh session.

By decision 11/7 of 24 May 1983, the UNEP Governing Council noted "the consultations carried out in accordance with Council decision 10/20 of 31 May 1982" and requested "the Executive Director to designate the South Asian Seas as a region to be included in the regional seas programme, in close collaboration with the South Asia Co-operative Environment Programme and Governments in the region, and to assist in the formulation of a plan of action for the environmental protection of the South Asian Seas".

As a first follow-up activity to decision 11/7 of the Governing Council, the Executive Director convened, in co-operation with the South Asia Co-operative Environment Programme (SACEP), a meeting of national focal points of the States of the region in order to seek their views on how to proceed in developing a comprehensive action plan for the protection and management of the marine and coastal environment of the South Asian Seas region (Bangkok, Thailand, 19-21 March 1984).

^{1/} Mediterranean Region, Kuwait Action Plan Region, West and Central African Region, Wider Caribbean Region, East Asian Seas Region, South-East Pacific Region, South Pacific Region, Red Sea and Gulf of Aden Region, Eastern African Region, and South Asian Seas 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 meeting discussed the steps leading to the adoption of an action plan and reached a consensus on the items to be considered for further development of the action plan^{3/}.

The meeting recommended that Governments, with the assistance of UNEP and other organizations as appropriate, should initiate the preparation of country reports reviewing their:

- national environmental problems defined as priority areas of regional concern;
- activities which may usefully be carried out under the action plan to resolve or mitigate these problems; and
- national institutional and manpower resources which are, or may be, involved in dealing with these problems, including the identification of the need to strengthen their capabilities.

It was also recommended that UNEP prepare in co-operation with SACEP, and other organizations as appropriate:

- a draft overview report, based on the country reports, reviewing the environmental problems of the region defined as priority areas;
- a document addressing the essential legislative aspects relevant to the action plan; and
- a draft action plan reflecting the conclusions of the country and regional reports.

The draft overview was prepared with the assistance of a consultant, Ms. M. Pathmarajah, whose work is gratefully acknowledged. The draft was presented, as document UNEP.WG.153/3, to the meeting of experts on the South Asian Seas regional programme (Bangkok, 2-5 December, 1986). Based on the comments received during and after the meeting, the draft was revised and is published as the present document.

^{3/} Report of the meeting of national focal points on the development of an action plan for the protection and management of the South Asian Seas region, Bangkok, 19-21 March 1984 (UNEP/WG.105/5).

INTRODUCTION

In developing regional programmes for the protection and management of the marine and coastal environment, UNEP has taken into account a comprehensive approach to environmental management which draws upon the following elements:

- **Environmental assessment:** This includes assessing and evaluating the causes of environmental problems, their magnitude and impact on the region; baseline studies; research and monitoring of the sources, levels and effects of marine pollutants; ecosystems studies and studies of coastal and marine activities and social and economic factors that may influence or be influenced by environmental degradation fall within this scope. Information generated through environmental assessment activities should assist national policy makers to manage their natural resources in a more effective and sustainable manner and to evaluate the effectiveness of legal/administrative measures taken to improve the quality of the environment.
- **Environmental management:** This includes co-operative regional projects on training in environmental impact assessment; management of coastal lagoons, estuaries and mangrove ecosystems; control of industrial, agricultural and domestic wastes; and formulation of contingency plans for dealing with pollution emergencies. Assistance and training, where necessary to enable national institutions to participate fully in the programme, is part of assessment and management.
- **Environmental legislation** promotes a legal commitment of governments through which clear expression is given to their political will to manage, individually and jointly, their common environmental problems. Co-operative regional and national action is most often supported by an umbrella regional convention elaborated by specific technical protocols.
- **Institutional and financial arrangements** address the designation of a secretariat (interim or permanent) for the regional programme, the schedule of meetings and the mode of financing the programme. UNEP, together with selected United Nations and other organizations, provides "seed money" or catalytic financing in the early stages of the regional programme. Governments of the region are expected to progressively assume full financial responsibility which is usually channelled through a special regional trust fund to which governments make annual contributions in addition to which specific project activities or national institutions participating in the programme may receive direct contributions.

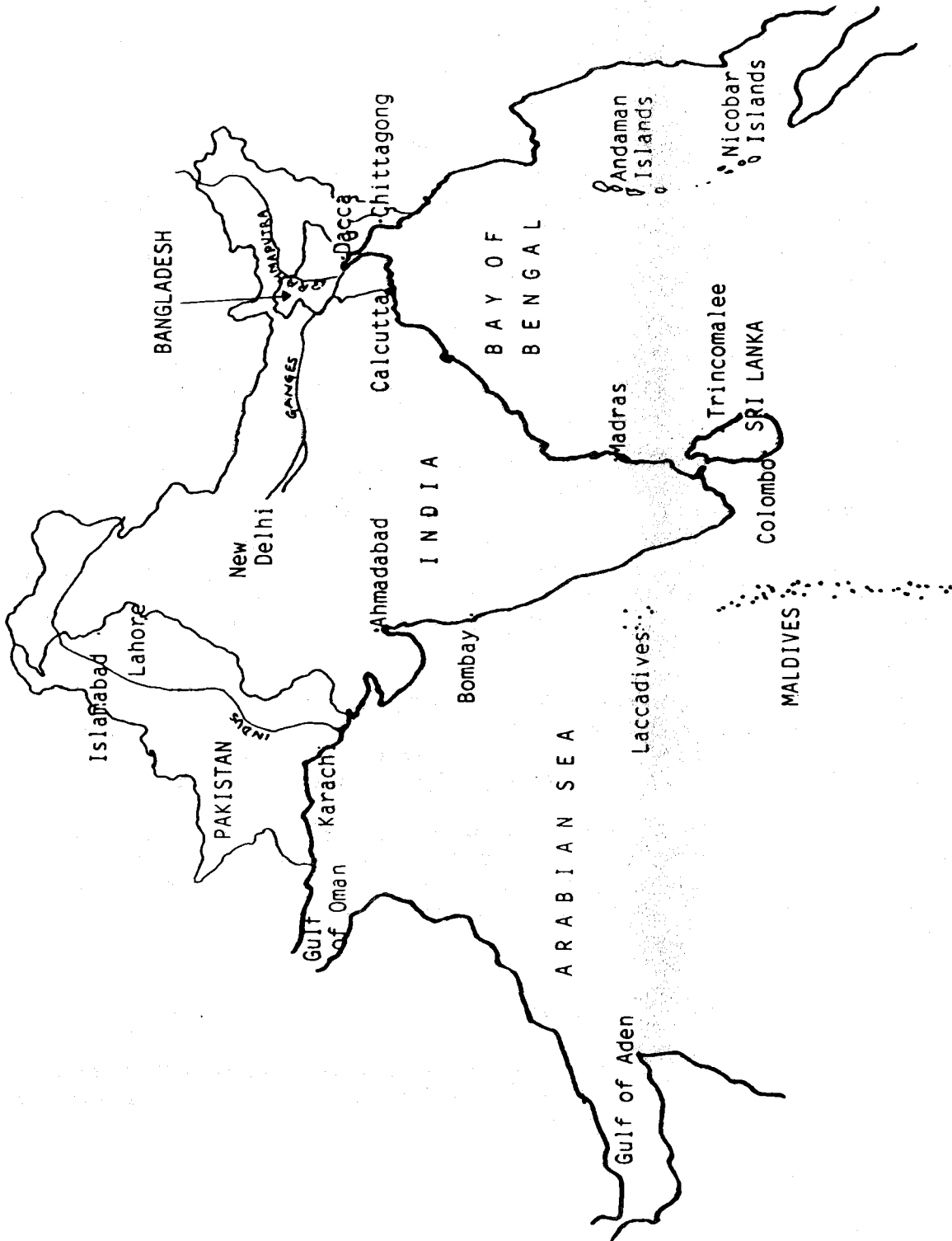
This document aims to outline some of the main environmental problems that exist in the South Asian Seas region and to set forth recommendations for activities and projects that may usefully be included in a regional programme aimed at controlling and preventing such problems. The recommended activities will address the four elements of the programme described above.

Details of geography, population, economy and marine related activities particular to each of the five states of the region may be found in the national reports prepared by those states and published in the UNEP Regional Seas Reports and Studies Series Nos. 59, 74, 75, 76 and 77. This document is based upon the information provided in those country reports.

GEOGRAPHIC SCOPE

For the purpose of the proposed South Asian Seas regional programme the geographic scope of the area has been provisionally defined to include the marine and related coastal environment of Bangladesh, India, Maldives, Pakistan and Sri Lanka.

GEOGRAPHY OF THE REGION



INDIAN OCEAN

OBJECTIVES

All the countries of the region have large numbers of people living close to the sea and making their living from the coasts. These people have traditional rights of access to fish and other marine resources. Coastal management, as it affects these traditional rights, is hence a matter of great sensitivity. Ensuring the health and enhancing the productivity of the coastal waters is of great importance to each country. It is recognized that actions taken in the coastal waters of one country or in the open sea can have far reaching effects on the waters of neighbouring countries. Regional studies, regional solutions and regional actions are thus necessary for effective management of the marine environment.

The States of the region are all developing countries with their major resources of revenue arising from agriculture, some industry, tourism and mining. As pressure increases on the land from growing populations and corresponding activities, expanding industrialization and larger tourist influxes, the effects of pollution in the marine environment are beginning to be felt more and more. The problems, although largely confined to the coastal areas where major economic activities take place, may have their effects elsewhere due to prevailing wind systems and current patterns.

As was agreed at the 1984 meeting of national focal points, the primary objective of the proposed regional programme should be the protection and management of the marine environment and related coastal ecosystems of the South Asian Seas together with the promotion of a corresponding environmental awareness. The main environmental problems to be addressed by the regional programme were also identified by the meeting of national focal points and elaborated upon in the country reports prepared by the governments of the region. These are discussed below.

MAJOR OCEANOGRAPHIC CHARACTERISTICS

Monsoons

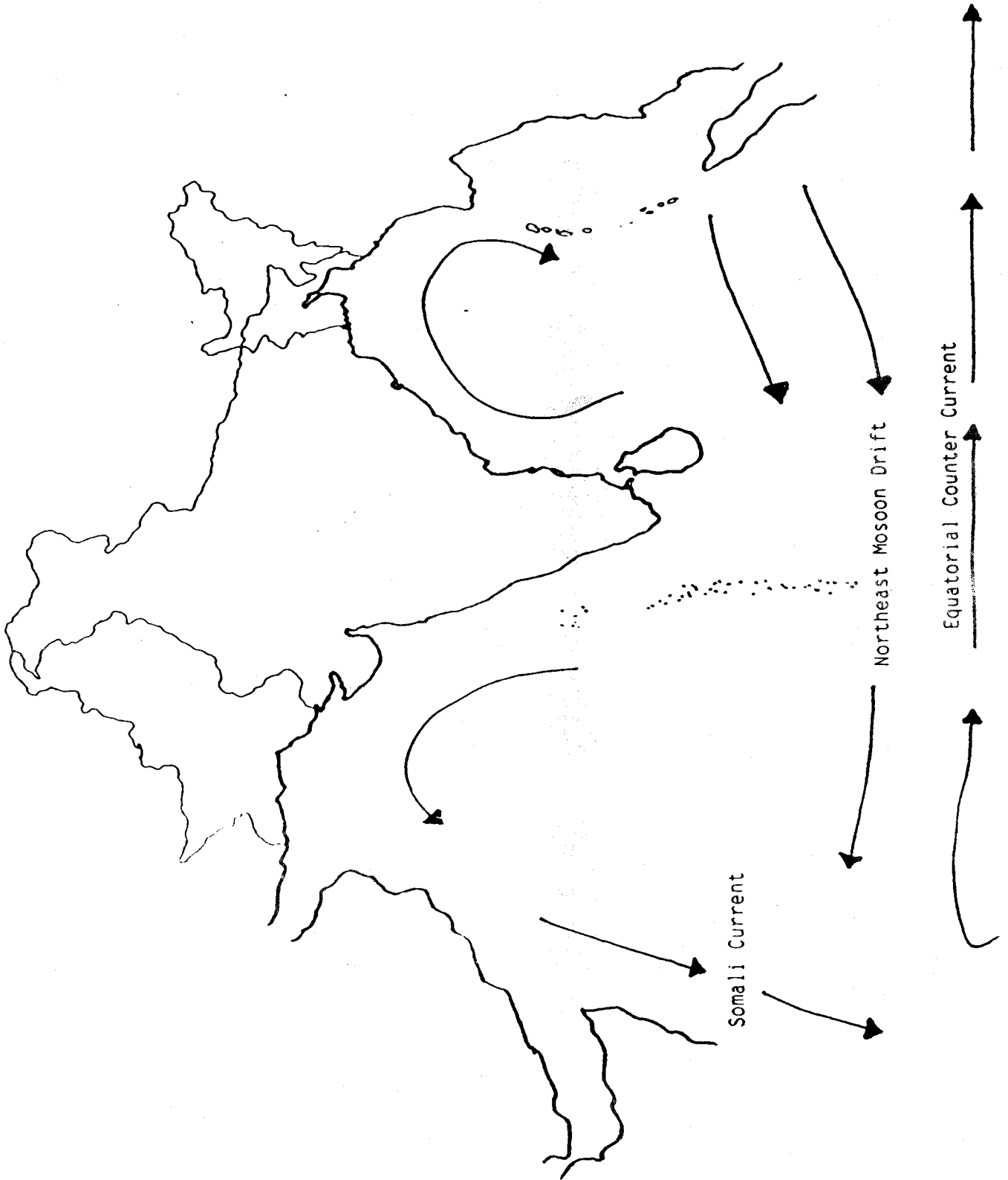
The Indian Ocean has unique features in its dynamic oceanography, meteorology and geology. These diverse factors together influence the currents and give rise to the seasonal monsoons particular to the northern hemisphere of the Indian Ocean North of latitude 10°S.

During the South-West (SW) Monsoon (April - October), the South-West Monsoon current flows eastwards, south of India, reaching up to 3 knots south of Sri Lanka. Then it branches, flowing clockwise in the Arabian Sea and the Bay of Bengal. The East African Coastal Current which becomes the Somali Current is influenced by the prevailing strong wind, with speeds of over 10 knots, and causes this current to continue its northerly flow into the Arabian Sea resulting in a cold, nutrient-rich upwelling along the Somali coast between 5° and 11°N.

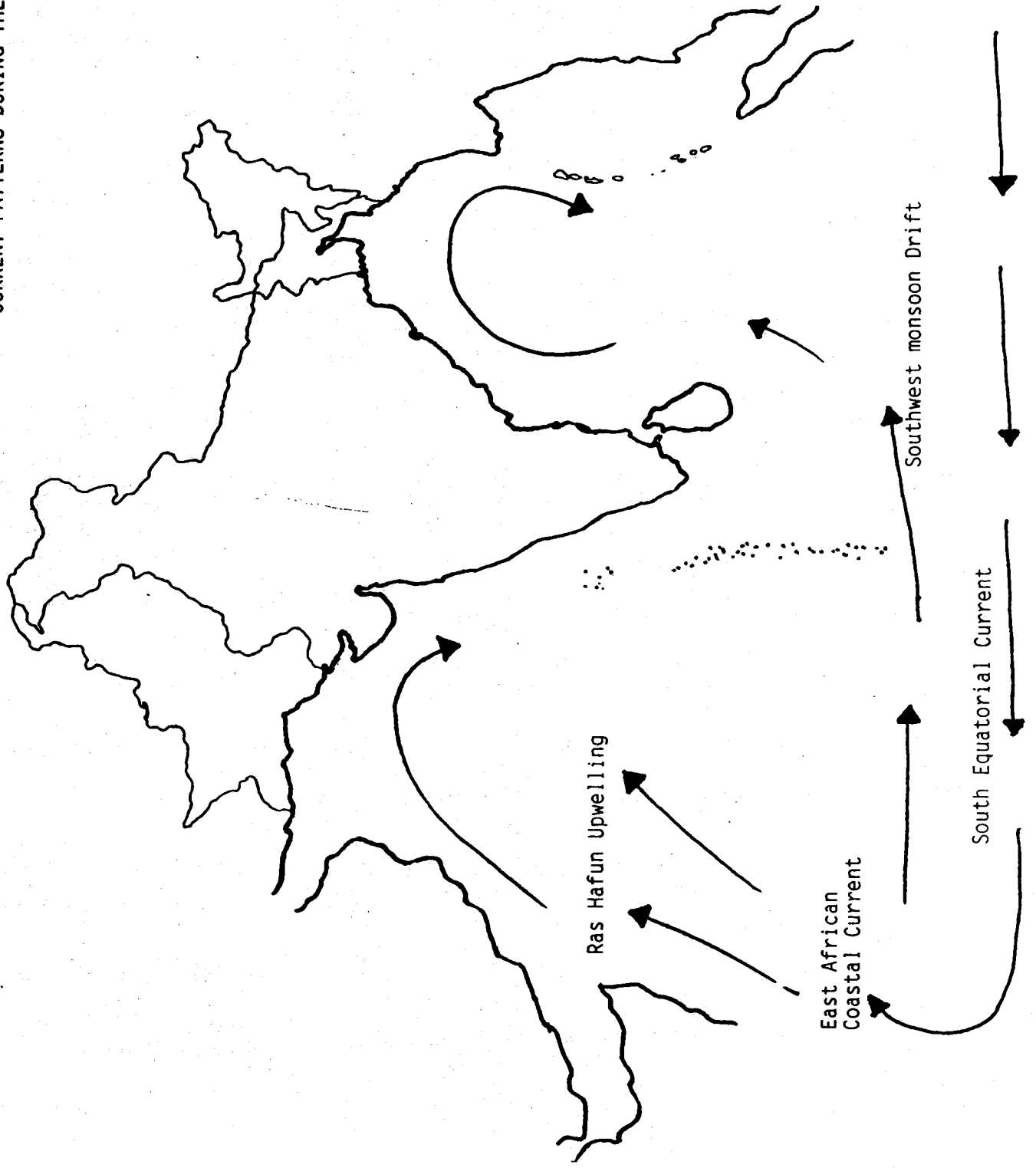
During the North-East (NE) Monsoon (November to March), the North-East Monsoon current predominates, flowing westwards. The Somali Current is less strong and partly reverses its flow to form the Equatorial Counter Current. The current pattern now flows counter-clockwise in the Arabian Sea and Bay of Bengal.

The North-East Monsoon is more intense in the Bay of Bengal and weaker in the Arabian Sea. The opposite is true for the South-West Monsoon.

CURRENT PATTERNS DURING THE NORTHEAST MONSOON SEASON



CURRENT PATTERNS DURING THE SOUTHWEST MONSOON SEASON



Salinity and water masses

In the northern ocean the salinity values vary seasonally. In the summer months it is high in the Bay of Bengal and the Arabian Sea. The increase in salinity in the summer is due, in part, to the dry season and in part to the upwelling of high salinity water in the western Bay of Bengal which then follows a southerly flow.

The Arabian Sea is an area of negative water balance where evaporation exceeds precipitation and runoff. The excess of evaporation over precipitation is maximum (100-150 cm) off the Arabian coast and decreases steadily towards the south-east. The high rate of evaporation results in the formation of several high-salinity water masses. The Arabian Sea high salinity water, formed in the north-western Arabian Sea, flows southward and can be traced as a tongue of high-salinity within the surface layer. The high salinity water in the Gulf, characterized by a sigma value of 26.6, flows through the Hormuz Strait and the Gulf of Oman into the Arabian Sea and maintains its density level at about 300 m depth. This water mass flows south, mostly east of 63°E longitude, and loses its characteristics in the southern Arabian Sea. The Red Sea water enters the Arabian Sea through the Strait of Bal-el-Mandab and the Gulf of Aden along sigma 27.2 and maintains its density level at about 700 m depth. This water mass is generally confined to south of about 17°N latitude.

Occasionally, the sub-surface high salinity water masses originating in the Gulf and the Red Sea form a thick layer which is vertically of almost uniform salinity, although the individual layers can still be recognized as weak salinity maxima. The whole layer is called the North Indian high-salinity intermediate water. The deep and bottom waters are of circumpolar origin, probably transported by a deep western boundary current through a chain of basins. They are called the North Indian Deep Water and North Indian Bottom Water.

In contrast to the Arabian Sea, the Bay of Bengal is a region of positive water balance. The average annual excess of precipitation is of the order of 70 cm. The total annual river runoff in the Bay of Bengal has been estimated to be about 2,000 km³. The high excess of precipitation over evaporation and the massive river runoff result in low surface salinities, especially in the northern Bay of Bengal. The salinity, lower at any level in the Bay of Bengal as compared to the Arabian Sea, increases steeply within the thermocline/pycnocline and a weak salinity maximum may be observed at a depth of about 500 m. The salinity thereafter decreases monotonously with depth. The South-West Monsoon Current probably carries the North Indian high salinity intermediate water from the Arabian Sea and fills the Bay of Bengal at intermediate depths, resulting in the salinity maximum. The deep water is of circumpolar origin probably derived from the central Indian basin.

Tides and waves

The tides are both diurnal and semi-diurnal. The mean range of spring tides along the northern coast of the Arabian Sea is 2.5 m at Aden, 5.7 m at Bombay and 1.1 m at Cochin. On the west coast of the Bay of Bengal and on the east coast of Sri Lanka, the mean spring tide range is about 1 m but the north and east coasts have 2.5 - 5.2 m ranges due to shallow depths.

In winter, in the Northern Hemisphere, the North-East Monsoon only causes small waves below 1 m but in summer, especially from June to August, the South-West Monsoon generates waves higher than 3 m.

Climate

The climate in the Indian Ocean is characterized and influenced by the monsoon seasons and in turn it influences both the land and the sea. The annual cycle is dominated by the heating and cooling of the Asiatic continent. A low pressure area over the Indo-Pakistan subcontinent during the summer causes wind systems over the North Indian Ocean to blow from the south-west whereas in winter, the north-east wind comes from the high pressure zone over the Tibetan Plateau.

The total annual precipitation is high, more than 3,000 mm in the central equatorial belt. The eastern part of the Bay of Bengal has heavy rainfall in contrast to the western side of the Arabian Sea which is very dry.

Geology

The continental shelves range in width from a few hundred metres to more than 200 km, for example off Bombay. In general the shelves are more prominent off the western coast than off the eastern coast of India. Numerous submarine canyons mark the continental slope, notably near the Ganges and Indus Rivers. Large sediment accumulations forming abyssal cones are also associated with these rivers. The continental rise averages a gradient of 1:40 at the base of the slopes to 1:100 at the abyssal plain boundaries and occasional sea mounts, sea knolls and canyons may be seen locally.

The pelagic sediments of the ocean floor consist of red clay merging with radiolarian ooze and some calcareous ooze. Terrigenous sediment found close to land is mainly kaolinite. Coral limestone is occasionally seen, and coral reefs and biohermal facies are found between 15°N and 20°S mainly on the western side.

Biology

The tropical Indian Ocean is considered very rich in shallow tropical marine fauna.

The Arabian Sea has the potential of being an exceptionally fertile area, especially during the South-West Monsoon, due to upwelling induced by wind stress. Some regions of the Arabian Sea are very fertile due to the discharge from rivers, for example at the mouth of the Indus, as well as from upwelling. High concentrations of phosphates are recorded here and large precipitation accumulations may be found.

The effect of river discharge is also important. In the Bay of Bengal, for example, there is a high inflow of mud from the Ganges river. The discharge from the turbid rivers is picked up by the North-East Monsoon Current and taken along the East Coast of India during the North-East Monsoon. The South-West Monsoon, with its heavy rains, causes an increasing flow of fresh water from the rivers with an increased sediment load entering the water. Increased sediment reduces light penetration and transparency and results in a decrease of plankton as measured in dry weight per m³. The sharply stratified low salinity at the surface, due to high fresh water from the Ganges and Irrawaddy Rivers, is the cause of the relatively poorer fertility seen in the Bay of Bengal as compared to the Arabian Sea.

The estuarine region of most rivers of the area have extensive mangrove growths. The mangrove area is economically important for firewood, tanin, medicinal products, pulp and paper, timber and aquaculture. They are also important spawning, nursery and feeding grounds for commercially important fish and shellfish species. Oysters, mangrove crab, mullet and penaid shrimp are found here. The mangroves have a distinct ecological character of their own. Due to heavy demands on land a large number of mangrove areas are being deforested. This activity, combined with siltation, is seriously affecting fisheries and environmental conditions in some of the areas of the region.

One of the main facies of marine life in the tropics is the coral reef which extends to a depth of approximately 15 m. Coral reefs are formed by colonies of stony corals, the individual animals of which are called polyps, which build up on the old skeletons of earlier dead corals. In the shallow regions of the coral reefs (2-3 m deep), the substratum is made up of sand, coral and encrusting algae and colonized by turtle grasses which are the only marine angiosperms. The 20°C isotherm is a rough indication of the lower limit of coralline growth.

The Indian Ocean contains between 3,000 and 4,000 species of fish, as well as species such as the dugong or sea cow an aquatic mammal peculiar to tropical waters. The numbers of these animals are on the decline as are those of the sea turtles.

The western and eastern extremities are fairly distinct in species composition with the Arabian Sea being slightly more productive than the Bay of Bengal. Due to areas rich in chlorophyll, nutrients, organic production and zooplankton, biomass should sustain large stocks of fish.

In the countries of the Indian Ocean, fish forms an important source of food. Fisheries contribute in a major way to the economy of the majority of these countries. Most fishing methods are fairly simple, and fishing by large vessels using advanced technology is somewhat restricted to the foreign presence in the area.

The demersal fish catches and particularly marine shrimps are rich in north-western parts of the Bay of Bengal but pelagic fisheries are lower than those of the Arabian Sea.

POLLUTION FROM HUMAN SETTLEMENTS

Organic pollution originating from human settlements is increasing with expanding populations, urbanization and volumes of sewage. Even large rivers are becoming polluted due to the level of human activity along their banks. Sewage treatment is virtually non-existent in the area. At an optimistic estimate, no more than 50 per cent of the total population in the countries bordering the Indian Ocean is provided with adequate sanitation arrangements. Uncontrolled flows of large quantities of domestic effluents may make the receiving water bodies eutrophic, and aquatic vegetation proliferates in such areas in great abundance. When the vegetation eventually dies and decays in large quantities, it makes the waters anoxic, triggering a vicious cycle of its own. In extreme cases, such a situation may even cause localized fish mortality.

The townships and human settlements of Bangladesh do not have any domestic waste treatment facilities, and the effluents, either directly or indirectly, find their way into the water bodies. Unplanned growth and lack of proper waste disposal systems further aggravate the problem. No surveys have so far been conducted of the quantity of either domestic effluents or solid wastes.

Disposal of solid wastes is also a serious problem. The most common system presently adopted is to dump the wastes in the outskirts of townships usually as landfill, which then becomes a breeding ground for house flies and mosquitoes. Such waste also finds its way into the water bodies during the flood season. The Government has given due consideration to the potential for the use of organic wastes to produce bio-gas.

The paucity of sewage treatment in the region is exemplified by the case of India where only 45 cities with a population of 100,000 have treatment facilities. The result is that high counts of coliform bacteria are found on the beaches and in coastal waters. The coastal areas around Bombay are polluted by domestic sewage and solid wastes and surveys of the Madras coast have revealed contamination of the shellfish.

Due to the limited land surface in the Maldives and the high population density of six hundred persons per km² pollution from domestic sources, coupled with provision of inadequate supply of drinking water, is a major issue in the country as a whole and particularly on Male with 40,000 inhabitants in less than 1 km². There is no public sewerage system excepting a short sewer on Male. Maldivians use the Gifili system extensively digging a small, new hole for every use.

Open beaches are also used as latrines. The Gifili system and general sanitary disposal methods for human wastes contaminate the precious groundwater thus leading to frequent outbreaks of diarrhoeal diseases and subsequent mortality in infants. An adequate and clean drinking water supply is hence very much in demand.

In Pakistan 80 to 280 litres per day of domestic wastes are produced per household. Raw sewage and untreated effluents enter the Manora Channel from several outfalls. The odour of hydrogen sulfide and the black colouring of the water testifies to the perpetual health hazards in these waters with solid wastes also being apparent along the banks. The nearby beaches are contaminated and high faecal coliform numbers observed.

Fish kills and a lack of fauna in this area shows the gravity of the problem. In addition contaminated edible fish has been noted near this site. Although two treatment plants exist only primary treatment is carried out, and the capacity of the plants is far below what is required.

Aside from some small establishments and an investment promotion zone a similar problem is seen in Sri Lanka where there is no sewage treatment. Sewage in the coastal environment and estuaries has caused the contamination of commercial shellfish by human pathogens. Although ocean outfalls are planned no provision has been made for the removal of solid waste. There is a risk that these will float back to the shoreline on 'unfavourable' tides and currents leading to coastal pollution particularly of an unaesthetic nature having heavy consequence on the amenability of the beaches and the tourist industry.

Sewage and domestic wastes disposal as well as solid wastes disposal presents a problem wherever there is a concentration of human population. Health and aesthetic considerations motivate action on these problems. Their effect on coastal waters is a factor which must be considered when assessing the effectiveness of the undertakings to improve disposal systems for solid and liquid wastes.

ENVIRONMENTAL HEALTH

Sanitation and water supply are important aspects to be taken into account in investigating environmental problems. The direct cause of lack of appropriate sewage disposal methods is that not only is the outlet area contaminated but using these areas leads to sanitary conditions unsafe for good health. This is also the end result when percolation of pollutants, whether from poor sewage disposal, agricultural or industrial effluents, can affect the water table from which potable water and water used for human and animal consumption is drawn.

These inadequate sanitary conditions, coupled with malnutrition in certain cases, is a prime cause of infant mortality in developing countries.

In India, about 25 per cent of the country's population live along the coastal areas. Provision of sanitation facilities and drinking water supply is far inadequate considering the demand. This is especially true in small towns and villages. The discharge of wastes from latrines along the beaches of Puri, a pilgrims town along the east coast, has considerably affected the aesthetic condition of the beach and is a constant health hazard to the bathers. Also waste disposal from village sewage creeks and dumping of fish landing wastes along the coasts contaminates the inhabiting shellfish. Consumption of bacteria contaminated shellfish by coastal villagers is often the cause of diarrhoea, etc.

In Bangladesh infectious diseases such as cholera and diarrhoeal diseases is one of the most immediate causes of death. Approximately 40 per cent of these deaths affect children and are transmitted by water-ways and through faecal contaminants. Pit latrines and buckets are predominant methods used for waste disposal in urban areas, and rivers and streams serve as waste removal systems in rural areas.

Although water is plentiful, a good supply is available only to a small amount of the population. In 30 townships, piped water systems are derived mostly from wells. Hand-pumped tube wells, surface ponds, tanks and rivers are the other sources. Although half the rural population and one fifth of the urban population have reasonable access to safe potable water, it is estimated that only 10 per cent of the rural population receive it efficiently.

In the Maldives pollution of the ground water is a major concern especially as the supply is so limited. Similar health problems arise from this contamination as elsewhere with diarrhoeal diseases causing high rates of infant mortality. Although the water is chlorinated the taste of this chlorination causes some of the population to reject it.

Piped water does not exist in the Maldives. The main source, a fresh water lens within each coral island, is being contaminated from various wastes. Excess drawing of water due to the small lens has led to salt water creeping in with the result that consumption at the ends of the lens becomes impossible due to elevated salinity. Wells and roof catchments are the alternative source of potable water. Water is so scarce in some cases that it has to be transported from other islands.

In Sri Lanka, problems of health related to unsafe sanitation practices are similar to those of other countries in the region. Again diarrhoeal diseases are a major concern. Food contamination of shellfish, crabs, prawns and lobster by waste water of coastal settlements is evident all along the coast. The city of Colombo is alone in having a sewerage system. Septic tanks and pit latrines are most common with some parts of the population practicing open defecation.

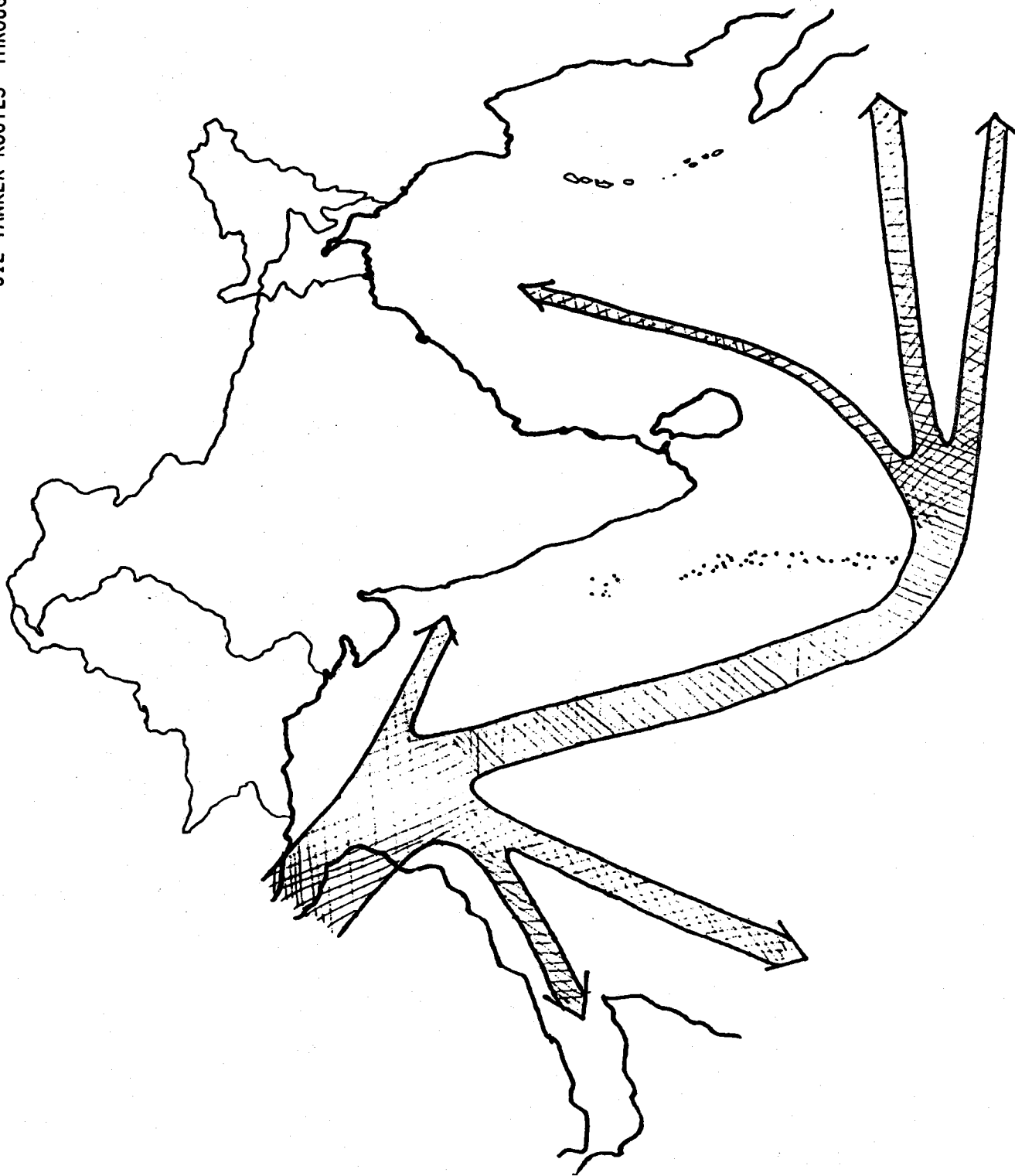
Shallow wells provide water in most parts of the country. The south and west coasts urban population are supplied with piped water but rural population depend on ground water.

OIL POLLUTION FROM COASTAL AND MARITIME SOURCES

A problem common to almost all the States of the region is oil pollution. The main route of the marine transport of oil from the Gulf countries is across the Arabian Sea, where it passes the southern tip of Sri Lanka across the southern Bay of Bengal through the Malacca Strait to the Far East and Japan. In 1983, 222 MT of oil was shipped to the Far East and Japan from the Gulf countries. This, coupled with the increasing emphasis on offshore oil exploration in many countries of the region, makes the northern Indian Ocean very vulnerable to oil pollution.

Sources of oil pollution are tanker disasters, ballast water and bilge washings. Fortunately, only a few tanker disasters have occurred, so far, along these tanker routes. However, the effect of the oil pollution can be seen on the beaches in the form of deposits of tar-like residue. The frequency and intensity of this residue depend on the current direction along the coastal region. Because of the monsoon winds, the surface currents change direction every six months. Whenever a shore-ward component of surface current develops, heavy deposition of tar balls occurs on the beaches.

OIL TANKER ROUTES THROUGH THE INDIAN OCEAN



There has not been any large scale oil spill catastrophe in the Bangladesh waters so far, and the only oil pollution in the water bodies of the country occurs from land-based sources and boats. This has not produced much of a pollution hazard because of the more or less rapid river currents. The level of oil derivatives in the rivers and the coastal waters has not yet been surveyed although there are persistent, undocumented reports of frequent sighting of oil slicks in the territorial waters of the country.

The levels of dissolved petroleum hydrocarbons is reported to be very low in the seas around India. However accumulation of "tar balls" is a chronic problem along the west coast of the country. Oil pollution occurring due to the tanker, ships and trawler operations has damaged coral reefs and sandy beaches. Considerable damage has been noted on some of the Indian territory atolls of the Lakshadweep and coral reefs of the Andaman and Nicobar group of islands.

The operation of an increasing number of vessels in the Male harbour in the Maldives causes some occasional oil slicks, however, these are of limited extent. Only one spill occurred from a tanker but again it was confined to the harbour and no damage was noticed.

Little oil pollution appears on the coast of Pakistan, but the ports are more prone to such sighting. Oil pollution arises from vessel activity, washings of bilges and land-based sources such as garages, workshops and shipyards. The Manora Channel is locally affected around the main oil terminal, small slicks almost always being apparent. Tar balls have been found along the beaches and in plankton samples. Some sandy and rocky intertidal zones near the shipyard are oil-smearred, and oil has even penetrated the sediment.

Some mortality was reported among fauna in Karachi harbour and tainting of commercial edible shellfish has also been noted.

Although there have been no reported oil spills in Sri Lankan waters there have been confirmed sightings of particulate petroleum matter (tar balls), being washed ashore along the southern coast. The presence of large numbers of oil tankers calling at the Port of Colombo or passing through the narrow traffic separation zone of Dondra, poses a constant threat to the marine environment in Sri Lanka. Approximately 5,000 tankers per year pass within five miles of Sri Lanka's coast posing serious risks of an accident occurring.

Spills during loading, transport and unloading are a major threat. Deballasting and ship tank washings are also of concern. Low-level contamination through oil discharged in other effluents from land-based sources has been noted to impart taints to fish and shellfish.

Handling of oil products in refineries, storage facilities, during transport, and at the point of use involves risks of spillage at all points. Tight control of methods of handling precautionary protective measure such as booms on water and bunds on land, and substantial penalties for carelessness leading to spills have been effective in many countries in reducing the oil discharged into water-ways and coastal waters. Negotiations with the oil companies backed by appropriate legislative authority could probably improve the situation, and a co-ordinated region-wide approach to the problems would provide strength in negotiations with multi-national oil companies.

POLLUTION FROM AGRICULTURAL ACTIVITIES

Fertilizers, pesticides and insecticides are quite abundantly used in the developing countries in agriculture, pest control and vector control. In many countries, organochlorine pesticides are either prohibited or are gradually being replaced by organophosphorous and carbamate pesticides. Use of the organochlorine and organomercurial pesticides has been banned in the industrial countries of the world. However, their total production has not been reduced, rather, a relative increase in their manufacture appears to be taking place. Most of the countries of the region note an increasing use of pesticides and fertilizers. Pesticide consumption in 1982-83 was approximately 6,000 metric tonnes and was expected to rise sharply, based on ESCAP Agricultural Requisite Scheme for Asia and the Pacific (ARSAP).

Precise data on the use of pesticides and fertilizers in Bangladesh is not available. Recent estimates indicate 3,000 tonnes of pesticides are imported into the country per year. Mis-handling is a common problem. The Directorate of Fisheries of Bangladesh reports increased use as having affected the spawning of freshwater fish in ricefields and killing plankton and affecting its production.

Very little study has been carried out on the accumulation and harmful effects of pesticides in India. However, a study shows plankton in the Arabian Sea off the West Coast of India having a DDT concentration range from 6.05 - 3.21 ppm wet weight. Use of pesticides, for example around Bombay, also contributes to local pollution problems.

Few pesticides are used in the Maldives as the lack of fertile top soil lends itself only to limited agricultural development and usually at subsistence level. DDT has been used extensively in malarial eradication campaigns and against rodent population.

In Pakistan the majority of drainage of pesticides from agricultural land is thought to find its way into the Indus River. However, sufficient information is not available in this field for the present.

Sri Lanka experiences ground water pollution by fertilizers percolating through the soil. This includes contamination of drinking water wells to the extent of surface run-off killing off trees and plants. Pesticides also leach out and enter the surface and sub-soil waters. Diffuse pollution from agricultural production, especially from spillage and leach of pesticides, can have widespread, less spectacular, effects by generally lowering the quality of coastal waters.

POLLUTION FROM INDUSTRIAL SOURCES

Similar to the use of pesticides and fertilizers, industrialization is on the increase in the region. The increase does not necessarily run parallel to the treatment processes required for this expansion. Industrial activities may discharge toxic substances, such as heavy metals used in industrial processes, which can become concentrated in the marine biological food chain.

Excessive discharges of organic materials from plant and animal processing plants may deplete the marine environment of oxygen so that its productive capacity is destroyed. Though these discharges are generally concentrated in small areas around the coast, they sometimes enter estuaries or other shallow waters of high potential productivity, and dispersed processing industries, such as tanneries, can have widespread, though less spectacular, effects by a general lowering of the quality of coastal waters.

In Bangladesh dumping of the industrial effluents causes localized water quality problems. In one such case a petroleum refinery's effluents have made the water unusable for the city of Chittagong. Surface water in the vicinity of Dhaka city has been affected giving high levels of organic activity in these waters.

Industrial pollution in India, as elsewhere, is very localized near the sites of industrial plants or sectors. The coastal waters around Bombay are particularly heavily polluted with discharges of industrial effluents. In general, however, pollutant levels especially those of heavy metals are below or within the permissible limits.

Scarcity of land and fresh water limits the establishment of industries in the Maldives. What little effluent is derived from the sole fishing canning factory is dispersed rapidly in the vast open waters around the island.

Most of the industrial activity in Pakistan is restricted around Karachi carrying about three hundred major and nine hundred minor industries in the Site area with about the same numbers in the Lite area. Effluent with a BOD load of 625 tonnes is carried by the Lyari River to the Manora Channel and a further 550 tonnes is transported by the Malir River to the tidal flats of the Gizri salt water creek and thence to the Arabian Sea. Several heavy metals are also reaching the coastal waters through industrial discharge. High concentrations of these build up occasionally jeopardizing the edible seafood in the vicinity.

The Kelani river in Sri Lanka has reported numerous fish kills due to the inflow of industrial effluent. Similarly the lagoon at Valaichchenai has turned dark brown due to pollution. Other areas also show anoxic conditions and/or decreases in fish numbers.

High dissolved oxygen and pH levels and low carbon dioxides and ammonia levels have led to eutrophication in Beira Lake. Industrial effluent is generally untreated and waste enters sources from which water is taken for cultivated land. Tainting of edible plants has been noted along the banks of the Kelani River.

TOURISM

Coastal tourism development in the region is mainly concentrated in the Maldives and Sri Lanka. This form of tourism is still in its early stages in the other countries, though resorts such as Goa (India) have already become internationally known. Although environmental standards of some coastal areas may not meet the immediate requirements of tourism, lack of beaches as such is not a major constraint. Some of the factors such as oil pollution and inadequate sewage disposal facilities, which have been identified as affecting the environment, also affect tourism.

India has a coastline of about 6000 km and tourism is beginning to develop as an industry and a major source of revenue along the beach sites of particularly Goa, Kerala, Tamilnadu and West Bengal. At present they are mostly a holiday venue for the local population.

The presence of coral reefs and mangrove wetlands attract a lot of academic and scientific excursions. However, due to the damage of corals by oil slicks, over exploitation by cement industries and other detrimental pressures on the reef, there is a serious threat to the immediate survival of these ecosystems.

Even though, the tourism oriented beach resorts in India are fairly unpolluted at present, increasing tourist inflow and establishment of hotels along the beaches would eventually create environmental problems in the near future. The solid waste accumulation along the beaches and disposal of raw sewage by beach hotels directly into the sea are some of the serious threats to the future growth of coastal tourism.

In Bangladesh, the beach resort Cox's Bazaar along the south-eastern coast is not at present a major revenue earner as it attracts mainly local inhabitants. However, this resort is claimed to be the world's longest beach and plans are underway to develop it for international tourism. The tourist-related environmental problem is that of coral collection around Saint Martin's Island.

A similar concern of damage to coral reefs is seen in the Maldives. Here tourism is a major source of income but is limited by controlled development. Atolls are selected for the establishment of resorts and tourism is restricted to these atolls. A wider programme for tourism throughout the country is at present being considered. The main environmental problems related to tourism are those of an adequate water supply and sufficient sewage disposal. Water resources were brought in from other islands to meet the demand on the resort atolls. The attractiveness of the resorts or beaches may also be spoilt by indiscriminate disposal of solid wastes and garbage.

The construction of landing jetties and barriers to control currents and erosion has had some overall adverse influence on the erosion/sedimentation patterns of some of the harbour regions. Corals too, have been affected by dredging and dumping for these constructions.

Sri Lanka also enjoys a popular tourist industry. However, rapid expansion of this industry in the 1970's led to improper construction of hotels on unstable sections of the coastline. This aggravated the already existing problem of erosion while the construction of protective barriers spoilt the aesthetic value of some beaches. The collection of coral for souvenirs may have aggravated a previously existing problem caused by coral mining which has now been banned.

Tourism, as a major source of revenue for Sri Lanka, competes with traditional subsistence activities such as local fishing. However, resorts and hotels also constitute a ready market for the catches of local fishing fleets. While cases can be cited of beach areas previously used by fishermen being developed for tourism and of local fish stocks being depleted, it is also true that the progressive mechanization of the fishing industry has led to degradation of beaches, oil deposits due to the proximity of shipping lanes, etc. Here, too, the water supply is sometimes inadequate. Another concern is the overload of already limited sewage disposal facilities.

COASTAL EROSION AND SEDIMENTATION

About 16×10^8 tonnes of sediment reaches the Indian Ocean from rivers flowing through the Indian sub-continent. Natural sedimentation is aggravated by human activities, such as mining on land, clearance of land for agriculture, lumbering, urbanization and industrialization, and dredging to deepen harbour channels and estuaries.

Soil erosion following changes of land use or changes of vegetative cover has in many areas increased sedimentation at the coast, destroying stable biological systems in the shallow waters and estuaries, which form the basis of marine food chains, and causing effects which may extend far out into the oceans well beyond the actual sedimentation site. Though the control of this is a matter of land use rather than water use it is important that those responsible for coastal management co-ordinate with the land management authorities to reduce soil erosion to the minimum. The health of coral reefs is particularly sensitive to excessive sedimentation. The silt load carried by the three river systems of Bangladesh is greater than that of any other river system in the world. The total annual sediment load of the river systems of Bangladesh has been estimated to be of the order of about 2.5 billion tonnes (Abbas, 1973). Of this total, the Brahmaputra river carries 1.7 billion tonnes and the Ganges 800 million tonnes annually.

The silt is deposited and forms sediment banks which are colonized by pioneering grass and become stable land. However these sites, when used for grazing, lose their stabilizing vegetation which may reverse the cycle resulting in erosion and a loss of this land. Tidal action can re-suspend this sediment and deposit it elsewhere. Considering tidal conditions it has been estimated that net accretion lies between 3210 and 3600 ha of new land (1972 - 1977).

In the Maldives extensive dredging has reclaimed land to expand the airport and the capital island. The main effects of the dredging, or from mining for sand, is that experienced on coral growth. Some damage of coral near resort islands has already become evident.

The islands of the Maldives are transient and strong current, swatches and wind-influenced water movements accentuate beach erosion. Changes in current patterns due to the construction of jetties and groins has also resulted in a certain amount of beach erosion.

The Indus River in Pakistan was estimated to discharge 250 million tonnes of sediment per year in 1940 and 50 million tonnes today owing to the different dams that have now been built on it. This may also have resulted in concurrent coastal erosion. Small streams also discharge large amounts of sediment, and this coupled with the erosion has made the coastal waters very turbid.

The sediment also has its sources in inland construction activities and, judging from the estimated 250,000 tonnes of dust that settles in Karachi each year due to dust storms chronic siltation, also affects Port Qasim. Semi-permanent dredging has since resulted in excessive turbidity which is a probable cause of the depletion of oyster stocks and the decreased productivity in the area.

Excessive siltation and sedimentation particularly from upland soil erosion has been reported in some of the major lagoons in Sri Lanka, sometimes causing the formation of sand beds and sand spits across the mouths of rivers and lagoons. This has affected the navigability of these areas and in some cases the salinity. Poor circulation in the water body has decreased fishing potential and migration, for example, of prawns. Retaining structures have, so far, not had sufficient impact. As in Pakistan, regular dredging is needed in some harbours due to excessive silting.

The south-west and west coasts have annual erosion rates of 1-7 m sometimes resulting in the need to relocate roads and homes. Traditional fishing activities, such as beach seining, have had to be displaced. Coastal construction and sand and coral mining have also contributed to the problems of sedimentation and erosion. Erosion in coastal areas has led to loss of aesthetic beaches aggravated by the loss of the coral cover due to exploitation and damage.

COASTAL ZONE AND MARINE ECOSYSTEM MANAGEMENT ^{4/}

Mangroves

Mangrove forests play a key role in the coastal environment. They constitute an important and productive resource in the region, which can be managed on a sustainable basis. They serve as a rich biological habitat for spawning grounds, nurseries and feeding grounds for economically important fishes and crustaceans. They act as a buffer zone and offer protection to vulnerable communities such as the coral reefs. They also stabilize the bottom sediments, control the local mean water level and the direction of water flow. Mangroves constitute a significant portion of the coastal wetlands in many countries and a fairly large percentage of the human population is dependent on them. Coastal wetlands and brackish water lakes and lagoons cover extensive portions of the coastal areas of the South Asian countries, especially in Bangladesh and Sri Lanka, and provide important habitats for commercial prawn and shrimp fisheries.

The mangroves of the Sunderbans, in Bangladesh, reportedly the largest block of mangrove forests in the world, cover almost 6,000 km² in the tidal plains. The most important economic species of the seven found in the Sunderbans are Heritiera formes, Excoecaria agallocha and Sonneratia apetala. The forests are worked by selective cutting and natural regeneration. Deforestation of mangrove swamps and over exploitation of the wood for fuel and timber have resulted in degradation of the habitat, especially with regard to loss of its role as a barrier against cyclones and tidal waves. A variety of different uses are found for the mangrove forests. Reforestation is being undertaken especially to protect embankments and new land accretions.

^{4/} This section and that on endangered and threatened species should be read in conjunction with IUCN/UNEP report on Management and Conservation of Renewable Marine Resources in the South Asian Seas Region, UNEP Regional Seas Reports and Studies No.62, which provides a more detailed account of existing situations.

Three zones exist in the forest: freshwater, saline and saltwater with differing species composition in each. About one third of the population is dependant upon the mangrove environment for their livelihood with an employment factor of over 300,000 being generated in the Sunderbans region alone.

In India there is a profusion of mangrove forests along the north-east coast where they are distributed among the major estuaries, deltas and back waters. An area just under 700,000 ha is covered by mangroves in the whole of India. On the west coast, however, they are scattered and comparatively small in area. Rhizophora, Avicennia, Bruquiera and Sonneratia are among the most important of the 45 species present. The mangrove forests in Sunderbans in India, adjacent to Sunderbans of Bangladesh, which form a very large area is one of 15 protected tiger reserves. Bhitarkanika, another large mangrove forest system on the coast of Orissa is also effectively protected.

They act as important captive, culture fisheries areas and are of great value to the wildlife, recreation and education. Reclamation, deforestation to convert the land for use in agriculture and urban expansion and pollution pose the major threats to this habitat in India. Industrial effluents from rapidly developing coastal industrialization destroy the fauna and flora, for example in Mahim Creek, Bombay. Heavy metals, petroleum, and increased turbidity are other major problems that are encountered.

The Maldives, although having clusters of mangroves scattered at random have no real mangrove forest. Although marsh lands exist the habitats are not of any great ecological importance due to their small size. The most important species are Avicennia marina, Bruquiera cylindrica, Rhizophora mucronata, Sonneratia caseolaris and Sonneratia acida.

In Pakistan, about 40 per cent of the 800,000 acres of swamps harbour mangrove stands. Mangroves, here, thrive best in low salinity waters. Changes in the flow of rivers, e.g. the Indus, have increased salinities and reduced mangroves in quantity and to low shrub-like growths. They remain luxuriant where the inflow of fresh water is high. There are eight species found in Pakistan, Avicennia marina being the most common.

Pakistan's coastal fauna does not seem to suffer heavily from ecosystem loss of mangroves. For example, on the Baluchistan coast shrimps are still abundant despite the relative lack of mangroves. However the habitat itself suffers from increasing turbidity and salinity. The increased turbidity is generated from dredging of harbours or reclamation (Gharo-Phitti Creek has led to the loss of some mangroves). Sewage, pesticides and oil are other detrimental pressures on the mangroves in Pakistan.

About 6,000 ha of mangrove forest with 28 different species are found in Sri Lanka most on the north-west and east coasts where they grow in narrow strips. Collection for fuel wood and loss of habitat due to land reclamation are the main causes of mangrove forest degradation. In addition clearance for coconut cultivation and human settlement have caused further stress. In Negombo area some species are cultivated for economic use. A major management problem is the lack of understanding of the importance of mangroves as a resource in the national economy.

Due to the ever increasing demand for land and fuel, many mangrove areas of the Indian Ocean region have been and are being destroyed. This has led to heavy siltation in the nearshore region. With no protective mangrove cover, the devastation of men and material caused during cyclones in coastal areas is severely aggravated.

Coral reefs

Coral reefs of the tropical Indian Ocean include fringing and barrier reefs, sea level atolls, and elevated reefs. Many coral reefs in the region are seriously threatened. Several coral reefs have almost disappeared because of the collection of coral debris and live corals for use as a raw material in the cement industry, while others have died due to their constant exposure to pollutants, particularly oil.

The only known coral reef in Bangladesh occurs around St. Martin's Island in the Bay of Bengal. Scientific knowledge of this area is still fairly limited. Reputedly a submerged reef, parts of it are said to be completely destroyed. The main causes of this are shell and coral collection but there is also the possibility that domestic and industrial effluents, dynamite fishing and recreational pressure add to the problem.

In India the north-west and south-east coast as well as the Laccadive Islands and Nicobar Islands harbour the fringing coral reefs and coral atolls which are of great significance. Coral is exploited mainly for use as white cement. Oil pollution, poses an increasing threat to the habitat. In addition they are collected extensively as ornaments for decorative purposes, as mortar and for white washing of houses in the construction business. Examples of this are in the region of Kavaratti reef in the Laccadives; and reefs found in the southern part of the Great Nicobar Island in the Andaman group.

Atoll shaped reefs form around the rims of the atolls of the Maldives. Micro atolls and patch reefs also exist here. The reefs here are wider and varied and may be sorted into several biological zones. There is a high diversity of formations and species. Generally the reefs are considered to be in good condition. Although some collection for building material and sporadic use of dynamite for fishing is noted, no scientific data is available on this or on the exploitation of fish or shell here. Coral mining and souvenir collection are the major potential dangers as well as the remaining occasional reports of spear fishing, which have been banned, and recreational activities.

Local depletion of some reef fish is reported to have occurred due to the collection of ornamental fish although this has not been confirmed. Limits have now been set to curtail the number of fish caught.

No known coral reefs have yet been discovered in Pakistan although some areas favour their growth.

Reefs and scattered coral colonies occur on much of the Sri Lanka coast-line especially at the north-eastern and south-western extremities. Systematic surveys of corals carried out recently have indicated Sri Lanka to have a rich species diversity. However, in certain areas deterioration has taken place. The main reasons for this are fishing with explosives, mining for coral lime, collection of exotic reef fish and sedimentation which has particularly deleterious effects in Palk Bay and the Gulf of Mannar. Intense coral mining has left large brackish pools where corals used to exist making the surrounding land sterile to agriculture. Erosion has also been a consequence of concentrated coral mining. Collection of the corals and shells and the effect of industrial effluent contribute to the destruction of this habitat. Cyclones cause damage to reefs by breaking off coral rubble which is then washed onshore. Attempts are being made to ban dynamite fishing and to curtail coral mining and its collection as ornaments and souvenirs.

Coral mining

Coral is a source of lime which is used for a variety of purposes particularly in the construction industry for mortar and white wash. The lime is obtained by processing the coral. It is also used in various industrial purposes and to reduce the acidity of soils.

In the Maldives coral rocks, rubble and sand are used for building homes and walls. Coral is collected from lagoons and sand banks. Half the mined coral is given to the government for public works. Coral is used for concrete, constructing and re-surfacing of roads. Several banks are disappearing as a results of this mining. The area of mining has been restricted, except for mining that is carried out for private use by local inhabitants. However, a study carried out for the United Kingdom Overseas Development Administration has shown that if mining continues at the current rate around North Male, this atoll will exhaust its coral stocks by the year 2014. There is an urgent need to find alternative sources of building material and to manage coral stocks on a sustainable basis.

In Sri Lanka, too, over 2,100 tonnes of coral are mined per year and over 5,300 are collected from the beach. Adverse consequences of this mining may be seen on the south-west coast. Despite the Coast Conservation Act this activity continues unabated due to lack of enforcement and due to the economic benefits mining.

These benefits are, however, out-numbered by the losses incurred to the environment from this industry.

Island ecosystems

Island ecosystems, though forming only a small portion of the total region, are especially dependent on careful management. There is no hinterland from which to draw water or other resources, and no alternative human habitats to withdraw to, should the present habitats become untenable. The biological system is fragile and delicate. Problems of waste disposal, erosion and sedimentation need careful monitoring and management.

The Maldives and Sri Lanka are most directly concerned due to their island nature. The coralline islands of the Maldives are constantly changing, building and eroding at a rapid rate and sometimes consisting only of sandbanks with pioneering plant species and seabirds. The coral sand surface allows little cultivation which is limited to coconuts and scrubs. Only 10 per cent of the land is cultivated. Lack of water is a major problem in Maldives as is the disposal of solid wastes.

Because of the limited land area of the island surface, the Maldives is one of the most thickly populated island nations in the world in terms of population per sq. m. of land area. The pressure of population growth upon the limited available land resources is enormous and this is emerging as the most serious environmental problem of these islands. The fuel wood resources on the islands are fast becoming scarce and such species as Hibiscus tiliaceus, Pemphis accidula, Scaveola taccada, Thespesia populnea and Tounfertai argenticia which have mostly low calorific heat value are nowadays being used as firewood for lack of better materials. Scarcity of firewood will become a very serious problem in the country before the end of the century. To counteract this a tree planting programme has been launched, and since 1984, 500,000 trees have been planted by the Government.

Although Sri Lanka is an island ecosystem its fauna and flora reflect the continental ecosystems. However, the problems it faces do mirror those of the Maldives although not to such a harsh extent. Foremost among its problems are those of coastal erosion and sedimentation, both from natural causes and from human activity.

In India, the three groups of islands namely, Andaman, Nicobar and Lakshwdeep are yet to be exposed to modern development and their ecology, except in a few cases such as damage of coral reefs, is fairly protected. For example, Narcodam, North and South Button etc., have been afforded protection by declaring them as a national park or sanctuary under the provisions of the Wild Life (Protection) Act, 1972.

Fisheries

Coastal waters provide a high proportion of the fish requirements of the region. There is a big variety of conditions in the water environment of the region - the extensive shallow waters at the head of the Bay of Bengal, the narrow continental shelf of Sri Lanka, and the coral atoll systems of the Maldives are examples.

Fish farming is highly developed in some parts of the region, but has the potential for increased production.

While emphasis in many developing countries is being placed on mechanization and increased effort in exporting fish resources conservation is necessary and action has to be taken to regulate the fisheries. Where these conservation practices have been exercised it is important to take into account the small-scale fishermen who are engaged in subsistence fishing in the coastal areas.

Fish represents the most easily augmentable source of protein in Bangladesh. Inland fisheries account for about 90 per cent of the total annual fish catch in Bangladesh, because of the deltaic nature of the country and the existence of vast stretches of natural inland water bodies. Fishing is the second most important economic activity engaging over 5 million persons.

Research work is required with regard to breeding and spawning grounds, seasons and the ecology of most of the economically important marine species of fish. Steps may also be necessary to protect their breeding and spawning grounds. Certain harmful fishing methods such as 'carbide booming fishery' is prevalent in the country, especially on the coral reefs of St. Martin's Island. In this method of illegal fishing, explosives of different types, including dynamite, are thrown into the waters near the reef edge, and the killed or stunned fish, including all the larval and juvenile fish and fry, as well as the corals in the vicinity are collected by diving.

The Directorate of Fisheries of Bangladesh and the Bangladesh Fisheries Development Corporation are undertaking projects to develop coastal marine fisheries in the Bay of Bengal. At present, several small- to large-sized mechanized fishing vessels are being operated under these projects.

Traditionally fishing has been undertaken by non-mechanized rivercrafts. Mechanized fishing vessels have been introduced only in very recent years and only limited scope has been recognized for the development of mechanized bottom-trawling or pelagic fisheries. The Government has initiated joint fishing ventures with some neighbouring countries in recent years. In Bangladesh, negative impacts due to over-fishing of commercially important fishery have not been reported.

Total annual fish landings in Bangladesh during 1982 were of the order of 650,000 metric tonnes which was less than landings 10 or 20 years ago, mainly because of the drastic decrease in the inland fish catches since 1962. The growth of the marine fish production has not been sufficient to offset the decrease in the inland catches. A recent World Bank report estimates that the potential for increasing marine catch is rather limited and costly except in the nearshore areas (mainly shrimps).

Very little aquaculture is being practised in the country in a systematic manner, although several modern advanced technology techniques have been demonstrated in recent years. The traditional practise of 'trapping and holding' or enclosing and fattening shrimps is used in paddy fields in the coastal areas. The Government is aware of the vast potential for developing aquaculture in the coastal regions to boost the supply of protein in the country.

India has an EEZ area of 2.02 million km² about 40 per cent of which is connected to the island groups of Andaman & Nicobar and Lakshadweep. With regard to commercially exploitable living resources the shelf area on the east and west coasts, as well as the near shore waters up to about 40 fathoms, are being exploited and most of the current production of 1,600,000 tonnes is harvested from the nearshore waters.

The increase from 720,000 metric tonnes during 1981 to the present production is mainly the result of mechanization. To date there are about 20,000 mechanized boats and 75 deep sea fishing vessels in the commercial sector operating in the nearshore waters. In addition, until March 1983 there were 38 chartered foreign fishing vessels operating in the nearby offshore areas.

The introduction of about 200 additional deep sea fishing trawlers to the Indian waters is envisaged. These activities are of special significance, particularly when the fishing operations are concentrated in such productive zones as off Gujarat, Konkan coast, Karnataka and Kerala in Wadge Bank and in the south-west coast including the waters around Lakshadweep. Similarly, off the east coast the highly productive zone of Sand Heads off Orissa and the waters around the Andaman and Nicobar would be the targets. These productive zones are not only exposed to the dangers of indiscriminate fishing but also exposed to man-made stress on the ecosystem through the operation of mechanized boats using fossil fuel.

The chief industry of the Maldives is fisheries. Fish is one of the basic staples in the Maldivian diet. The entire fisheries of the country is marine in nature. Annual export value of fish, exported mostly in the form of sun-dried 'Maldivian fish', accounts for 90 per cent of the country's total exports. However, the fisheries is organized on a small scale and basically limited to near-shore fishing grounds.

Tuna fishing from sail boats using live-bait is a traditional fishery in the Maldives, and mechanization of the fishing crafts has only very recently been introduced and popularized. There are unconfirmed reports in recent years of some decrease in commercial tuna populations in certain areas and seasons at certain depths in the fishing grounds, but this is yet to be scientifically investigated and confirmed. Considering the low intensity of fishery so far, the chances of such a decrease, if at all true, being caused by over-fishing is very remote. 35,000 metric tonnes of fish was landed in 1981, of which skipjack tuna alone accounted for 21,000 metric tonnes with an average catch per unit effort of 140 kg. Huvadhu and Madhosmadulu atolls were the most productive with annual landings of 6,400 and 5,300 metric tonnes respectively.

The marine fauna and flora and the marine fisheries resources of Pakistan are fairly extensive. The total fish catch of Pakistan is around 300,000 metric tonnes a year. The marine fisheries industry of the country earns about 900 million rupees per year from export-oriented products. Shrimps constitute its most important component.

Over 85 per cent of the total production or about 183,000 metric tonnes of the fishing industry in Sri Lanka comes from marine fisheries. Out of this 98 per cent of the fish is produced by coastal small scale fisheries. There are indications that the coastal small-scale fishery is approaching maximum sustainable yield levels, but there is still scope for expansion in offshore and inland fisheries

The total marine area available for exploitation is about 525,000 km². The inland fishery resource base is comprised of an estimated 123,000 ha. of brackish water lagoons, estuaries and mangrove swamps, and 137,600 ha. of fresh water tanks and reservoirs.

Production of the coastal fishery resource yields out 180,000 metric tonnes, that of offshore and deep sea fisheries yields 1,000 mt and the inland fisheries yields 335,000 metric tonnes. However, the annual maximum sustainable yield levels are being reached and in some cases have been overtaken.

In Sri Lanka, there are several harmful fishing activities practised in marine waters e.g. the use of small meshed nets to catch juveniles, laying of nets in mouths of lagoons, and killing of fish by explosives such as dynamite. Legislation has been promulgated in an attempt to stop this activity.

At present the contribution from aquaculture fisheries in Sri Lanka is negligible. Nevertheless, efforts popularize fish production by culture, mainly in freshwater bodies, have been increased during the past few years. Development in aquaculture has begun using Tilapia mossambica, T. nilotica, Chenos and shrimp culture are also being undertaken.

Most of the shrimp exploitation occurs in inshore and brackish water areas. The shrimp production represents a high proportion of marine export products. Increased attention is being given to it especially in the processing and quality control sectors. Excessive capture of juveniles has depleted many species, and shrimp stocks are on the decline in most of the region. This coupled with the loss of habitat has seriously affected their numbers.

Other living resources

Other important living resources include marine mammals, turtles and birds as well as marine algae, shells and sponges. Of these the former is discussed below under the section on threatened species. The latter are extensively exploited in the countries of the region, particularly for ornamental shell trade, mother-of-pearl items, etc. For example, seaweeds are already in commercial use in India and Sri Lanka where they are used for food, fertilizers and pharmaceuticals. In India 100,000 tonnes of marine algae can be harvested every year. Culture of marine algae is also being undertaken in India. Siltation is a problem for cultivation areas as well as changes in species diversity due to industrial and domestic effluents.

In Sri Lanka much of the algae collected is exported as food to foreign countries. Here, too, the possibility of commercially cultivating marine algae is under investigation.

THREATENED SPECIES

Many species of wildlife, which are now found in the restricted areas, have had their numbers diminished substantially, sometimes to the extent of being on the verge of extinction. This is primarily due to loss of habitat, owing to human encroachment and, for some species, exploitation for a variety of purposes including food, skins, fur, pets, etc. Animals may also be hunted for their skin or fur.

In Bangladesh, although the export of skins and furs is forbidden, they may still be found on the local market. Over five per cent of the mammalian species in the country have become extinct over the last century. There is special concern over twenty species peculiar to the mangrove ecosystems some of which have been designated 'endangered' or 'vulnerable' in the International Union for Conservation of Nature and Natural Resources Red Data Book. Of particular interest among these is the Royal Bengal Tiger for which 3 wildlife sanctuaries have been established.

Marine turtles are threatened by the collection of their eggs and hunting of the adults for local consumption and sometimes international trade. Under the Bangladesh Wildlife (Protection) Order several species are protected and hunting, killing or capture of many species is banned. Prohibitions have been promulgated with regard to immature and pregnant animals and to the suckling duration of the females when they are accompanied by young.

The conservation status of the Ganges-Bhramaputra susu, found in India and Bangladesh, has not been reviewed recently by IUCN but it is probably threatened. The construction of river barrages has been the main reason for the decline in numbers. The concern is amplified since the Farakka Barrage has separated the reservoir population in the relatively less exploited Bhramaputra system from that in the Ganges system.

The protection of coral reefs and marine turtles is of prime concern in the Maldives and the slow-growing deep sea black coral is threatened. Legislation has been promulgated to ban the export of black coral and all turtle products as well as other corals in 'processed' forms. Export of ornamental fish is also regulated as there were reports of certain species becoming rarer. There are plans underway to declare some atolls of the Maldives as biological preserves and/or sanctuaries.

In Pakistan, all sea turtles have been declared endangered and are fully protected. The Indus dolphin or susu inhabits the Indus river and tributaries, but only a few hundred remain now within the Sind and Punjab provinces where they are protected by law. This endangered species has declined as a result of its habitat being changed by impoundment and water diversion and also by exploitation for human consumption, although numbers are increasing in the Indus Dolphin Game Reserve, which was established in 1974.

Turtles, dugongs and lobsters are threatened in Sri Lanka. Although laws exist to protect the dugong and turtles, infringement and lack of control has resulted in continued killings and collection of eggs. The habitat loss of a number of species is also a serious problem. A complete ban was placed on lobster fishing off a stretch of the Colombo coast following heavy depletion of stocks. Minimum catch size was also imposed but enforcement is difficult due to excessive demand created by the tourist industry. Although not yet considered threatened, some coral reef fish taken for the aquarium trade are becoming less abundant.

The Chank fishery has minimum catch size laws and sailing over pearl banks is prohibited to protect over-exploitation. The killing of sperm or baleen whales is outlawed but dolphins still suffer heavy casualties especially as by-catch in fishing.

Much attention has been given in recent times to the conservation of marine mammals. In 1979 at the International Whaling Commission the entire Indian Ocean north of 55° S was declared a Cetacean sanctuary. The whale populations off the eastern coast of Sri Lanka are under observation. Baleen, fin, blue, minke, sei, Bryde's and humpback whales all inhabit the region. Pygmy, dwarf sperm and killer whales, dolphins, porpoises and dugongs are also found in the marine environment of the region. Although unsure of the status of many of these species it is certain that the dugong and freshwater Indus susu are depleted. Many of the coastal species of small cetacean are killed as a result of incidental capture. Much more attention and study needs to be given to marine mammals to fill the existing gaps in knowledge concerning their status.

Sea turtles are protected throughout most of the region by wildlife protection acts. For example, in India, one of the largest breeding colonies of the Olive Ridley Turtle is effectively protected on the Gahirmatha coast in Orissa. Nevertheless, collection of eggs and killing of adults for food and tortoise shell are still common practice. Various uses are made of the different parts of turtle. In addition to this direct catch a great number are also killed in incidental capture in trawl nets and habitat loss and disturbance are widespread problems.

A list of the threatened species in the South Asian Seas region has been included as Annex I.

MARINE PARKS, RESERVES AND SANCTUARIES

Special priority has been given to the establishment of marine reserves to preserve typical or specially significant ecosystems. Such reserves are key elements in effort to preserve endangered fauna and flora.

In India the Gulf of Kutch Marine Park has been established on the north-west coast, Nandar Marine National Park was declared in the South Andamans but has never been implemented, and Pitti Island, in Lakshadweep, is a bird sanctuary. A Marine National Park has been proposed for the Gulf of Mannar and Krusadai Island, and an area on the Malvan coast has been recommended for protection, particularly aimed at the development of tourism. The need for protected areas in the Andamans, Nicobars and Lakshadweeps is considered of particular urgency. Numerous recommendations have also been made for reserves for turtles, mangroves and other marine habitats and species.

Some of India's marine, coastal, island, mangrove and estuarine national parks and sanctuaries are:

Andaman and Nicobar Islands:

Middle Button Island N.P.	44	sq. km.
Mount Harriet N.P.	46.62	"
North Button Island N.P.	44	"
Saddle Peak N.P.	33.18	"
South Button Island N.P.	3	"
Barren Island Sanctuary	8.10	"
Crocodile Sanctuary	102	"
Narcondum Island Sanctuary	6.81	"
North Reef Island Sanctuary	3.48	"
South Sentinel Sanctuary	1.61	"
Wandoor N.P.		
Lehabarrack Sanctuary		
Battimalva Sanctuary		
Tillanchong Sanctuary		
Megapode Sanctuary		
Inter Sanctuary		
Marine N.P.	261	"

Goa, Daman and Diu:

Cotigao WLS	105	sq. km.
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Gujarat:

Marine N.P.	162.89	sq. km.
Khijadia (Birds) Sanctuary	6.05	"
Marine Sanctuary	57.92	"

Orissa:

Bhitarkanika WLS	650	sq. km.
Point Calimere Birds Sanctuary	17.26	"

West Bengal:

Sunderbans N.P.	2585	sq. km.
Lothian Island WLS	38	"
Holliday Island WLS	3.50	"
Sajnakhali WLS	362.36	"

In Bangladesh, although it was proposed in the 1973/4-1977/8 Conservation Plan that 8 per cent of land should be protected for wildlife, less than 3 per cent of total land area is covered by protected areas. They thrive as undisturbed breeding grounds for fauna and flora. Hunting of any sort and public access is prohibited. To protect this special ecosystem, the whole of the Sunderban mangrove area is under surveillance. In 1966 a programme of planting mangroves was begun to protect the eastern coast from wind and waves. The programme has been successful and led to the accretion of land with sufficient stability. Over 30,000 hectares have been replanted. 80 per cent of the fuel wood collected is distributed free and the rest marketed. Over-grazing by cattle is monitored.

St. Martin's Island, Bangladesh, is being surveyed as a potential marine park.

In the Maldives, the reef system as a whole needs to be protected and preserved. There are plans to declare some atolls as preserves or sanctuaries.

In Sri Lanka attempts were made to establish marine parks with little success so far. However, fresh attempts are being made in this direction. Hikkaduwa Marine Sanctuary was declared in 1979 but regulations are poorly enforced. Cabinet approval was granted in 1980 to the Ministry of Fisheries to enact the necessary regulations under the Fisheries Ordinance to declare five marine sanctuaries.

In Pakistan protected areas include mangroves of the Indus delta.

ENVIRONMENTAL EDUCATION

Of prime importance in all matters concerning protection of the marine and coastal environment is environmental awareness and education. The people of the countries of the region need to be educated in how to utilize the environment in a manner which ensures safeguard of the natural conditions and prevents over-exploitation of resources.

In Bangladesh environmental education is incorporated into the school curricula and five universities offer courses in environmental sciences. A variety of courses are also offered at different research institutes.

In India structured environmental education is recent, and few universities have undergraduate programmes in this field. Post graduate research is more extensive and basic environmental education is now being included in the school programme. Research in marine pollution has attained significant status in India, and a substantial amount of data has been collected in different fields.

In the Maldives environmental education is included in the secondary school fisheries curricula. Awareness of the importance of the atoll environment and its resources are emphasized in this programme. Hydrography, fish biology and marine fauna and flora are also studied.

Pakistan has carried out some research on marine pollutants and contaminants but the data is fairly scanty. Several laboratories exist which have the capability to carry out the necessary experiments, but lack of sufficient trained manpower remains a problem.

Sri Lanka, too, ensures environmental education in primary and secondary schools. Environmental degrees are offered at an MSc level as well as undergraduate levels. Environmental training programmes also exist for public officers.

The promotion of environmental awareness like that of environmental education is of major importance if a certain degree of care in the use of natural resources is to be obtained. This is particularly true for developing countries where education is not easily accessible to the entire population and where literacy figures may be unknown. In these cases in addition to pamphlets, newsletters and notices, demonstrations, posters, and films may help to promote responsibility for the environment in an attractive way.

The importance of this awareness programme is also emphasized by the high percentage of the population that reside and are dependent on the coastal area for its livelihood. Instructing the coastal population in the utilization of their resources as well as the creation of national parks and reserves is a major step towards promoting public awareness on the means by which the environment can be protected.

LEGISLATIVE ASPECTS

Several acts and laws exist in all the States of the region which provide for a certain amount of control over actions detrimental to the environment; e.g., banning of dynamite fishing and control of the number of trees to be felled. However, such laws are often not strictly enforced and some may need to be expanded, updated or strengthened. A particular problem faced by all the States is the lack of resources with which to enforce these laws. For example, surveillance in national parks is difficult to carry out due to lack of staff and financial support. Annex II lists the national institutions which deal directly or indirectly with the environment.

An important aspect to be taken into account in the formulation of legislation is to allow for regional harmonization whenever regional actions are to be undertaken, such as for activities involving migratory species.

It is also important if environmental degradation from sources both within and outside the region is to be controlled that the States of the region become party to international conventions concerned with the marine and coastal environment, such as certain agreements developed under the auspices of the International Maritime Organization (IMO) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

It is strongly recommended that Governments negotiate and adopt a regional legal agreement through which the co-operative regional activities of the action plan could be developed and sustained. A formal legal agreement is useful in providing a framework for harmonizing national legislation and creating, as necessary, new legislation relating to environmental problems. A regional agreement gives more emphasis and continuity to governments' commitments by providing a forum for regular, high-level consultation among the parties to the agreement during which the implementation of the programme may be reviewed and by laying a legal basis on which to build financial support for continuous co-ordinated action. Domestically, through its participation in a regional agreement, each government will be better placed to solicit support for the national activities to be carried out as part of the action plan. Experience has demonstrated that it is best to adopt the action plan together with a regional convention so as to reinforce the fundamental link between the two and to promote a continuing political commitment at the highest level by the Governments concerned.

PRIORITY AREAS OF CONCERN

Land-use planning in an appropriate, nationally and beneficial way, is a major undertaking necessary for all the countries of the region. In the islands coastal zone management should focus on the immediate shoreline with urban and economic planning avoiding localized stress on the environment. This also applies to the continental nations, but here inland activities play a primary role due to the vast rivers that carry large quantities of sediment to sea. Any change in this load, whether increase or decrease can have an adverse affect on the coastline by leading to excessive sedimentation or erosion.

Sedimentation results in smothering of coral reefs, increased turbidity affects primary productivity and aesthetic impacts on the beaches where the river outfall lies. Furthermore it renders manoeuvring in ports difficult due to sediment build-up, where repeated dredging becomes necessary. Deltas and sand bars may be formed altering the coastal dynamics. Excessive sedimentation in one area can mean erosion in another.

Erosion due to decreased silt loads can mean the loss of land and ensuing instability in the coastal zone. Deltaic and estuarine areas can be reduced, and vegetation and habitat degraded resulting in a slow loss of the ecosystem. Beaches may disappear due to lack of replenishment from inland. Coastal construction meant to retain the land may, in some cases, deplete it down stream due to changes in current patterns.

The loss of aesthetic beaches is a factor affecting tourist activity in the region. The Maldives, Sri Lanka and, to a lesser extent, India enjoy high tourist revenues which may be jeopardized by lessening attraction of this feature. Negative impacts on the scenery and wildlife as a whole and the threat to coral reefs are to be felt throughout the region.

Coral reefs are threatened by collection for the lime processing industry and as souvenirs and are damaged by the haphazard anchoring of boats and the occasional use of dynamite in fishing. Land based sources of pollution of various sorts are also a constant threat as is that of possible contamination from oil and smothering from dumpings of dredging materials.

These are problems also faced in the mangrove areas where not only is the habitat itself harmed but a valuable ecosystem, commercially important in terms of a breeding ground for shrimps and some fry, is threatened. Two major ecological habitats to be protected are the Gulf of Kutch and the Ganges mouth area.

Oil pollution is one of the prime concerns of the countries of the region. One of the main routes for the transportation of oil from the Middle East to the Far East crosses through the southern half of the Northern Indian Ocean. Aside from the possibility of a major spill occurring, is the probability of small continual contaminants from washing of tanks, refineries and harbour activities. These may initially be localized but can be transported along shore with the continually moving currents and tides.

The States of the region are well aware of the problem of pollution and also of the species that are becoming threatened and endangered due to their over-exploitation or indiscriminate killing. Loss of particular habitats has also led to diminished numbers of particular species indigenous to the region and a decline in numbers of rare species due to their capture for human consumption in local areas.

Localized problems are in fact, what is most commonly seen throughout the region. Although much of the industrial and domestic effluents are carried to coastal waters by rivers there is also some direct dumping. In each case there is a localized effect of a particular nature depending on whether the source is domestic or industrial. Included in this group are agricultural, thermal and solid wastes. As the major urban centres and industrial sites are often situated along the coast, the coastal waters are the most convenient dumping site, and hence intense local problems arise.

RECOMMENDATIONS FOR PRIORITY ACTION

On the basis of the information provided in the national reports, and taking into account the priority areas of regional concern identified by the 1984 meeting of national focal points, the following proposals are presented for consideration as activities to be included in the regional action plan.

General

For all the priority areas of environmental concern, baseline studies are of vital importance. Surveys of the present status of coastal and marine ecosystems and studies on the effects of exploitation and pollution on these ecosystems are imperative. Training of manpower especially

with field and laboratory expertise is an urgent requirement. Coupled with this is the necessity to establish an appropriate legislative framework and to develop institutional arrangements for effective implementation of this legislation as well as for the co-ordination of environmental management.

Oil pollution

States of the region should review their national regulations on oil discharge into coastal waters and update and strengthen them as necessary. All important sources of marine oil pollution within national jurisdiction should be brought under effective control. This includes refinery operations, ships bound to or from national ports, and hydrocarbon exploration and exploitation on the continental shelf.

States of the region should strive to improve the monitoring of oil pollution levels and contributing practices, the operation of vessels in coastal waters and the enforcement of anti-pollution regulations concerning oil discharges.

States of the region should investigate the feasibility of ratifying international agreements on prevention of pollution of the sea by oil discharged or spilled from ships. Special attention should be given to MARPOL 73/78, which contains a comprehensive system of discharge limitations and restrictions.

States of the region should consider co-ordinated regional actions to improve compliance with international and national anti-pollution regulations concerning oil discharges from vessels. Co-operative surveillance programmes may be considered. States may also consider co-ordination of enforcement efforts such as mutual or delegated rights of pursuit, arrest, and detention of offending vessels passing through regional waters.

States of the region should consider petitioning IMO under the provisions of MARPOL 73/78 for the creation of a non-discharge zone in all the waters of the region, to prevent any significant discharge of oil by tankers passing through regional waters and to simplify surveillance and enforcement of international standards by the States.

States of the region should adopt national contingency plans detailing administrative responsibilities in case of significant oil spills in ports or along the coast and, as far as practicable provide sufficient contingency equipment to combat foreseeable spills. States of the region should develop facilities for the combating of acute as well as chronic oil pollution.

States of the region should consider adopting a regional contingency plan integrating national plans. They should also consider making equipment available for spills elsewhere in the region and providing for the stockpiling of equipment for the entire region at a single point or several points.

Industrial waste

National Governments should institute programmes to monitor the environmental effects of industrial waste discharges, to evaluate the effects of existing plants, and to assess the likely environmental effects of proposed major industrial projects. They should strive to improve their regulation of industrial waste discharges through the adoption of general and sectorial policies.

A variety of actions may be taken on a regional level to provide technical support for the regulation of industrial waste discharges. These include the creation of information exchanges, the adoption of general environmental protection and assessment principles and technical guidelines, information and advisory workshops, and staff training programmes.

There should be special environmental and social assessment of the siting and operation of large facilities on the coast, such as industrial and energy facilities, ports, and tourist facilities.

Conservation of living resources

Governments should co-ordinate, through the establishment of national environmental bodies and otherwise, actions affecting living marine and coastal resources, and should strive to improve and expand the survey and assessment of their condition, including important habitats and significant rare or endangered marine animals.

States of the region which have not yet done so should consider ratification of the major international conservation conventions relevant to the region. These include the Convention of Wetlands of International Importance, especially as Waterfowl Habitat; the Convention concerning the Protection of the World Cultural and Natural Heritage; the Convention on International Trade in Endangered Species of Wild Fauna and Flora; and the Convention on the Conservation of Migratory Species of Wild Animals.

States, acting individually or on a regional basis, should improve the training of government officials at all levels whose duties involve the conservation of living marine and coastal resources. This includes administrative officials, conservation officers, and game and park rangers. Such training may include organization of workshops and seminars on the conservation of living marine and coastal resources. Programmes of education on the significance and characteristics of living marine and coastal resources conservation on a broad basis, aimed at local officials and the general public, would also be beneficial.

Protection of marine and coastal habitats

States of the region should consider the establishment of additional marine and coastal national parks and reserves in cases in which critical or important marine and coastal habitats are threatened by human activities. They should consider co-operating on a regional basis to designate such parks and reserves with a view to the establishment of a coherent regional system of protected areas, in order both to create a representative regional network of natural areas and to protect migratory species within the region. To this end, there is a need for comprehensive classification of coastal and marine habitats at both the national and regional levels.

Governments should consider strengthening national legislation and regulations to protect marine and coastal habitats and rare or endangered species. States should also consider harmonizing their national legislation and regulations on a regional basis to simplify the surveillance of activities affecting marine and coastal habitats and species and necessary enforcement. This may include regulations on the harvest, sale and export of corals, mangrove forests and animal products.

Governments should consider the implementation of innovative management approaches for important marine and coastal habitat areas, such as mangroves and coral reefs. These may include special planning exercises, interagency consultations and adoption of special management plans for such areas. Special management approaches could help to integrate the preservation of important habitats into balanced development plans for such areas. An evaluation of the present situation by an appropriate inventory which would take into account the area covered by existing mangrove populations and the rhythm of destruction of these populations should also be considered. The UNESCO mangrove project presently underway should be of great value in promoting basic mangrove research and investigations on the mitigation of the harmful effects of coastal developments on mangrove ecosystems.

Protection of threatened species

National Governments should engage in special programmes, when necessary and practicable, for the effective management and protection of threatened species. This would include on-site protection of such species in their habitat areas and artificial enhancement of breeding and the rearing of juveniles.

Special attention may be given to certain endangered species, such as the dugong and sea turtles. Intensified surveys and other biological studies of dugong and sea turtle populations and behaviour should be promoted. They should consider regionally co-ordinated activities to conserve populations, in the light of their natural and economic values with a view to avoiding inconsistent national regulations and management programmes. Such activities may usefully be carried out within the context of a regional legal agreement which specifically addresses the measures to be taken by each State, individually or jointly.

Planning and management of coastal and marine related land-use

Upland land-use patterns and practices should be monitored in order to reduce soil loss resulting in siltation at the coast and increased fluctuation of freshwater flow in rivers due to loss of the retentive properties of upland vegetation.

Correct soil conservation practices should be adopted, implemented, and enforced, and terracing and other necessary erosion control measures should be applied.

Large-scale afforestation programmes should be commenced. Loss of forests by commercial lumbering or accelerated cutting for fuel wood or charcoal should be prevented. Increased study may be focused on the fuel cycle and improved means found to manage fuel resources. This includes improving the efficiency of domestic and charcoal producing stoves, establishing centralized or local fuel wood plantations, and improving government management of state forests.

Priority attention may be given to the development of alternative sources of domestic energy, including solar and wind power, biogas production, new forms of biomass conversion, and low-head hydropower.

The likely effects of major upstream hydraulic works, including major hydropower projects and irrigation facilities, should be assessed in terms of their effects on coastal and marine natural systems. The results of this assessment should be taken into account when decisions are made on the design and operation of such works.

When coastal areas, especially floodplains and wetlands, are converted to agricultural use there should be careful consideration of the effects on the habitat of marine species. The use of agricultural chemicals, especially pesticides but also fertilizers, should be carefully controlled and their effects monitored. Certain cultivation practices in the coastal areas can lead to erosion, especially in areas where geological instability or storm hazards could result, and such practices should be avoided.

In connection with urban development, detailed physical planning should be carried out to reduce user conflicts in the coastal zone and degradation of coastal resources. Regular surveys and assessments of urban development should be made.

The probability and effects of rapid municipal growth at new or established urban centres on the coast in connection with expanding coastal and marine activities or facilities should be carefully evaluated. Every effort should be made so that planning and provision of services keep pace with the growth of coastal urban areas. Planning, services and investment should be focused on the preservation of environmental conditions and amenities and the maintenance and improvement of health factors.

Marine fisheries development

Governments should try to control destructive or wasteful fishery practices, including severe over-fishing in accessible reef areas, use of small mesh-sized nets, use of numerous fish traps and gill nets near reefs, beach seining or weirs in estuaries that catch a large number of juveniles, disposal of edible by-catch from commercial operations, and the use of fishery methods that lead to incidental catch of important non-target species such as turtles, dolphins and dugongs.

To assist in meeting the objective of sound biological management of economic stocks, fish stocks should be surveyed as far as is practicable. Governments should promote the biological study of fish stocks subject to extensive exploitation. Such studies could include behavioural characteristics and natural population structure.

Under-utilization of fishery resources should be identified and assessed. In the case of highly migratory species, such studies should be formulated or conducted on a regional basis.

Positive social and economic measures should be taken for the development of marine fisheries in the region, including the development of infrastructure to support enhanced fishery activities; improved commercial organization to provide fishermen and firms with an outlet for their catch; financial support when warranted; and market development and promotion for existing and new catches and products on a local, national and international level.

When economically justified, commercial fisheries development should be assisted through improvement of infrastructure (including port and storage facilities), financial support and organizational measures, and through market development programmes.

Special coastal management issues

The probable effects of construction at the shoreline - including seawalls, piers, jetties, breakwaters, and reclamation - should be considered before projects are undertaken. Non-structural approaches should be adopted whenever possible.

Areas of the coast which are hazardous due to the probability of inundation by fresh or salt water during storms should be demarcated and human activities within them carefully limited.

Activities on sea and coastal dunes and bluffs and barrier islands should be carefully restricted so that these sensitive features are not destabilized on a chronic or acute basis.

Environmental health factors

Every effort should be made to ensure that every resident of the coastal zone is served by convenient, safe, and sufficient supplies of water for drinking and household purposes.

Existing sewage and treatment systems should be carefully maintained and upgraded and new systems or expansions implemented whenever desirable and practical.

Low cost alternative systems of treatment for centrally-collected waste should be investigated, implemented when appropriate, and adequately maintained. These include oxidization ponds and the use of sewage as fertilizer after some form of treatment.

Alternative, low-cost, decentralized methods of waste disposal should be developed and implemented through popular education, and popular action when necessary. Unsanitary human waste disposal practices should be combated through programmes of public education.

Adequate equipment and manpower should be made available for the organized and effective removal of solid wastes to approved disposal sites. Solid waste dumping sites should be carefully sited and operated. Wastes should be pre-screened and partitioned as necessary before ultimate disposal. Leaching of noxious substances into ground, surface, or coastal waters should be avoided. Every effort should be made to control the informal dumping of solid wastes at unapproved locations by private individuals.

Within the framework of the International Drinking Water Supply and Sanitation Decade, special efforts are being undertaken by most States to improve, to the extent feasible, their drinking water supply and excreta disposal situation by 1990. The particular needs and health requirements of coastal populations should be evaluated and alternative solutions developed which adequately reflect the specific conditions and potentials of coastal settlements.

CONCLUSIONS

It can undoubtedly be seen that the marine environment plays a crucial role in the economy and life-style of the countries of the region. The environment is generally under stress owing to increasing pressure from the growing population, industrialization and demand for resources.

There is a pressing need for baseline research, survey and data to fill existing gaps in environmental knowledge. To ensure appropriate management of the environment, skilled manpower is necessary, hence training programmes are essential. National participation in regional activities should promote exchange of information and expertise.

All States should adopt comprehensive environmental legislation together with methods of ensuring enforcement. Environmental education and awareness are of prime importance in the region so that the population may learn and understand the value of the natural resources available to them.

ANNEX I

LIST OF THREATENED SPECIES FOR
THE SOUTH ASIAN SEAS REGION
FROM THE DATA BASE OF THE IUCN CONSERVATION MONITORING CENTRE

Taxon name	Common name	World. Cat.
<u>MAMMALS</u>		
Order PRIMATES		
Family Cercopithecidae		
<u>Macaca silenus</u>	Lion-tailed Macaque	E
<u>Presbytis johni</u>	Nilgiri Langur, Black Leaf Monkey, John's Langur	V
Order CETACEA		
Family Platanistidae		
<u>Platanista indi</u>	Indus Dolphin, Susu	E
Family Balaenopteridae		
<u>Balaenoptera musculus</u>	Blue Whale, Sulphur-bottom Whale	E
Order CARNIVORA		
Family Canidae		
<u>Cuon alpinus</u>	Asiatic Wild Dog, Dhole, Red Dog	V
Family Ursidae		
<u>Melursus ursinus</u>	Sloth Bear	I
Family Viverridae		
<u>Viverra zibetha</u>	Malabar Large spotted Civet	E
Family Felidae		
<u>Felis margarita scheffeli</u>	Pakistan Sand Cat	E
<u>Felis marmorata</u>	Marbled Cat	I
<u>Felis temmincki</u>	The Asiatic Golden Cat, Temminck's Cat	I
<u>Neofelis nebulosa</u>	Clouded Leopard	V
<u>Panthera pardus</u>	Leopard	V
<u>Panthera tigris</u>	Tiger	E
Order PROBOSCIDEA		
Family Elephantidae		
<u>Elephas maximus</u>	Indian Elephant, Asian Elephant	E
Order SIRENIA		
Family Dugongidae		
<u>Dugong dugon</u>	Dugong	V
Order PERISSODACTYLA		
Family Equidae		
<u>Equus hemionus khur</u>	Indian Wild Ass, Ghor-Khar	E

Order ARTIODACTYLA

Family Bovidae

<u>Bos gaurus</u>	Gaur, Indian Bison	V
<u>Gazella dorcas</u>	Dorcas Gazelle	K
<u>Hemitragus hylocrius</u>	Nilgiri Tahr	V

BIRDS

Order PELECANIFORMES

Family Pelcanidae

<u>Pelecanus crispus</u>	Dalmatian Pelican	V
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Family Fregatidae

<u>Fregata andrewsi</u>	Christmas Frigate Bird	V
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Order FALCONIFORMES

Family Accipitridae

<u>Haliaeetus albicilla</u>	White-tailed Eagle	V
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Family Falconidae

<u>Falco peregrinus</u>	Peregrine Falcon	V
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Order GRUIFORMES

Family Gruidae

<u>Grus leucogeranus</u>	Siberian White Crane	E
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Family Otididae

<u>Choriotis nigriceps</u>	Great Indian Bustard	E
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Order CHARADRIIFORMES

Family Scolopacidae

<u>Limnodromus semipalmatus</u>	Asian Dowitcher	R
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<u>Tringa guttifer</u>	Nordmann's Greenshank, Spotted Greenshank	I
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Order STRIGIFORMES

Family Strigidae

<u>Athene Blewitti</u>	Forest Little Owl	I
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Order CORACIFORMES

Family Coraciidae

<u>Eurystomus orientalis irisi</u>	Ceylon Broad-billed Roller	I
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REPTILES

Order TESTUDINES

Family Emydidae

<u>Batagur baska</u>	Batagur, River Terrapin, Tuntong, Sungei	E
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<u>Heosemys silvatica</u>	Cane Turtle	I
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Family Testudinidae

<u>Geochelone emys</u>	Burmese Brown Tortoise	K
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<u>Geochelone travancorica</u>	Travancore Tortoise	K
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Family Cheloniidae		
<u>Caretta caretta</u>	Loggerhead Turtle, Cares, Tartaruga domar, Uruana, Suruana	V
<u>Chelonia mydas</u>	Green Sea Turtle,	E
<u>Eretmochelys imbricata</u>	Hawksbill Turtle, Carey, Tartaruga verdadeira and de Pente	E
<u>Lepidochelys olivacea</u>	Olive Ridley Turtle, Pacific Ridley Turtle, Parlama	E
Family Dermochelyidae		
<u>Dermochelys coriacea</u>	Leatherback, Leathery Turtle, Luth, Barriguda, Tartaruga	E
Family Trionychidae		
<u>Trionyx nigricans</u>	Dark Soft-shell Turtle, Bostami Turtle, Gazari, Madari	R
Order CROCODYLIA		
Family Corcodylidae		
<u>Crocodylus palustris</u>	Mugger, Marsh Crocodile, Borad-snouted Crocodile	V
<u>Crocodylus porosus</u>	Estuarine Crocodile, Salt- water Crocodile	V
Family Gavialidae		
<u>Gavialis gangeticus</u>	Charial, Gavial	E
Order SAURIA		
Family Varanidae		
<u>Varanus griseus</u>	Desert Monitor, Agra Monitor (India), Agra, Bengal - Lizard	V
<u>Varanus griseus caspius</u>	Central Asian Monitor	V
Order SERPENTES		
Family Boidae		
<u>Python molurus</u>	Indian Python, Burmese Python	V
<u>Python molurus molurus</u>	Indian Python	V
FISHES		
Order CYPRINIFORMES		
Family Cyprinidae		
<u>Barbus cumingi</u>	Cuming's Two-Banded Barb, Pothaya	V
<u>Barbus nigrofasciatus</u>	Black Ruby Barb, Bulath Sapeya	V
<u>Barbus pleurotaenia</u>	Side Striped Barb, Hitha Massa	V
<u>Barbus tittaya</u>	Cherry Barb, Dola Tittaya	V
<u>Labeo fisheri</u>	Green Labeo, Gadaa	E
<u>Rasbora vaterifloris</u>	Vateria Flower Rasbora, Hal Mal Tittaya	V

Family Cobitidae		
<u>Lepidocephalus jonklassi</u>	Spotted Loach	E
Order PERCIFORMES		
Family Gobiidae		
<u>Sicydium halei</u>	Red Tail Goby	V
Family Belontiidae		
<u>Belontia signata</u>	Combtail, Pulutta	R
<u>Malpulutta krestseri</u>	Ornate Paradisefish	V
Family Channidae		
<u>Channa orientalis</u>	Smooth Breasted Snakehead	R
 <u>INVERTEBRATES</u>		
Phylum MOLLUSCA		
Order ARCHIAEOGASTROPODA		
Family Trochidae		
<u>Trochus niloticus</u>	Trochas, Top Shell	CT
Family Turbinidae		
<u>Turbo marmoratus</u>	Green Snail, Turbo	CT
Order VENEROIDA		
Family Tridacnidae		
<u>Tridacna maxima</u>	Small Giant Clam	K
<u>Tridacna squamosa</u>	Scaly Clam, Fluted Clam	I
Order PTERIOIDA		
Family Pteriidae		
<u>Pinctada margaritifera</u>	Black-lipped Pearl Oyster	CT
<u>Pinctada maxima</u>	Gato-lipped Pearl Oyster	CT
Sub Phylum CRUSTACEA		
Order		
Family Palinuridae		
<u>Palinurus spp.</u>	Spiny Lobsters	CT
Sub Phylum INSECTA		
Order LEPIDOPTERA		
Family Papilionidae		
<u>Atrophaneura jophon</u>	Sri Lankan Rose	V
<u>Graphium epaminondas</u>		K
Family Danaidae		
<u>Idea iasonia</u>		R
<u>Idea malabarica*</u>		R
<u>Parantica nilgiriensis*</u>		R
<u>Parantica taprobana</u>		R

* Distribution in relation to coast not certain.

Family Nymphalidae		
<u>Doleschallia bisaltide andamana</u>	Autumn leaf, Leafwing	R
Order HYMENOPTERA		
Family Formicidae		
<u>Aneuretus simoni</u>	Sri Lankan Relict Ant	K
Phylum COELENTERATA		
Order ANTIPATHARIA	Black Coral	CT

BANGLADESH

Taxon name	Common name	World Cat.
<u>MAMMALS</u>		
Order LAGOMORPHA Family Leporidae <u>Caprolagus hispidus</u>	Assam Rabbit, Hispid Hare	E
Order CARNIVORA Family Canidae <u>Cuon alpinus</u>	Asiatic Wild Dog, Dhole, Red Dog	V
Family Felidae <u>Panthera pardus</u> <u>Panthera tigris</u>	Leopard Tiger	V E
Order PROBOSCIDEA Family Elephantidae <u>Elephas maximus</u>	Indian Elephant, Asian Elephant	E
Order SIRENIA Family Dugongidae <u>Dugong dugon</u>	Dugong	V
Order ARTIODACTYLA Family Suidae <u>Sus salvanius</u>	Pygmy Hog	E
<u>BIRDS</u>		
Order ANSERIFORMES Family Anatidae <u>Cairina scutulata</u>	White-winged Wood Duck	V
Order FALCONIFORMES Family Falconidae <u>Falco peregrinus</u>	Peregrine Falcon	V
Order CHARADRIIFORMES Family Scolopacidae <u>Limnodromus semipalmatus</u> <u>Tringa guttifer</u>	Asian Dowitcher Nordmann's Greenshank, Spotted Greenshank	R I

REPTILES

Order TESTUDINES

Family Emydidae

Batagur baska

Batagur, River Terrapin, E
Tuntong, Sungei

Family Testudinidae

Geochelone emys

Burmese Brown Tortoise K

Family Trionychidae

Trionyx nigricans

Dark Soft-shell Turtle, R
Bostami Turtle, Gazari,
Madari

Family Cheloniidae

Chelonia mydas

Green Turtle E

Eretmochelys imbricata

Hawksbill Turtle, Carey E

Lepidochelys olivacea

Olive Ridley Turtle, E
Pacific Ridley Turtle,
Parlana

Caretta caretta

Loggerhead Turtle E
Cares, Tartaruga domar,
Uruana, Suruana

Family Dermochelyidae

Dermochelys coriacea

Leatherbadi, Leathey E
turtle, Luth, Barriguda,
Tartaruga

Order CROCODYLIA

Family Crocodylidae

Crocodylus palustris

Mugger, Marsh Crocodile, V
Broad-snouted Crocodile

Crocodylus porosus

Estuarine Crocodile, Salt- V
water Crocodile

Family Gavialidae

Gavialis gangeticus

Gharial, Gavial E

Order SERPENTES

Family Boidae

Python molurus

Indian Python, Burmese V
Python

Python molurus molurus

Indian Python V

INDIA

Taxon Name	Common name	World Cat.
<u>MAMMALS</u>		
Order PRIMATES		
Family Cercopithecidae		
<u>Macaca silenus</u>	Lion-tailed Macaque	E
<u>Presbytis geei</u>	Golden Langur	R
<u>Presbytis johni</u>	Nilgiri Langur Black Leaf Monkey, John's Langur	V
Order CETACEA		
Family Platanistidae		
<u>Platanista indi</u>	Indus Dolphin, Susu	E
Family Balaenopteridae		
<u>Balaenoptera musculus</u>	Blue Whale, Sulphur-bottom Whale	E
Order CARNIVORA		
Family Canidae		
<u>Canis lupus</u>	Wolf, Gray Wolf, Grey Wolf	V
<u>Cuon alpinus</u>	Asiatic Wild Dog, Dhole, Red Dog	V
Family Ursidae		
<u>Melursus ursinus</u>	Sloth Bear	
Family Viverridae		
<u>Viverra megaspila civettina</u>	Malabar Large spotted Civet	E
Family Felidae		
<u>Felis marmorata</u>	Marbled Cat	I
<u>Felis temmincki</u>	The Asiatic Golden Cat, Temminck's Cat	I
<u>Neofelis nebulosa</u>	Clouded Leopard	V
<u>Panthera pardus</u>	Leopard	V
<u>Panthera tigris</u>	Tiger	E
Order PROBOSCIDEA		
Family Elephantidae		
<u>Elephas maximus</u>	Indian Elephant, Asian Elephant	E
Order SIRENIA		
Family Dugongidae		
<u>Dugong dugon</u>	Dugong	V
Order PERISSODACTYLA		
Family Rhinocerotidae		
<u>Rhinoceros unicornis</u>	Great Indian Rhinoceros	E

Order ARTIODACTYLA

Family Bovidae

Bos gaurus

Gaur, Indian Bison

V

Gazella gazelle

Indian Chinkara

K

Hemitragus hylocrius

Nilgiri Tahr

V

BIRDS

Order PELECANIFORMES

Family Pelecanidae

Pelecanus crispus

Dalmatian Pelican

V

Order FALCONIFORMES

Family Falconidae

Falco peregrinus

Peregrine Falcon

V

Order GRUIFORMES

Family Otididae

Choriotis nigriceps

Great Indian Bustard

E

Order STRIGIFORMES

Family Strigidae

Athene blewitti

Forest Little Owl

I

Order CORACIIFORMES

Family Coraciidae

Eurystomus orientalis irisi

Ceylon Broad-billed Roller

I

REPTILES

Order TESTUDINES

Family Emydidae

Batagur baska

Batagur

E

Heosemys silratica

Cane Turtle

I

Family Testudinidae

Geochelone travancorica

Travancore Tortoise

K

Family Cheloniidae

Caretta caretta

Loggerhead Turtle, Tortuga de mar, Cares, Tartaruga domar, Uruana, Suruana

V

Chelonia mydas

Green Sea Turtle, Tortuga Verde del Atlantico and Pacifico, Tortuga Blanca

E

Eretmochelys imbricata

Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira and de Pente

E

Lepidochelys olivacea

Olive Ridley Turtle, Pacific Ridely Turtle, Tortuga verde, Parlama

E

Family Dermochelyidae			
<u>Dermochelys coriacea</u>	Leatherback, Leathery Turtle, Luth, Barriguda, Taratuga		E
Order CROCODYLIA			
Family Crocodylidae			
<u>Crocodylus palustris</u>	Mugger, Marsh Crocodile, Broad-snouted Crocodile		V
<u>Crocodylus porosus</u>	Estuarine Crocodile, Salt-water Crocodile		V
Family Gavialidae			
<u>Gavialis gangeticus</u>	Gharial, Gavial		E
Order SAURIA			
Family Varanidae			
<u>Varanus griseus</u>	Desert Monitor, Agra Monitor (India), Agra, Bengal - Lizard		V
Order SERPENTES			
Family Boidae			
<u>Python molurus</u>	Indian Python, Burmese Python		V
<u>Python molurus molurus</u>	Indian Python		V
<u>INVERTEBRATES</u>			
Sub Phylum INSECTA			
Order ODONATA			
Family Epiophlebiidae			
<u>Epiophlebia laidlawi</u>	Relict Himalayan Dragonfly		V
Family Aeshnidae			
<u>Indophlebia asiatica</u>			V
Order ANOPLURA			
Family Haematopinidae			
<u>Haematopinus oliveri</u>	Pygmy Hog Sucking Louse		E
Order LEPIDOPTERA			
Family Papilionidae			
<u>Graphium epaminondas</u>			K
Family Danaidae			
<u>Idea malabarica</u>			R
<u>Parantica nilgiriensis</u>			R
Family Satyridae			
<u>Lethe europa tamuna</u>			R
Family Nymphalidae			
<u>Doleschallia bisaltide andamana</u>	Autumn leaf, Leafwing		R
<u>Neptis sankara nar</u>			R

MALDIVES

Taxon name	Common name	World Cat.
<u>MAMMALS</u>		
Order SIRENIA		
Family Dugongidae		
<u>Dugong dugon</u>	Dugong	V
<u>REPTILES</u>		
Order TESTUDINES		
Family Cheloniidae		
<u>Eretmochelys imbricata</u>	Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira and de Pente	E
<u>INVERTEBRATES</u>		
Phylum MOLLUSCA		
Order VENEROIDA		
Family Tridacnidae		
<u>Tridacna maxima</u>	Small Giant Clam	K
<u>Tridacna squamosa</u>	Scaly Clam Fluted Clam	I
Phylum COELENTERATA		
Order ANTIPATHARIA	Black Coral	CT

PAKISTAN

Taxon name	Common name	World Cat.
<u>MAMMALS</u>		
Order CETACEA		
Family Platanistidae		
<u>Platanista indi</u>	Indus Dolphin, Susu	E
Order CARNIVORA		
Family Canidae		
<u>Canis lupus</u>	Wolf, Gray Wolf, Grey Wolf	V
Family Ursidae		
<u>Selenarctos thibetanus gedrosianus</u>	Baluchistan Bear	E
Family Felidae		
<u>Panthera pardus</u>	Leopard	V
Order SIRENIA		
Family Dugongidae		
<u>Dugong dugon</u>	Dugong	V
Order PERISSODACTYLA		
Family Equidae		
<u>Equus hemionus khur</u>	Indian Wild Ass, Ghor-Khar	E
<u>BIRDS</u>		
Order PELECANIFORMES		
Family Pelecanidae		
<u>Pelecanus crispus</u>	Dalmatian Pelican	V
Order FALCONIFORMES		
Family Accipitridae		
<u>Haliaeetus albicilla</u>	White-tailed Eagle	V
Family Falconidae		
<u>Falco peregrinus</u>	Peregrine Falcon	V
Order GRUIFORMES		
Family Gruidae		
<u>Grus leucogeranus</u>	Siberian White Crane	E
Family Otididae		
<u>Choriotis nigriceps</u>	Great Indian Bustard	E

REPTILES

Order TESTUDINES

Family Cheloniidae

Caretta caretta

Loggerhead Turtle, Tortuga V

de mar, Careas, Tartaruga

domar, Uruana, Suruana

Green Sea Turtle, Tortuga E

Verde del Atlantico and

Pacifico, Tortuga Blanca E

Olive Ridley Turtle,

Pacific Ridley Turtle,

Tortuga verde, Parlana

Chelonia mydas

Lepidochelys olivacea

Order CROCODYLIA

Family Crocodylidae

Crocodylus palustris

Mugger, Marsh Crocodile, V

Broad-snouted Crocodile

Family Gavialidae

Gavialis gangeticus

Gharial, Gavial E

Order SAURIA

Family Varanidae

Varanus griseus

Desert Monitor, Agra V

Monitor (India), Agra,

Bengal - Lizard

Central Asian Monitor V

Varanus griseus caspius

Order SERPENTES

Family Boidae

Python molurus

Indian Python, Burmese V

Python

Indian Python V

Python molurus molurus

Family Elapidae

Naja oxiana

Central Asian or Oxus Cobra E

SRI LANKA

Taxon name	Common name	World Cat.
<u>MAMMALS</u>		
Order CETACEA		
Family Balaenopteridae		
<u>Balaenoptera musculus</u>	Blue Whale, Sulphur-Bottom Whale	E
Order CARNIVORA		
Family Canidae		
<u>Cuon alpinus</u>	Asiatic Wild Dog, Dhole, Red Dog	V
Family Ursidae		
<u>Melursus ursinus</u>	Sloth Bear	I
Family Felidae		
<u>Panthera pardus</u>	Leopard	V
Order PROBOSCIDEA		
Family Elephantidae		
<u>Elephas maximus</u>	Indian Elephant, Asian Elephant	E
Order SIRENIA		
Family Dugongidae		
<u>Dugong dugon</u>	Dugong	
Order ARTIODACTYLA		
Family Bovidae		
<u>Bubalus bubalis</u>	Water Buffalo, Wild Asiatic Buffalo	V
<u>BIRDS</u>		
Order PELECANIFORMES		
Family Fregatidae		
<u>Fregata andrewsi</u>	Christmas Frigate Bird	V
Order FALCONIFORMES		
Family Falconidae		
<u>Falco peregrinus</u>	Peregrine Falcon	V
Order CORACIIFORMES		
Family Coraciidae		
<u>Eurystomus orientalis irisi</u>	Ceylon Broad-billed Roller	I

REPTILES

Order TESTUDINES

Family Cheloniidae

Caretta caretta

Loggerhead Turtle, Tortuga de mar, Cares, Tartaruga domar, Uruana, Suruana V

Chelonia mydas

Green Sea Turtle, Tortuga Verde del Atlantico and Pacifico, Tortuga Blanca E

Eretmochelys imbricata

Hawksbill Turtle, Carey, Tortuga Carey, Tartaruga verdadeira and de pente E

Lepidochelys Olivacea

Olive Ridley Turtle, Pacific Ridley Turtle, Tortuga verde, Parlama E

Family Dermochelyidae

Dermochelys coriacea

Leatherback, Leathery Turtle, Luth, Tortuga Tora, Barringuda, Tartaruga E

Order CROCODYLIA

Family Crocodylidae

Crocodylus palustris

Mugger, Marsh Crocodile, Broad-snouted Crocodile V

Crocodylus porosus

Estuarine Crocodile, Salt-water Crocodile V

Order SERPENTES

Family Boidae

Python molurus

Indian Python, Burmese Python V

Python molurus molurus

Indian Python V

FISHES

Order CYPRINIFORMES

Family Cyprinidae

Barbus cumingi

Cuming's Two-Banded Barb, Pothaya V

Barbus nigrofasciatus

Black Ruby Barb, Bulath Sapeya V

Barbus pleurotaenia

Side Striped Barb, Hitha Massa V

Barbus titteya

Cherry Barb, Dola Tittaya V

Labeo fisheri

Green Labeo, Gadaya E

Rasbora vaterifloris

Vateria Flower Rasbora, Hal Mal Tittaya V

Family Cobitidae

Lepidocephalus jonklassi

Spotted Loach E

Order PERCIFORMES

Family Gobiidae

Sicydium halei

Red Tail Goby

V

Family Belontiidae

Belontia signata

Combtail, Pulutta

R

Malpulutta krestseri

Ornate Paradisefish

V

Family Channidae

Channa orientalis

Smooth Breasted Snakehead

R

INVERTEBRATES

Phylum MOLLUSCA

Order VENEROIDA

Family Tridacnidae

Tridacna maxima

Giant Clam

K

Sub Phylum INSECTA

Order LEPIDOPTERA

Family Papilionidae

Atrophaneura jophon

Sri Lankan Rose

V

Family Danaidae

Idea iasonia

R

Parantica taprobana

R

Order HYMENOPTERA

Family Formicidae

Aneuretus simoni

Sri Lankan Relict Ant

K

Phylum COELENTERATA

Order ANTIPATHARIA

Black Coral

CT

IUCN STATUS CATEGORIES

ENDANGERED (E)

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are taxa that are possibly already extinct but have definitely been seen in the wild in the past 50 Years.

VULNERABLE (V)

Taxa believed likely to move into the "Endangered" category in the near future if the causal factors continue operating.

Included are taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance, taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured, and taxa with populations that are still abundant but are under threat from severe adverse factors throughout their range.

N.B. In practice, "Endangered" and "Vulnerable" categories may include, temporarily, taxa whose populations are beginning to recover as a result of remedial action, but whose recovery is insufficient to justify their transfer to another category.

RARE (R)

Taxa with small world populations that are not at present "Endangered" or "Vulnerable", but are at risk.

These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

INDETERMINATE (I)

Taxa known to be "Endangered", "Vulnerable" or "Rare" but where there is not enough information to say which of the three categories is appropriate.

INSUFFICIENTLY KNOWN (K)

Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

COMMERCIALY THREATENED (CT)

Taxa not currently threatened with extinction, but most or all of whose populations are threatened as a sustainable commercial resource, or will become so, unless their exploitation is regulated.

This category applies only to taxa whose populations are assumed to be relatively large.

N.B. In practise, this category has only been used for marine species of commercial importance that are being overfished in several parts of their ranges.

ANNEX II

LIST OF NATIONAL INSTITUTIONS WHICH DEAL DIRECTLY
OR INDIRECTLY WITH THE ENVIRONMENT

Bangladesh	Department of Environmental Pollution Control Bangladesh Water Development Board Water Pollution Control Board Flood Control and Water Resources Division Forest Department Municipal Corporations Division of Ports, Shipping and Inland Water Transport
India	National Institute of Oceanography Department of Environment Control Board for Prevention and Control of Water Pollution Department of Shipping and Transport Department of Ocean Development
Maldives	Ministry of Agriculture Ministry of Fisheries - Marine Research Section Ministry of Health Department of Tourism Ministry of Home Affairs Ministry of Planning and Development Ministry of Atoll Administration Ministry of Transport Ministry of Education President's Office National Security Services (Surveillance) Voice of Maldives (Broadcasting - Env. educ.)
Pakistan	Pakistan Environmental Protection Council Pakistan Environmental Protection Agency Environment and Urban Affairs Division Port and Shipping Department National Institute of Oceanography
Sri Lanka	Central Environmental Authority Marine Pollution Authority National Aquatic Resources Agency Coast Conservation Department Ministry of Fisheries National Hydrographic Office Coast Conservation Advisory Council Centre for Research on Indian Ocean Marine Mammals 1982