REGIONAL SEAS

UNITED NATIONS ENVIRONMENT PROGRAMME

Management and conservation of renewable marine resources in the Red Sea and Gulf of Aden region

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PREFACE

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

The Regional Seas Programme was initiated by UNEP in 1974. At present it includes eleven regions 1/ and has over 120 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to controlling environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the Governments concerned. It is designed to link assessment of the quality of the marine environment and the causes of its deterioration with activities for the management and development of the marine and coastal environment. The action plans promote the parallel development of regional legal agreements and of action-oriented programme activities 2/.

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

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

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

2/ UNEP: Achievements and planned development of UNEP's Regional Seas Programme and comparable programmes sponsored by other bodies. UNEP Regional Seas Reports

The document reviews the past and on-going conservation activities relevant to the Red Sea and Gulf of Aden region at the regional and national levels; identifies priority concerns of the Governments bordering the region; and contains recommendations for interregional and regional projects to be undertaken to address these concerns. The assistance of a consultant, A.R. Dawson Shepherd, in the preparation of this document is gratefully acknowledged. In addition, the sections dealing with fishery aspects of conservation have been prepared by J. Beddington and J.A. Gulland. The report has been compiled and edited by the Tropical Marine Research Unit, University of York, UK.

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INTRODUCTION

Area.

The Red Sea is a narrow elongated body of water running NNW-SSE between the land masses of Africa and Arabia. At its northern end it forks to form the Gulfs of Suez and Aqaba while, in the south, it meets the Gulf of Aden and the Indian Ocean through a narrow strip of water 26km wide and < 200m deep (Morcos 1970), the Bab-el-Mandab, between Djibouti and Perim in South Yemen (PDRY). The Gulf of Aden forms an integral part of the north west Indian Ocean.

The Red Sea is approximately 360km across at its widest point and is about 1,932km in length. It has a total surface area of 438,000 sq km and a maximum depth of 2,246m (Couper, 1983), see also Morcos (1970). The Gulf of Aden, as defined by the protocol relating to the Regional Convention for the Conservation of the Red Sea and Gulf of Aden, is bounded by the following rhumb lines; From Ras Dharbat Ali (16°39'00"N, 053°03'05"E), thence to a point (16°00'00"N, 053°25'00"E), thence to a point (12°40'00"N, 55°00'00"E) lying ENE of Socotra Island, thence to Ras Hafun (10°26'00"N, 51°25'00"), (PERSGA 1981).

Ten countries border the Red Sea and Gulf of Aden, six of these; Jordan, Saudi Arabia, Sudan, Somalia (Democratic Republic), Popular Democratic Republic Yemen (PDRY), Arabic Republic of Yemen (YAR), and the Palestine Liberation Organisation (PLO) are represented in the Regional Convention for the conservation of the Red Sea and Gulf of Aden (PERSGA, 1981).

Table 1. lists geographic information for each of these countries from (Couper, 1983).

Country	area km^2	Population	Popn per sq km	Coast (km)
Jordan	91,000	2,300,000	25.0	28*
Egypt	1,001,400	43,565,000	44.0	2420**
Saudi Arabia	2,149,690	8,755,000	4.1	1840**
Sudan	2,505,813	20,180,000	8.1	717*
Ethiopia	1,223,600	30,370,000	25.0	1011**
N. Yemen	195,000	6,140,000	31.0	452**
S. Yemen	332,968	2,060,000	63.0	1550**
Djibouti	23,000	124,000	5.4	300**
Somalia	637,657	5,100,000	8.0	2957*

* Information from Couper (1983) converted from nautical miles.
** Information from FAO Fishery Country Profiles (1982-1983).

General nature.

In comparison with other seas and oceans of the world the Red Sea is relatively young with a history of about 70 million years. It is thought that the original basin was created as the tectonic plates of Africa and Arabia began

to move apart (Krenkel, 1925). Sea-floor spreading and the associated creation of new mantle continues and provides a potential source of exploitable mineral deposits on the bottom of the central Red Sea. Initially the link between the Red Sea basin and the Mediterranean may have been broken and re-established several times, then there may have been a period of influence from both the Indian Ocean and the Mediterranean. Subsequently, however, it seems that all links were severed and the Red Sea again became isolated. The almost total lack of Mediterranean species (save for a few that have penetrated through the Suez Canal during the last century) has been taken to suggest that, during its most recent period of isolation, the Red Sea must have dried up sufficiently for all its previous fauna to have been lost (Klausewitz, 1964). This period of drying may well have given rise to the extensive evaporite deposits that provide a potential source of exploitable mineral deposits in the region. The present channel to the Indian Ocean via the Bab-el-Mandab probably only became re-established about 300,000 years ago (Freund, 1970). A shallow sill still remains and has great importance to the oceanography of the area. Throughout this period the Gulf of Aden remained linked to the Indian Ocean and continued to widen as the Arabian and African plates drifted apart.

The Red Sea and Gulf of Aden are typically bounded by a narrow (1-50km) coastal strip, backed by high hills or mountains which rise to 3,000m in some regions. The seabed can be visualised as three-tiered with a central trough reaching to depths of more than 2,000m. This trough is absent from the Gulf of Suez and the vicinity of Bab-el Mandab. From this trough the seabed rises, abruptly, to a terrace at a depth of between 1,000m and 600m; this terrace rises again to a continental shelf which is rarely deeper than 300-400m, and is often much shallower. The width of this shelf varies considerably down the Red Sea and in the Gulf of Aden and is of major significance in determining the nature and distribution of shallow water marine habitats. It is on this shelf that almost all the offshore coral reefs and islands are located, generally occurring where faulting within the shelf floor has lifted parts of the seabed close to, or above, the water's edge. The coastal plain can be viewed as a third terrace, rising abruptly in turn to the Red Sea hills and the escarpments of the Hejaz and the African rift. Thus the Red Sea and Gulf of Aden rift-valley system can be viewed as an overall four-tier structure. Further discussions of the coastal geomorphology of the region can be found in Cox (1931), Guilcher (1955), Allan and Morelli (1970), Brown (1970), and Dubertret (1970).

Climate.

Wind.

Prevailing wind direction and rainfall tend to be determined by the north-east monsoon in winter and the south-west monsoon in the summer. The prevailing wind direction is NNW throughout the year in the northern Red Sea except for occasional southerly winds that blow during the winter months. In the south (south of 20°N) the prevailing wind direction in the summer is northerly whilst in the winter it is SSE.

An intermediate situation holds in the central Red Sea between these northerly and southerly influences. This area is characterised by relatively low pressure calms. By the beginning of summer this intermediate zone moves gradually south giving rise to the seasonal transition in wind directions in the southern Red Sea.

In addition, in the coastal zone, there is a diurnal change of wind direction from offshore during the day to onshore at night driven by differential heating and cooling of the land and sea.

In the Gulf of Aden the high surrounding mountains reduce the influence of the south-west monsoon so that prevailing wind direction is north-west in the summer. During the rest of the year the north-east monsoon gives rise to easterly winds over the Gulf which veer to the south-east towards Bab-el-Mandab.

Temperature.

The air temperature is lowest, throughout the year, over the northern Red Sea. The temperature increases rapidly south of 26°N. The warmest zone of the Red Sea is between 20°N, and 16°N. The shores of the Gulf of Aden are considered to be among the hottest region of the world.

Table 2 - maximum and minimum air temperatures for various localities in the Red Sea and Gulf of Aden (from table 2 of Morcos, 1970).

Location	Max. temp.	Min. temp.
Suez	39.5°C	06.0°C
Jeddah	42.0°C	13.5°C
Massawa	43.0°C	19.0°C
Perim	39.5°C	24.0°C

Rainfall.

Rainfall throughout the Red Sea is very low (see below from Table 3 of Morcos, 1970). The high mountains surrounding the Red Sea cause the south west monsoon to lose its moisture before reaching the Red Sea, consequently, rainfall is low during the summer. Most of the limited rainfall occurs in the winter when converging air masses give rise to showers of short duration often associated with thunderstorms and occasionally with dust-storms. The highest rainfall is generally recorded from the central Red Sea where the northern and southern Red Sea air masses meet. As is usual in very dry climates the annual rainfall is subject to great variation from year to year.

Table 3 - average rainfall in mm/year for various localities in the Red Sea and Gulf of Aden region (from table 3 of Morcos, 1970).

Location	Average rainfall (mm/year)
Suez	21
Aqaba	23
Ghardaqa	03
Jeddah	63
Port Sudan	109
Massawa	193
Perim	43

Fate of rainfall.

Rivers - There are virtually no year-round flowing rivers into the Red Sea and Gulf of Aden. Hemming (1961), reports that wadi's Falcat, Shari, Ma'assrai, and Lebca, in northern Ethiopia, regularly flow as far as the sea.

Flash floods - Because most rainfall in the region falls in short showers and thunderstorms flash floods are a widespread feature. They generally occur at less than yearly intervals at one location and are more frequent in the southern Red Sea than in the north.

Groundwater seepage - Groundwater seepage occurs at a number of locations in the Red Sea and, where it occurs, it often gives rise to coastal palm groves. Ormond et al. (1984a-c, 1985a-d) report the locations of coastal freshwater seepage along the Red sea coast of Saudi Arabia. Exploitable seepage of freshwater may occur offshore of Sudan (Schroeder, 1982).

Dew - Coastal vegetation depends on dew for water for much of the year.

Mist oasis - conditions for mist oasis formation occur when warm moist sea air rises, cools, and condenses on hitting the coastal scarp. Mist oases often support a higher level of vegetation than the coastal plain and are reported from Egypt, Oman and Sudan.

Desalination - Large communities along the Red Sea coast of Saudi Arabia are dependent, directly or indirectly, on desalinated water (Couper, 1983; SWCC, 1982). This supply of desalinated water is central to the development and increased direct and indirect exploitation of coastal resources in the region.

Oceanography.

The Red Sea and Gulf of Aden are linked through the Bab-el-Mandab. The Bab acts as a shallow sill which physically limits the influence of the Indian Ocean on the Red Sea. The connection between the Red Sea and the Mediterranean, via the Suez canal, can effectively be ignored in the oceanography of the Red Sea.

Tides.

The Red Sea is a long, elongate, body of water and tidal range is low. The average spring range is about 0.5m but decreases from both ends (1m at Perim) towards the centre, where near Port Sudan and Jeddah there is no appreciable diurnal tide. Another nodal zone with negligable tide occurs just to the north of Bab-el-Mandab between Assab and Mocha.

In addition to diurnal tides there is a seasonal change in mean sea level (higher in the winter) of up to 37cm at Port Sudan, 6cm at Perim, and 12cm at Suez (Morcos, 1970).

Tidal range in the Gulf of Aden is greater than in the Red Sea and reflects the unrestricted influence of tides within the Indian Ocean.

Water currents.

Many water currents in the Red Sea are driven by wind. Wind patterns reflect the influence of the Indian Ocean monsoons and daily and seasonal differential heating of the land and sea. In addition, and because the Red Sea is relatively land locked and is surrounded by arid desert, water currents are generated through salinity gradients and buoyant flux (Klinker et al., 1976). Tidally driven currents have some local significance which should not be underestimated. All these influences, for example, control the direction and rate of water exchange between the Red Sea and Gulf of Aden through the Bab-el-Mandab. Surface water currents tend to be anti-clockwise with low salinity water travelling north up the east coast of the Red Sea, becoming more saline as it crosses to the west, and then travelling south down the west coast of the Red Sea. This general pattern does not necessarily hold locally due to deflection and eddying caused by the shape of the coastline and the presence of offshore reef complexes. As it is, the currents tend to be slow moving and ill-defined.

The residence time of water in the Red Sea is not known. A figure of one year is quoted for the Gulf of Aqaba (Klinker et al., 1976). The relatively uniform vertical salinity and temperature profiles in the Red Sea (Couper, 1983) are probably the result of extensive vertical mixing.

The body of water in the Gulf of Aden is under the influence of three significant water current regimes. Firstly there is wind/tide/salinity driven water exchange with the Red Sea through the Bab-el-Mandab. Secondly there is the influence of the South-East Arabian upwelling (which is monsoon wind generated). Thirdly there is the influence of the Somali upwelling (which is generated by turbulence associated with the Somali current). These upwellings bring relatively cool, low salinity, nutrient rich, water to the surface. The South-East Arabian upwelling directly influences the coastal area in the vicinity of the South Yemen (PDRY)/Oman border and the Somali upwelling directly influences the coast of Somalia to about 11°N, where it comes up against a tongue of warm water originating in the Gulf of Aden. Offshore, however, in the Gulf of Aden, there are cooler waters at least 100km north of 52°E, suggesting a cyclonic eddy that may superficially influence the oceanography of the Gulf of Aden.

Salinity and temperature.

For the reasons given above the temperature and salinity of the Red Sea are high. Salinities of 41ppt are recorded in surface waters at the north end of the Red Sea and decrease steadily to 36-37ppt in the Gulf of Aden. In the northern Red Sea there is a higher rate of vertical mixing with more saline deeper water as well as a high rate of evaporation. In the southern Red Sea there is the influence of water exchange with less saline waters from the Gulf of Aden and higher levels of freshwater input. The salinity, at every latitude, is higher in the autumn than the spring. At sub-surface levels the salinity also decreases from north to south but the trend becomes weaker in deeper strata (Morcos, 1970). In deeper water, in the Red Sea, the salinity is remarkably uniform at 40.6ppt compared with a range of 36-37ppt in the shallows in the Gulf of Aden to 34.9ppt at depth (Couper, 1983).

This variation in salinity is also reflected by the range in temperature. Average annual surface water temperatures increase from 22°C, uniformly down the Red Sea to a maximum of 28°C. In addition there is a slight increase in water temperature from west to east across the Red Sea (Morcos, 1970). A well defined seasonal thermocline developes above 200m in the summer.

Water temperatures are remarkably constant at depth. At 183m water temperature increases from 18.3°C, in the north to 23.9°C, in the south. At depths of more than 366m the temperature is constant at around 21.6°C, throughout the Red Sea. Localised water temperatures of up to 56°C, (Couper, 1983) and 59°C, (Schroeder, 1982) have been reported from the deep Red Sea and reflect the high temperatures associated with creation of new mantle material.

At Bab-el-Mandab the turbulence resulting from water exchange over the shallow sill separating the Red Sea and Gulf of Aden brings these slightly cooler 21.5°C waters to the surface. Water temperatures in the Gulf of Aden are much more variable and reflect the influence of the three current regimes described on page 5. Thus surface water temperatures may reach 25°C, whilst water in upwelling areas may be at 15°C (Couper, 1983).

CONSERVATION AND MANAGEMENT ACTIVITIES

International

International conservational activities.

The Saudi Sudanese Red Sea commission is determining standards for the release of mine tailings from exploitation of the metaliferous deposits in the central Red Sea.

Co-ordination of all Red Sea and Gulf of Aden activities is the responsibility of ALECSO. ALECSO provides the interim secretariat for PERSGA with UNEP (Regional seas)/UNESCO (COMAR)/IUCN advising as required.

IMCO has been approached, via the regional seas programme of UNEP/PERSGA, to assist in advising on the establishment of a regional oil combatting centre.

COMAR (COastal MARine project of UNESCO) is a major inter-regional project on research and training leading to the integrated management of coastal systems.

Egypt, Israel, Jordan, Saudi Arabia and Sudan are all reported to have national UNESCO Man and the Biosphere (MAB) committees. Several of the MAB projects are relevant to the review - e.g. Project 5, Ecological effects of human activities on the value and resources of lakes, marshes, rivers, deltas, estuaries and coastal zones.

Since 1976 a number of seminars, training courses, and workshops have been held in the framework of PERSGA with support from UNESCO and UNEP.

Sudan - January 1983, a symposium on the Red Sea, Gulf of Aden, and coastal NW Indian Ocean was convened with support from ALECSO, the Saudi Sudanese Red Sea commission and UNESCO.

Saudi Arabia (Jeddah) - January 1984, Symposium on the coral reef environment of the Red Sea partly funded by UNESCO.

Saudi Arabia is a co-sponser of the world charter for nature in the general assembly of the United Nations (cited Hicks, 1985).

In 1980 the Indian Ocean Alliance (IOA, 1980) approved several recommendations;

Recommendation 1 : That the Governments of the Indian Ocean coastal states form an Indian Ocean Alliance for conservation, including rational use of natural resources and related research, and that a working group be set up and convened as soon as possible to discuss details for its establishment and operation.

Recommendation 10 : That the Governments of the Indian Ocean coastal states request IUCN to set up a regional project for marine turtles in the Indian Ocean which would be Oceanwide, to bring together existing data and provide new data which can be used in the design of a rational management programme including education at national levels.

Recommendation 12 : That the Governments of the Indian Ocean coastal states consider the problem of sea-shell collecting at national level and work for the establishment of protected areas which can provide breeding nuclei of marine molluscs for repopulating over-exploted areas.

Recommendation 13 : That the Governments of the Indian ocean coastal states request that intergovernmental organisations concerned with oil pollution control take urgent action to deal with the increasing problem of spillage in the Indian Ocean.

Several recommendations relate to the Indian Ocean whale sanctuary and the protection of marine mammals.

International Laws and Conventions.

- The Indian Ocean whale Sanctuary includes the Red Sea and Gulf of Aden (IWC, 1981).

- 6 countries (see page 1) are members of the Red Sea and Gulf of Aden Environment Programme (PERSGA, 1981). It is interesting to note here that in The Environmental Law of the Sea (IUCN, 1981) eight countries are quoted as being menbers of PERSGA, this includes Ethiopia and Egypt.

- In 1982 a conference of plenipotentiaries, convened by ALECSO, and including six coastal states and Palestine (represented by the PLO) adopted the Regional Convention for the Conservation of the Red Sea and Gulf of Aden. The convention also signed a protocol on co-operation to combat pollution emergencies. The process of ratification by member states, of the convention, is proceeding. For example see the Saudi Arabian EPPCOM resolution 1 (1984). The convention provides adequate protocol for the development of a comprehensive programme for the conservation of the Red Sea and Gulf of Aden including the open sea (PERSGA, 1981).

- The African Convention on the conservation of natural resources (1968) includes the following signitories from the Red Sea and Gulf of Aden region - Djibouti, Egypt and Sudan (Navid, 1981).

- Other legislation appropriate to the region is that pertaining to the law of the sea which divides the sea into three regions:

1. Internal waters.
2. An exclusive economic zone where the nation has control over, but is required to ensure non-over exploitation of stocks.
3. High seas totally covered by international agreements.

Somali law no. 37 of 10.9.72 sets a 200 nautical mile economic zone (Salah unpubl. man.). The Somali government has signed, but not ratified, the UN convention on the law of the sea. The country fully supports part 10 of the convention which aims to protect and preserve the marine environment.

- The Saudi Sudanese Red Sea commission was set up to exploit deep sea metaliferous deposits between Saudi Arabia and Sudan and has observer status at the United Nations conference on the Law of the Sea (Nawab, 1980).

- Egypt, Israel, Jordan and Sudan are signitories of CITES (Traffic, 1984). Saudi Arabia is considering becoming a signitory (EPPCOM, 1984).

- Egypt, Jordan, Saudi Arabia, Sudan, Ethiopia, and South Yemen (PDRY) are parties to the World Heritage Convention (Oryx 1983, vol. 17, no. 2, p.58). North Yemen (YAR) ratified the convention in January 1984. Only one of these countries, Ethiopia, has a natural site inscribed under the convention and it, (Simen), is inland.

- Egypt, Israel and Somalia have signed the Bonn convention on migratory species.

- Djibouti and South Yemen (PDRY) are members of the Indian Ocean alliance. In 1980 the alliance approved various recommendations (IOA, 1980).

- Jordan is a party to the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR or Wetlands convention).

- The Red Sea is to become a 'special area' where operational oil discharges are restricted (MARPOL, 73/78) once the necessary reception facilities are provided (IMO, 1983). Two other conventions relate to this and are of relevance to the region.

- The International Oil pollution compensation fund of 1971 (IOPC).

- The International convention on civil liability for oil pollution damage.

National Conservational activities.

For additional conservation activities in the region see the Coral Reef Directory (in press).

Jordan.

Proposals for designation of a marine park bordering 7km of the Jordanian Red Sea coast have been completed. The programme is funded jointly by ALECSO, PERSGA and the Aqaba Regional Authority (A.R.A.), (Jordan Times, August, 1984). The Jordanian Government has opened a 'Protection of the Environment Office' which has representatives from several ministries. In addition the A.R.A. has a blue-print for a five year plan starting in 1989 which will include improvements in tourist facilities, cleaning of beaches, completion of a sewage system, and revitalisation of the fishing industry (Jerusalem Star August 1984).

Egypt.

Experts are to undertake a survey of the Hamata marine area in the coming year. Activities aimed at conserving the protected areas designated in the north Egyptian Red Sea are continuing (see pages 13 & 14). UNESCO/UNDP have provided finds for the period 1980-1984 for studies on aquatic and environmental pollution protection.

Saudi Arabia.

A preliminary identification and survey of critical shallow water marine habitats in the Saudi Arabian Red Sea has just been completed in cooperation between MEPA/IUCN/PERSGA and ALECSO (Ormond et al., 1984a-c, 1985a-d). Various recommendations arising from that survey have been incorporated into EPPCOM resolution 4 (1984). If approval of resolution 4 is given, by the council of Ministers, a detailed coastal zone management plan will be developed during the period of the moratorium. A coastal zone management workshop is planned for 1985.

Sudan.

It is hoped, that Sudan's first marine national park will be established at Sanganeb atoll north east of Port Sudan. Some years ago the reef was declared 'closed to commercial fishing', and IUCN and WWF provided funds for a feasibility study and the preparation of management plans. Sanganeb atoll was nominated by the Sudanese Government as a World Heritage Site in 1983. The nomination was deferred, partly because the area has yet to be declared. A preliminary proposal has also been submitted for a 'Port Sudan Marine National Park' (Schroeder, 1982). Further afield other areas have been identified as candidate sites for marine parks and reserves (Ormond, 1980). These include two particular areas:

The Suakin archipelago - about 100km south of Port Sudan. This archipelago provides a large group of scattered reefs, atolls, and islands, including some of the richest coral communities in the Red Sea, and islands with significant turtle and seabird nesting.

Islands north of Port Sudan - a region about 80km north of Port Sudan including the Taila Islands, Mersa Inkafeil and all, or part, of Mukkawar Island. The area includes well-developed mangroves, as well as reefs, seabird colonies, and turtle breeding grounds.

Ethiopia.

Political events during the last ten years have prevented implementation of the conservation designations identified on page 15.

In 1983 IMO (IMO, 1983) held an Ethiopian national seminar on marine pollution prevention, control, and response. The seminar was funded by SIDA (Swedish International Development Agency) and UNEP. As a result of the seminar the marine transport authority agreed to co-ordinate the formation of a working group to address the development of a national oil spill contingency plan. The report of the meeting identifies a draft set of regulations by the Ethiopia sea ports administration which addresses the subject of cargo discharge/loading, oil spillages, and deterrent penalties. IMO representatives at the meeting recommended that the penalties be increased to realistic levels.

North Yemen (YAR).

UNESCO/UNDP have funded an advisory mission for development of a marine research institute. There are plans, in 1985, to undertake a preliminary shallow water critical marine habitat survey of North Yemen through the Marine conservation focal point at the University of Sana'a and funded through PERSGA/ALECSO.

A good stand of Avicennia marina mangrove occurs at Oreste point on the Saudi/North Yemen (YAR) border. It has been recommended (IUCN/Hicks, 1985) that the area of this mangrove stand that lies within Saudi Arabian jurisdiction should be given protected status. It is suggested that a similar recommendation should be extended to the area controlled by North Yemen (YAR).

Preliminary data and information suggests that two particular areas may be candidate sites for marine parks (Ormond, 1980). These are;

Isa peninsula - the southwest side of the Isa peninsula not far from Salif. This area probably has the best coral reefs on the North Yemen (YAR) mainland and is convenient for tourists and visitors from Hodeida.

The Zugar Islands - which are located at a potentially interesting zoogeographic point on the boundary between the Indian Ocean and the Red Sea. They apparently have a rich interesting sublittoral fauna.

South Yemen (PDRY).

The Marine Science and Resources Research Centre (MSRC) was established in 1983 by the Government of South Yemen (PDRY) and with the assistance from UNESCO and the Islamic development bank. Funding for the centre is available for the period 1977-1986. The MSRC is a functional unit of the Ministry of Fish Wealth and the research activities will include mariculture and the assessment and monitoring of marine pollution.

As a result of a visit to South Yemen (PDRY) Ghadaf and Stirn, (1983) report on preliminary recommendations for protected areas.

The Peninsula Ras Abu Quizara - to include rocky shores and submarine communities on primary hard bottoms, and coral fields.

Vicinity of Perim island - Transient coral fields and hard bottom communities in the region of Perim island and the lagoon of Ghuraira.

Socotra - Part of the unique terrestrial/marine environment of Socotra. With reference to this the UNEP state of the environment report for 1980 (UNEP, 1980b) states that the Government of South Yemen (PDRY) intends to transform Socotra into a natural reserve because of its zoogeographic importance and diverse flora and fauna.

Nishtun - The far eastern marine environments in the Nishtun area.

In addition they proposed a series of activities to be developed at the Institute of Marine Sciences.

The Ministry of Fish Wealth submitted a project document to UNEP concerning fisheries development with the aim of protecting the marine environment and enhancing coastal management programmes. It was proposed that a mission comprising FAO, IAEA, IUCN, UNEP and RSP visit South Yemen (PDRY) to develop the project.

A sewerage system is under construction and is planned to be completed by 1985. It is intended that the system discharge 20-25 million cubic meters of primary treated wastewater into the sea. The UNEP/ECWA mission reports that monitoring of this discharge is not adequate and that the water should be used for land irrigation.

Tangi, (1984) reports on consultations with South Yemen (PDRY) authorities regarding formulation of a comprehensive action plan for protection and development of the marine environment and coastal area resources. He reports that funds are unavailable from RS/PAC for this purpose at this time and suggests that ROWA (UNEP regional office for West Asia) seek the required funds.

Ehrenfield (1981) suggests that a high international priority, by reason of large population size, should be the protection of the Hawksbill, Eretmochelys imbricata, nesting population at Jabal Aziz. In addition South Yemen (PDRY) provides a major nesting area for the Green turtle, Chelonia mydas with the highest nesting levels reported for the Arabian peninsula (Ross & Barwani, 1981) and in the top ten sites for nesting of this species worldwide. For these reasons conservation of these nesting areas should also be considered a high international priority.

Somalia.

Five ministries are involved in conservation activities in Somalia and their roles are not defined. Singh, (1983) refers to 4 institutes associated with marine conservation activities in the region.

Simonetta and Simonetta (1983) report on two protected areas incorporating a coastal element in the Somali section of coast bordering the Gulf of Aden. The first "Zeila" was established by the British as a huge partial reserve covering N.W. Somalia. However, the reserve area was never enforced. Simonetta and Simonetta (1983) propose that this reserve area should be subdivided into two reduced and separate areas, one to include Zeila and the islands of its coast. They suggest that the second area, "Daalo" forest, should be extended to the coast.

Turtles are recognised as having economic significance, and the creation of turtle reserves forms one part of a proposal in a draft for new legislation.

National Laws.

Jordan.

There are national laws concerning marine pollution (1961 article 51/18), and concerning fishing activities (1/11/56). There is the natural resources authority law (no. 12 1978). In addition the Royal Society for the Conservation of Nature, the Aqaba Regional Authority, the Environmental department within the Ministry of Municipalities rural affairs and the environment, and the Marine Science station of the Department of Sciences, the University of Jordan, all have a significant role in developing marine conservation in Jordan (UNEP, 1980a).

Reefs in the area are deteriorating rapidly for a variety of reasons including coastal development, high recreational use, sewage and phosphate input (Walker & Ormond, 1982).

The Royal society for the conservation of nature proposed an act in May 1979 for the prevention of marine and coastal pollution. Proposals for designation of a marine park bordering 7km of Jordanian Red Sea coastline have been completed. The programme is partly funded through ALECSO/PERSGA and also through the Aqaba Regional Authority (ARA), (Jordan Times August 1984).

Egypt

See international conservation status in this section.

The first formal marine reserve was established in Israeli held territory in 1960 and has been administered by Israel's Nature Reserves Authority. However, the reserve only occupies 700 meters of coast and is suffering deterioration because of its proximity to Eilat port and town (Fishelson, 1973; Loya, 1975, 1976).

In Egypt preliminary pollution abatement legislation was passed in 1962. A new water pollution prevention law was enacted in 1983. It is hoped that the creation of an 'Egyptian Environmental Affairs Agency' will lead to measures enforcing and strengthening this legislation - particularly those relating to oil activities in the Gulf of Suez.

Myers (1980) reports that the collection of corals, shells, and other marine animals is forbidden and spearfishing or the taking of coloured reef fishes is prohibited throughout the mainland Red Sea province and on the Sinai coast to the south of Tor.

During the period when Israel occupied the Egyptian Sinai, Israeli legislation established a series of marine reserve zones, including Ras Mohammed, along the Sinai coast of the Gulf of Aqaba (Fishelson, 1980). In 1981 parts of the coast of eastern Sinai were proclaimed protected nature areas by an IUCN resolution at the 15th. general assembly. The assembly also recommended these areas as World Heritage Sites.

Egyptian conservation law no. 102 of 1983 (Sinai newsletter, 1984) set up the legislative framework for the creation of protectorates. The law also tentatively identified Ras Mohammad and Tiran I./Sinafir I., and the Hamata marine zone (specifically mentioning mangrove growth), south of Marsa Alam for designation. On Nov. 13th. 1983 Prime Ministerial decree (no. 1068 of 1983) was issued stating that the Ras Mohammed area was considered a national protectorate in accordance with law 102 (Ormond, 1985). The designation of Ras Mohammed as a marine protectorate included an order forbidding a variety of activities likely to harm the environment. The order also established a branch of The Environmental Affairs Agency to supervise the operation of the protectorate. One aspect of concern in this designation is that, among the park legislation banning all environmentally damaging practices, lies a clause permitting fishing and hunting under certain conditions which can be set by the administration (Wells, Oryx vol. 18, no. 3).

Saudi Arabia.

A comprehensive set of air and water quality standards have been promulgated by the Meteorological and Environmental Protection Administration of the Ministry of Defence and Aviation (MEPA 1983). The Royal Commission at Yanbu operates a 'zero-discharge' policy (Royal Commission, 1981).

There is a certain amount of existing legislation aimed at protecting species and habitats in Saudi Arabia.

All areas of Saudi Arabian Government have input into Marine conservation activities through the inter-ministerial Environmental Protection Committee (EPPCOM). However, the lead on environmental matters is taken by the Meteorological and Environmental Protection Administration of the Ministry of Defence and Aviation (MEPA). The Ministry of Agriculture and Water Resources has responsibility for the exploitation of plant and animal resources in the Kingdom including their protection in Asir park.

The comprehensive list of resolutions presented by the Environmental Protection Committee (EPPCOM, 1984) for consideration by the Council of Ministers provides a framework for meeting national and international requirements for conserving the coastal and offshore marine environment of the Saudi Arabian Red sea. Note particularly resolutions 3, 4(a), and 4(b).

Resolution 3 - seeks approval, by the National council of Ministers, for a National plan for combatting oil pollution and other hazardous substances in emergency cases.

Resolution 4(a) - if approved by the council of ministers, will result in a moratorium on development and construction, for three years, in a wide range of proposed coastal and offshore conservation areas.

Resolution 4(b) - if approved by the council of ministers, will ban new coastal infilling, dredging and solid waste disposal in a zone that includes all of Saudi Arabian Red Sea territorial waters and 100m inland of the high water mark or the furthest annual extent of tidal inundation.

Asir National park has already been designated and includes a coastal element. Asir national park is on the list of potential sites for world heritage status.

Sudan.

The environmental health act of 1975 (Schroeder, 1981, 1982) stipulates that no solid, liquid, or gas, which may be actually or potentially harmful to man or animal shall be put into the sea. In 1975 the existing (1937) fisheries legislation was modified and strenghtened to give a measure of protection to the reefs. Spear-guns were completely banned, and coral and shell collecting, and taking inedible reef fish species prohibited. More recently a new fisheries act was ratified by the National Cabinet and National Assembly. This act includes enabling legislation to permit the establishment of marine parks and reserves, and regulates construction in and near the sea (Ormond, 1985). Sanganeb atoll was nominated by the Sudanese Government as a World Heritage Site in 1983. The nomination was deferred, partly because the area has yet to be declared.

The focal point for marine conservation activities is the Institute of Oceanography of the National Council for Research. A driving force for conservation is the Marine Conservation Committee.

Ethiopia.

Dogali Heroic Park on Mits'iwa's south coast was established in 1970/1971, (AWLF, 1972). Proclamation no. 139 of 1978 has, as a major purpose, the prevention of marine pollution (IMO, 1983).

As early as 1968 parts of the Dahlak Islands were proposed as a marine park following a survey by Carlton Ray, and legislation was apparently prepared though it has never been put into effect (Berhanu, 1975). Political events during the last ten years have prevented implementation of these plans.

Djibouti.

Legal protection for Muscha (Mouscha) islands marine national park was established in 1972 (Indian Ocean Coral Reef Directory, in press). The South Maskali islands integral reserve is part of the Muscha islands marine national park and was established in 1980. All aquatic and subaquatic activities are forbidden under Decree No. 80-062-PR/MCTT (Coral reef directory, in press).

North Yemen (YAR).

North Yemen is a party to the World Heritage Convention having ratified it in January 1984. Law no. 13 of 1975 is in connection with sanitary provisions in harbours and airports. Law no. 13 of 1976 relates to various aspects of marine pollution. It identifies the protocol for forbidding discharge of oil, ballast, rubbish, and other harmful substances into the marine environment. Resolution no. 83 of 1977 established a central committee and local committees for the protection of the environment and combatting epidemic diseases. Law no. 20 of 1978 relates to fisheries and designates a permit/licensing system for fishing as well as banning the use of explosives or harmful substances for fishing (State of environment report for North Yemen, UNEP, 1980c).

North Yemen (YAR) has no definite plans for the setting up of a national Institution dealing with overall aspects of science and technology. The focal point for regional marine conservation programmes is the University of Sana'a.

South Yemen (PDRY).

The UNEP/ECWA mission to South Yemen (UNEP, 1984) reports that environmental protection is not considered as a priority in the current five year plan. However, despite this conservation activities are proceeding.

Laws exist concerning the marine environment, coastal zone, and fishing forbidding the discharge of oil, ballast, rubbish, and other harmful substances in the marine environment. Law no. 24 of 1979 prohibits the use of toxic, explosive, or chemical substances for the purpose of fishing.

Law no. 13 of 1976 legally established the National Environment Council (UNEP, 1980b). The assignment report (UNEP, 1984) refers to the National council for the protection of the environment being established by presidential decree law no. 8. The national council for the environment and the public corporation of fish wealth (which has a fisheries training and research center) have responsibility for the open sea. Responsibility for the conservation of nature, wildlife, and genetic resources is the responsibility of the Ministry of Culture and Tourism, (State of the environment report for South Yemen, UNEP 1980b).

Somalia.

A coastal zone plan falls within the 1982-1986 five year development plan.

Article 7 of law no. 15 (1969) prohibits damage to any flora in a zoned reserve without written permission of the Minister of livestock, forestry and range, (Singh, 1983). The National range agency of this Ministry is responsible for protected areas plans (Salah, A.M., unpublished manuscript).

Basic marine fisheries legislation is contained in the maritime code of 1959 amended 1967 which entrusted fisheries regulation to the maritime authority which falls under the ministry of marine transport and ports (Salah, unpublished manuscript).

The Ministry of fisheries was established in 1977. Fishing is only allowed by concession from the Ministry. A draft law exists to amend the maritime code of 1959, (Singh, 1983). Article 70 of the maritime code allows the prohibition of fishing in certain areas. Article 71 prohibits dynamite, electric current, chemicals or similar methods to kill or stun fish or other animals or to sell fish caught in this way, (Singh, 1983).

RESOURCES HABITATS AND SPECIES

Open Sea.

Character.

There are two significant features relating to the biology of the open Red Sea that distinguish it from the Arabian Gulf and the Indian Ocean. The first is that the epipelagic zone from the surface to 100m is relatively nutrient poor (Weikert, 1982). The second is that the region has a relatively low phytoplankton and zooplankton diversity. Sukhanova (1969) cited in Kimor (1977) reports that the central Red Sea is the poorest in phytoplankton species with more diverse populations in the northern and southern parts. However, this may reflect the intensity of study in each of these regions. It is, in fact, more likely that there is a decreasing phytoplankton and zooplankton diversity northwards in the Red Sea (Kimor 1977).

A number of factors probably determine this situation. Firstly there are no significant nutrient rich upwellings in the Red Sea. Secondly there is little freshwater input and associated run-off of nutrient rich soil material. The situation is slightly different in the Gulf of Aden due to the probable peripheral influence of the South Arabian and Somali upwellings. Indeed, Watson (personal communication), reports that the North Somali coastal zone is very rich in pelagic species.

The relative oligotrophy of the Red Sea obviously limits the numbers of higher animals that the open sea can sustain e.g. - fish, turtles, mammals. Indeed it can be seen that most of these animals are directly, or indirectly, dependent on shallow water substrates for their food.

Occurrence and extent.

In general (Kimor, 1977) most contributors to the biogeography of the Red Sea agree that epipelagic species are able to pass over the dividing sill at Bab-el-Mandab with the surface currents generated by the monsoon winds. This may explain the general decrease in phytoplankton and zooplankton diversity on moving up the Red Sea as the influence of the Indian Ocean flora and fauna is diluted.

There is a certain degree of endemism reported for Red Sea phytoplankton - for example; Dinophysis caudata, D. maris rubri, and D. miles of the dinoflagellates, and Trichodesmium erythraeum of the filamentous blue-greens. The latter species is supposed to bloom giving the Red Sea its characterisitc red colour. Evidence that the open Red Sea has a regional identity is further supported, Kimor (1977), by the observation that the Red Sea, unlike neighbouring bodies of water, has a dominance of dinoflagellates vs. diatoms.

Conservational Status.

The conservation status of the open sea is generally good within the open Red Sea and Gulf of Aden. However, oil pollution and the disposal of metaliferous muds from the proposed deep sea mining programme in the central Red Sea are pointed out as areas of concern. Regional marine conservation developments are proceeding at a realistic pace in view of the poor state of development of many of the countries bordering the Red Sea and Gulf of Aden. Conservation programmes should concentrate on:

- Ratifying international agreements.
- Regional co-operation in conservation activities.
- Developing local facilities and expertise.
- The identification of critical marine habitats.
- The development of coastal zone management plans.
- Public awareness and education.

Human and economic value.

The major value and use of the open Red Sea and Gulf of Aden is as a highway for commercial trade. The open sea provides a highway for the provisioning of countries bordering the Red Sea and Gulf of Aden, revenue to the Egyptian government from the Suez canal, and time and energy saved to companies that would otherwise use The Horn (see Heathcote et al., 1984).

The open sea provides a source of clean salt-water for desalination plants on the Red Sea coast of Saudi Arabia (SWCC, 1982).

For the reasons already pointed out the open Red Sea has a relatively low fisheries potential. This potential may be slightly higher in the Gulf of Aden due to the peripheral influence of the South Arabian and Somali upwellings. For example the fisheries catch in South Yemen (PDRY) was 143,000 tons in 1975 (UNEP, 1980b) whilst in North Yemen (YAR) it was 75,000 tons in 1974. However, this may simply reflect an increase in fishing effort. The Bab-el-Mandab has potential value in that it could be dammed to produce a significant source of hydro-electric power (Morcos, 1970).

Targeted exploitation.

There is a limited open water fishery in the Red Sea. Most of the fisheries in this region are associated with shallow water habitats. In South Yemen (PDRY), however, the fishery is larger and over 50% of the fishery is pelagic, (Ghadaf and Stirn, 1983), see also section on pelagic fisheries.

Incidental exploitation.

Most types of indirect exploitation of the Red Sea and Gulf of Aden will be controlled through International and National legislation.

- Water for desalination : SWCC (1982), Couper (1983).
- Disposal of trash/litter.
- Disposal of oil.
- Disposal of mine tailings : See Lange et al., (1980).
- Sewage disposal : See Ormond et al., (1982a, 1982b, 1984a); Sheppard (1983a and b); Ghadaf & Stirn, (1983).
- Incidental input of phosphates : Walker and Ormond (1982).
- Disposal of other chemicals/wastes : See PERSGA (1981).

Oil industry.

Oil pollution of the open sea and its subsequent impact on shallow water marine habitats is a cause for serious concern at this time. The regional conventions relating to, and the capacity to cope with, oil spills on a national and regional basis should be vigorously persued. In addition it must be noted that great care should be taken to ensure that appropriate dispersants/clean-up methods are used.

There are two major sources of oil pollution in the open Red Sea and Gulf of Aden. The first is from poorly maintained environmental standards in the Egyptian oilfields of the Gulf of Suez, (Wennenk & Nelson-Smith, 1979; Barratt, 1982; Hanna, 1983; Heathcote et al., 1984). The second is from deballasting by ships at sea which is probably a more significant source of oil pollution in the southern Red Sea and Gulf of Aden, (Gupta & Kureishy, 1981).

In 1982 oil output from the Gulf of Suez of 35Mmt represented a 1.3% share of the world market. In addition it is reasonable to suppose that substantially more than 100Mmt of crude oil per year is being transported through the Red sea and Gulf of Suez from various sources and these carriers will probably return south in ballast, (Heathcote et al., 1984).

The Sumed oil pipeline linking Ain Sukhna on the Gulf of Suez to Sidi Kerir on the Mediterranean has a capacity of 80Mmt/year.

The oil pipeline serving Yanbu al Sinaiyah on the Red Sea coast of Saudi Arabia has a capacity of 100Mmt/year. In addition there is a major oil processing and loading terminal at Yanbu al-Sinaiyah in Saudi Arabia that operates a 'zero-discharge' policy (Royal Commission, 1981).

Concern has been voiced (Oryx 1985, Vol. 19 no. 1 p. 16) at the potential pollution that may result from construction of an oil pipeline from Iraq to Aqaba.

A number of companies are exploring for oil on the Somali continental shelf (Singh, 1983).

Some oil exploration is reported offshore of Sudan (Indian Ocean Coral Reef Directory, in press). Similarly, oil has been discovered on the northern border of South Yemen (PDRY)/southern border of North Yemen (YAR), and exploration is taking place offshore of both countries.

In addition individual countries bordering the Red Sea and Gulf of Aden have their own coastally situated offloading, bunkering, and refining facilities, for example at Rabigh and Jeddah in Saudi Arabia, at Port Sudan in the Sudan, at the Assab refinery in Ethiopia, and at Aden. It should be noted that Assab refinery is installing a sand filter system to further improve the quality of the treated effluent discharge, (IMO, 1983).

See later references to oil-pollution and its effects on turtles, and birds, using the open sea for feeding and migrating.

The oil has its most obvious impact when it is blown into the coastal zone; firstly into close contact with sensitive shallow water biological communities such as mangroves, seagrasses, and coral reefs; and secondly when it is washed ashore onto beaches.

Waste-discharge.

Litter dropped at sea significantly pollutes beaches along the Red Sea, Ormond et al., (1984a-c, 1985a-d); Wennink & Nelson Smith (1977). The open sea should not be seen as a potential site for dumping of waste materials (see also deep sea). For example Lange et al. (1980), Abu Gideiri (1981), suggest that a surface disposal of mine tailings from the exploitation of metaliferous deposits in the central Red Sea should be avoided. Firstly because it may significantly alter local water transparency which will decrease local plankton productivity (which is already low). Secondly because of the presence of unpredictable surface high speed water currents which may well carry the mine tailings into the vicinity of Jeddah.

Sedimentation.

Mine tailings if Saudi Sudanese Red Sea Commission exploitation of metaliferous deep sea brines commences, (Lange et al., 1980).

Some sediments of terrigenous origin (and any associated pollutants may be carried out to sea by occasional flash floods.

Recreation and tourism.

Small sailing boats regularly transit through the Red Sea and Gulf of Aden. Ferries operate in the area particularly during the Hajj. Tourism dependent on the coastal zone and associated open sea is a relatively important source of revenue to Egypt, and Jordan.

Deep Sea.

Character.

There are several features characterising the deep Red Sea. Temperature and salinity are high and homogeneous compared to the Indian Ocean. The waters are relatively oligotrophic and species poor and the benthos is almost desert like (Weikert, 1982). However, because the region is tectonically active there may be areas of benthos supporting a chemotrophically based food chain.

The situation is much more heterogenous in the deep sea in the Gulf of Aden where there is a peripheral influence from the South Arabian and Somalian upwellings. Where these upwellings have an influence the temperature and salinity vary considerably, the waters are more eutrophic and there is a higher biomass of, for example, mesopelagic fish.

Occurrence and extent.

Three distinct habitat zones are evident in the central Red Sea water column (Weikert, 1982).

- A nutrient poor epipelagic zone from the surface to 100m.

- A mesopelagic zone from 100-750m.

- A desert-like bathypelagic zone from 750-1,850m characteristic of much deeper water in open oceans where zooplankton abundance is very reduced and there is very low productivity.

In addition the generally low productivity of the Red Sea phytoplankton and zooplankton is reflected by a low standing stock in the benthos (Theil, 1980).

This limit to the productivity and diversity of the deep Red Sea is restricted by two further conditions. Firstly transport of organic debris below 1,100m by sinking is ineffective because high water temperatures make the rate of decay too rapid. Secondly the high temperatures and salinities resulting from the landlocked nature of the Red Sea are unfavourable to deep sea plankton species.

Conservational status.

There is no evidence for any change in the conservational status of the deep Red Sea and Gulf of Aden. Priority areas of concern should be identified as the metaliferous mining of deposits in the central Red Sea and any plans to dispose of toxic waste materials in this habitat.

See reference to the Saudi Sudanese Red Sea Commission and the Regional Convention for the Conservation of the Red sea and Gulf of Aden Environment and the Law of The Sea.

Human and economic value.

The deep sea benthos provides an exploitable source of metaliferous deposits, (Ross et al., 1973; Nawab, 1980).

The cooler deep water in the Gulf of Suez Sea could possibly be exploited to condense freshwater. Hot spots in the central Red Sea could have significance in energy production.

Targeted exploitation.

Nearly one half of the mesopelagic biomass recorded from the Western Indian Ocean is found in nearshore areas of the Arabian Sea (Gjosaeter & Kawaguichi, 1980). However, survey work suggests that there may be large variations in abundance in the North Arabian Sea. Pelagic trawl surveys have found high densities of mesopelagic fish at the upper end of the Gulf of Aden, along the coast of South Yemen (PDRY), (around 400 kg/hour trawling). A very dense mesopelagic fish layer was usually observed between 150 and 200m and a more diffuse one between 250 and 300m. A figure of $60g/m^2$ for the whole of the Gulf of Aden region is given by survey assessment. The mesopelagic fish resource is presently not exploited.

Deep-sea lobster, Peurulus sewelli is being exploited in South Yemen (PDRY) waters. This subject is treated under "other crustaceans", (page).

Mining of metaliferous deposits in the central Red Sea is proposed, (Lange et al., 1980).

Incidental exploitation.

J. Bourot (Oryx vol. 17 no. 2, p.104) points out that deep-sea mining may be synonymous with wildlife destruction.

Waste-discharge.

The deep Red Sea and Gulf of Aden should not be considered for disposal of toxic wastes including radioactive materials. The area is tectonically active and does not, therefore, fulfil the internationally agreed criteria for disposal of such substances. In additon the residence time of deep sea water in the Red Sea is considered to be low (Morcos, 1970).

Open Soft Bottom Habitats.

Character.

Open soft-bottom habitats may be defined as those soft-bottom habitats where water circulation is not restricted. Initial reference has already been made to the deep sea benthos.

Relatively little work has been done on these habitats in the Red Sea and Gulf of Aden. Several shallow water open soft-bottom habitats have been identified along the Saudi Arabian Red Sea (Ormond et al., 1984a-c, 1985a-d). They include;

- wide expanses of sand/silt with characteristic hemichordate 'hillocks' which may also support shrimp/goby holes.
- regions supporting seagrasses.
- regions of fine sand supporting a veneer of micro-algae which may, in turn, support dense grazing populations of molluscs, characterised by Olive shells, and sand-dollars.

Because these areas (except for the seagrass beds) appear to be relatively unproductive they tend to be overlooked and until more is known about their importance this should not, necessarily, be so.

Conservational status.

The conservational status of open-soft bottom habitats in the Red Sea and Gulf of Aden is generally good. However, areas of concern are increasing coastal development, oil-pollution, waste discharge and phosphate loading.

Targeted Exploitation.

Open soft bottomed habitats are distributed between areas of coral and support a limited amount of trawling in the region. Relatively small amounts of shrimp are taken in the Gulf of Suez, in the waters off southern Saudi Arabia and North Yemen, (YAR), and off southern Sudan. Other species caught include lizard fish, (Saurida sp.), snappers (Lutjanus spp.), horse mackerels (Trachurus), scad (Decapterus) red mullets (Upeneus spp.) and Threadfin bream (Nemipteridae). For further information see the sections on demersal fisheries.

Incidental Exploitation.

There are no records of incidental exploitation on soft bottomed habitats in the region, but elsewhere turtles of various species are taken in shrimp trawl nets, so it may be expected that some incidental exploitation of turtles may occur.

Enclosed Soft Bottom Habitats.

Character.

Enclosed soft-bottom habitats may be described as those habitats where water circulation is restricted. They tend to be subject to a higher range of temperatures, salinities and oxygen levels than occur in open water soft-bottom habitats. Because enclosed soft-bottom habitats occur in sheltered waters substrate particle size is generally smaller than that found at equivalent depths in open water soft-bottom habitats.

Enclosed soft-bottom habitats in the Red Sea and Gulf of Aden are represented by bays, sharms and mersas. Recent opinion suggests that they have been formed as erosional features by rivers or wadis cutting through emergent reef at a time of more frequent rain and lower sea level (Whiteman, 1971; Rabaa, 1980).

Sharms and mersas typically have an entrance of 0.2 to 1km across. They may extend for up to 10km inland and remain narrow and winding throughout - as at Sharm Obhur north of Jeddah or Mersa Shinab in north Sudan, or widen out into 'lakes' several kilometers across - as at Sharm Suleiman or Mersa as Sarraj north of Jeddah. However, many sharms and mersas are simply shallow bays partly or completely closed off by a coral fringing reef.

Enclosed soft bottom habitats are often backed by extensive flats that are inundated on a seasonal basis (Ormond et al., 1984a-c, 1985a-d). During this period of wetting they often develop a growth of micro-algae that may have seasonal significance to the primary production of the coastal zone.

Occurrence and distribution.

In general terms, a decrease in quantity and quality of coral reefs down the Red Sea is balanced by an increase in the quantity of soft-bottom communities (Ormond et al., 1985b). However, because the Red Sea is probably made up of several zoogeographic provinces, each region may have a significance not simply related to the diversity of its flora and fauna.

Enclosed soft-bottom habitats are restricted in number and distribution. For information on the occurrence and distribution of soft-bottom habitats along the north Egyptian coast see Barratt (1982), for the Saudi Arabian Red Sea, see Ormond et al. (1984a-c, 1985a-d), for the Sudanese coast see Ormond (1980), for the north Ethiopian coast see Hemming (1961), for the North Yemen coast see Ormond (1980), for the South Yemen coast see Hirth et al., (1973).

Conservational status.

Enclosed soft-bottom habitats are restricted in number and distribution. They also have great value. Several sharms and mersas, particularly along the Red Sea coast of Saudi Arabia, are deteriorating or being destroyed through coastal development. The conservation of these habitats should be a priority. To some extent this priority has already been recognised, (see the section dealing with Conservation and Management Activities).

Human and economic value.

Enclosed soft-bottom habitats are critical marine habitats and should be given special status in any coastal zone management plan.

- The waters are sheltered and often provide a safe anchorage and so are often selected for industrial and harbour development.

However these sites also have various features which should prevent their use in this fashion.

- They are limited in number and area.

- Water exchange is restricted so that the effect of pollutants is increased.

- Many are scenically attractive and provide sheltered waters that are ideal for recreational use.

- They support several critical habitats including mangrove stands, and seagrass beds.

- They are nursery areas for fish and shrimp.

- They are already physically and chemically stressed.

Oil industry.

See other sections. There is some disposal of waste oil into lagoons in the vicinity of Jeddah, (Ormond, et al, 1982a, 1982b).

Waste discharge.

The potential impact of sewage discharge from Jeddah is noteworthy.

Direct destruction.

- Sudan : New Suakin port.
- Saudi Arabia : Sharm Dhaba. Sharm Wejh. Royal Commission activities at Yanbu al-Sinaiyah. Hatiba island project. Corniche development north and south of Jeddah. Water circulation to several small areas of enclosed soft-bottom habitat altered due to development (Ormond et al., 1984a-c, 1985a-d).

Recreation and tourism.

Enclosed soft-bottom habitats have particular recreational and touristic value. They often occur in aesthetically attractive locations and provide sheltered waters for water sports.

- Egypt : The area by the Hurghada Sheraton in Egypt.
- Sudan : Port Sudan harbour/creek.
- Saudi Arabia : Several sharms/mersas along the Saudi Arabian Red Sea have existing recreational importance - Sharm Suleiman and Sharm Obhur north of Jeddah - The Jeddah corniche lagoon - Sharm Yanbu and Sharm al Khaur north of Yanbu, (see Ormond et al., 1984a-c, 1985a-d; IUCN/Hicks, 1985).

Mangroves.

Character.

Mangroves are halophytic plants that live in the intertidal fringe of tropical shallow waters. They can survive in this environment through a specially developed salt secretion process that makes them particularly vulnerable to coating by both inert and chemically active materials.

The term mangrove covers a wide variety (60 or so) of species of tree which belong to a number of effectively unrelated families, but which are found growing, often together, in a characteristic situation along the edge of brackish or seawater shores in many parts of the tropics. Here they may form zones of dense forest, up to several km wide, and contain as many as 20 or so different species. Such diverse and expansive communities are found in only a few areas and are not represented in the Red Sea and Gulf of Aden.

Three species of mangrove are reported from the Red Sea and Gulf of Aden. They are Avicennia marina which is found throughout the area, Rhizophora mucronata which is found in a few very restricted locations and Bruguiera gymnorhiza which is recorded from Sudan and reportedly found in North Yemen (YAR).

Occurrence and extent.

The Red Sea lies at the geographical limits of mangrove growth. Mangrove is virtually absent from the Gulf of Aqaba (Por et al., 1977) and from the Gulf of Suez (Kassas & Zahran, 1977) where growth may be limited by low temperatures and a lack of suitable substrate (Ormond et al., 1984a).

Soft-bottom habitats suitable for mangroves are relatively rare in the Red sea. This is particularly the case in the north, because much of the coastline is edged by a narrow reef flat leading to a well developed fringing reef that drops off steeply into deep water.

In addition it has been suggested (Saenger et al., 1983) that mangroves do need a good amount of freshwater input for best development. There is a very limited input of freshwater into the Red Sea and Gulf of Aden and the salinity, particularly of the Red Sea, is high. This may restrict mangrove development. It has also been suggested that the location of the most extensive stands of mangrove in the Red Sea and Gulf of Aden may be linked to a source of freshwater input. Whilst this hypothesis has not been proved it does have major implications on mangrove management in the region. Increased use of natural sources of freshwater in the coastal zone is already having an effect on localised water table levels, which could ultimately effect mangroves.

A further general feature that may control the extent of individual mangrove stands, particularly in the Red Sea, is tidal range. Tidal range in the Red Sea is low and many of the most extensive stands occur in the south where tidal range is higher than in the central Red Sea. Where extensive stands do occur in the central Red Sea, for example on Birema Island in the Wejh bank, they tend to be associated with existing reef rock structures that mimic the dendritic system of consolidated mud tidal channels that supply and support

large mangrove stands in areas with a higher tidal range. Mangrove consolidated tidal exchange channels were found in several large stands in the southern Saudi Arabian Red Sea (Ormond et al., 1985b, 1985c). Through much of the Red Sea mangrove stands form a narrow fringe of growth that may be delimited by low tidal range.

Mangroves in the Red Sea tend to be found in sheltered waters associated with enclosed soft-bottom habitats. The stands are protected by headlands and islands or by intertidal sand/silt spits (Ormond et al., 1984a, 1985b). They also occur in shallow bays protected by a fringing reef (Hemming, 1961). Fig. 1 indicates the distribution of known mangrove stands in the Red Sea and Gulf of Aden.

Egypt : Small stands of Avicennia marina - including the most northerly Red Sea stand (Por et al., 1977) are found at restricted locations throughout the Egyptian Red Sea (Kassas & Zahran, 1967; Zahran, 1977). Rhizophora mucronata is reported from the southern Egyptian Red Sea 900-1000km south of Suez (22°40'N, to 23°N), (Kassas & Zahran, 1967; Zahran, 1977).

Sudan : Avicennia marina is reported from the area (Zahran, 1977). R. mucronata and B. gymnorhiza have both been recorded for the region (Andrews, cited in Hemming, 1961 & Zahran, 1977). However, Kassas (cited in Zahran, 1977) reports that the stand of B. gymnorhiza near Suakin no longer exists.

Saudi Arabia : Avicennia marina is found in the Saudi Arabian Red Sea south of 27°30'N. The incidence of A. marina increases southwards (Ormond et al., 1984a-c, 1985a-d). R. mucronata is only found at 5 restricted sites in the Saudi Arabian Red sea and is always associated with A. marina. The total area of R. mucronata is probably less than 20 hectares (Ormond et al., 1985b).

North Yemen (YAR) : A. marina is reported from the area (Ormond, 1980). B. gymnorhiza is reported from the islands off-shore of Hodeida (Draz, 1956).

Ethiopia : Hemming (1961) observed only A. marina along the Eritrean coast of Ethiopia. Zahran (1977) reports that the shoreline of the Ethiopian coast and southwards to the far end of the African Red Sea coast is fringed by A. marina.

Somalia : Extensive stands of A. marina are reported along the Somali coast to the south of the Gulf of Aden. Occasional small stands of A. marina have been observed behind sand spits along the north coast of Somalia (Watson, pers. comm).

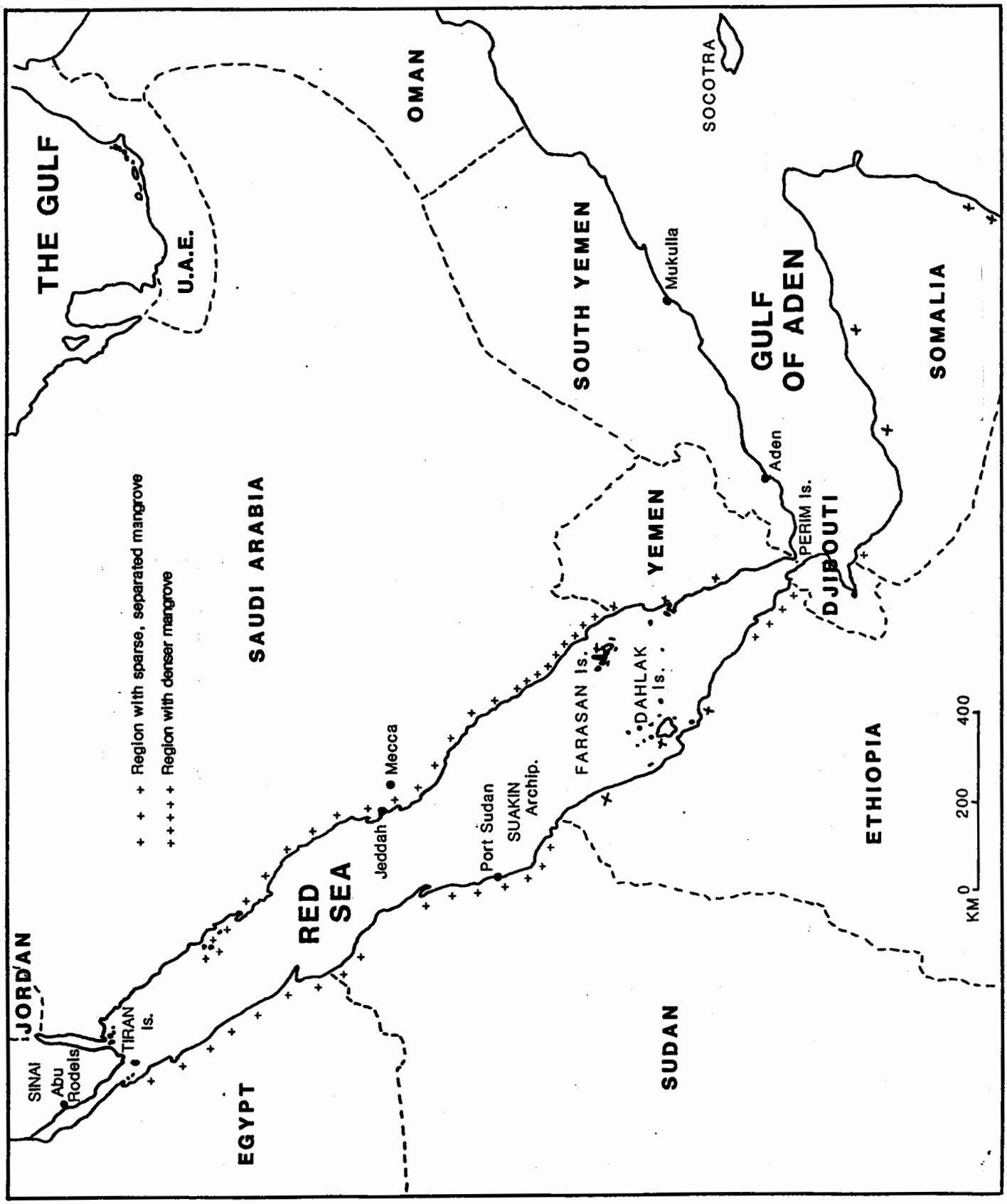
South Yemen (PDRY) : No refence to mangrove along the South Yemen coast could be found. Barratt et al., (1984) report very occasional Khawrs with stands of A. marina from the south Arabian coast of Oman.

Conservational status.

There is little evidence for a significant deterioration in extent or health of mangrove stands in the Red Sea and Gulf of Aden. The most notable deterioration appears to be associated with camel grazing and is significant only in restricted areas. However, there are a number of areas of potential concern.

Figure 1

Distribution of known mangrove stands in the Red Sea and Gulf of Aden region. (Note that for some countries of the region (e.g. Somalia, Djibouti, North and South Yemen and Ethiopia) information is incomplete .



- A trend towards increasing coastal development particularly in Saudi Arabia that may directly or indirectly destroy mangrove habitat.

- A trend towards an increasing human population particularly in Saudi Arabia that may lead to increased exploitation of mangroves.

- The risk from oil pollution.

See the section on Conservation and Management Activities for additional information. Note specifically that extensive areas of mangrove along the Saudi Arabian Red Sea will be subject to protection. Removal of timber from forests is controlled by the Royal decree on Forests and farmlands, some mangrove stands would not be classified as forests under the decree (IUCN/Hicks, 1985). Also the 'Conservation areas' under Royal Commission jurisdiction at Yanbu al-Sinaiyah contain Avicennia marina mangrove (Sheppard, 1983a).

The Ras Mohammed marine protectorate in Egypt includes a small stand of Avicennia marina.

Human and economic value.

In recent years it has come to be appreciated that mangroves constitute a very valuable and ecologically highly significant natural habitat. Numerous uses of mangrove have been documented (Saenger et al., 1983).

In addition mangroves also have an indirect value in tending to control both coastal erosion and coastal flooding (Davis, 1940; Carlton, 1974).

Most significantly, however, it has been found that mangrove communities are often highly productive especially by comparison with the productivity of neighbouring areas of the open ocean. A figure of 350-500 gC/m^2 yr^{-1} seems typical for mangrove primary production (Golley et al., 1962; Miller, 1972; Lugo & Snedaker, 1974). Consequently, the mangrove is frequently the basis for important marine fisheries either directly or through export of nutrients. In addition mangrove roots can provide recruitment habitats for juvenile fish and invertebrates.

Mangroves in the Red Sea and Gulf of Aden are important bird breeding areas (Ormond et al., 1984a). See also the section on birds in this report.

In the Red Sea and Gulf of Aden Kassas (cited in Zahran, 1977) reports the use of the bark of B. gymnorhiza for dyeing. Mangroves in the region are grazed, (particularly by camels), used for building material (net stands, shacks, and bird traps) and for cooking and heating (see Ormond et al., 1984a-c, 1985a-d; IUCN/Hicks, 1985).

It has been suggested that the Avicennia marina mangrove stands at Yanbu al-Sinaiyah may have significance as a filter bed for sewage (Sheppard, 1983a).

It seems probable from their limited infauna and their frequently restricted growth that the productivity of Red Sea mangrove stands may, in many cases, be quite low compared to that of denser more extensive mangroves growing under more favourable conditions nearer the equator. In fact Por et al., (1977) suggests that the mangroves they studied near Nabq in Sinai operate a tightly closed recycling of nutrients, and probably do not contribute significantly to the productivity of neighbouring, nutrient poor, oligotrophic waters.

However, there are large stands, particularly in the southern Red Sea, with a diverse infauna (Ormond et al., 1985b), that may contribute significantly to the productivity of the coastal zone.

In addition, and in a desert environment with little green vegetation, the mangrove stands have a landscape value that should not be underestimated.

Targeted exploitation.

The major impact to mangroves in the Red Sea and Gulf of Aden appears to be from direct exploitation. The level of exploitation of mangroves, particularly in the Saudi Red Sea, may increase as the coastal population (sustained by desalinated water) increases and unless it is controlled will do significant, and probably, irreperable harm (see Ormond et al., 1984a-c, 1985a-d; IUCN/Hicks, 1985).

Major current use of mangrove in the Red sea and Gulf of Aden can be summarised as:

- grazing for camels.
- felling for various uses including minor construction (shacks, fish net stands, bird traps etc.).
- cutting for firewood.

However, in general, mangroves are already depauperate in the region so that targeted exploitation of the useful species must be minimal. Neither is there likely to be any targeted exploitation of mangrove associated fauna for the same reasons.

Incidental exploitation.

Areas of concern relating to mangroves are also those relating to enclosed soft-bottom habitats (see earlier section). Particularly in Saudi Arabia note developments resulting in mangrove deterioration, through;

- restricted water exchange through coastal development.
- lowering of the freshwater table.
- increased visitor use of the coastline.

In addition Ormond et al. (1984b, 1985d) report a single incidence of a diseased stand of Avicennia marina from the coastline between Al Lith and Qunfidha in the central Saudi Red Sea. No obvious human influence was evident.

Oil industry.

Mangroves along the Red Sea coast of Egypt have been severely impacted by oil at several locations, particularly at Abu Minqar (Barratt, 1982). In October 1982 the A. marina appeared healthy despite the oil impact. However, in Autumn 1983 it is suggested (Heathcote et al., 1985) that some of the mangrove appeared unhealthy.

Waste discharge.

A limited flow of sewage is reported to pass through a stand of mangrove at Yanbu al-Sinaiyah (Sheppard, 1983a). No resulting damage is reported. There is little evidence for any damage to mangrove in the Red Sea and Gulf of Aden through waste discharge.

Sedimentation.

Mangroves are particularly sensitive to sediment because it can lead to a clogging of the aerial root system. It has been suggested that the existance of dead mangrove at the back of large mangrove stands in some areas in the Red Sea may be natural and be part of a cycle in which there is a reduction in water supply to these plants as sediments collect at the seawards edge of the stand and the stand moves seawards.

Direct destruction.

In general stands of mangrove in the Red Sea and Gulf of Aden continue to be healthy and are not subject to heavy levels of exploitation, but Kassas (cited in Zahran, 1977) reports the loss of B. gymnorhiza from the Suakin region of Sudan.

Severe damage to several stands of Avicennia marina (probably through over-grazing) are reported from the southern Saudi Arabian Red Sea (Ormond et al., 1985b-d; IUCN/Hicks, 1985).

Stands of A. marina in the Royal Commission conservation areas at Yanbu al-Sinaiyah appear to be suffering slow deterioration through encroachment.

There has been a marginal loss of mangrove in a number of stands along the Saudi Arabian Red Sea coast through coastal development.

Mangroves along the Red Sea coast of Egypt have been severely impacted by oil at several locations, (see Oil industry above).

Habitat destruction.

Development along the Saudi Arabian Red sea coast has resulted in a change in water circulation to a number of enclosed soft-bottom habitats, some of which support mangroves. Only marginal loss has been noted in these stands and this is usually due to direct destruction through construction (Ormond et al., 1984a-c, 1985a-d).

It should be noted that Olive Ridley turtles may be less common in this area than they have been in the past as they prefer mangrove environments which may be less extensive than they used to be, (Ross & Barwani, 1981).

Recreation and tourism.

An increasing number of people, particularly in Saudi Arabia, have access to the coastal zone and to associated mangrove stands.

Mangroves have particular significance in that they often provide the major source of green vegetation in the extremely arid coastal zone.

Mangroves also act as a focus for wildlife which can be viewed by visitors.

Recent and current conservation projects.

Eyptian conservation law 102 specifically mentions mangrove in identifying the proposed Hamata marine protectorate south of Hamata.

Recommendations for marine reserves in Sudan (Ormond, 1985) include an area north of Port Sudan with mangroves.

Proposals for a marine park in the Dahlak Islands of Ethiopia include reference to the protection of mangroves.

A preliminary critical marine habitat survey of North Yemen (YAR), which will identify the location of major mangrove stands, is to take place in 1985.

A large stand of Avicennia marina mangrove straddles the Saudi/North Yemen border at Oreste point. Protection of this stand is suggested.

Seagrasses.

Character.

In all about 50 species in twelve genera are recognised and the highest diversity is found in the Indo-west Pacific. Seven genera occur in the Red Sea from where Lipkin (1975, 1976) reports 9 species, Halophila stipulacea, Halophila ovalis, Halodule uninervis, Thalassodendron ciliatum, Thalassia hemprichii, Cymodocea serrulata, Cymodocea rotundata, Enhaulus acoroides, and Syringodium isoetifolium, (see also Den Hartog, 1970). Aleem (1979), in a study of seagrasses on the Saudi coast between Yanbu and Shu'aiba, found all these species, plus an additional one, Halophila ovata.

An important feature of the seagrass plant is its extensive root and rhizome system which enables it to colonise various soft-bottom substrates, provides a semi-permanence to the seagrass community, and also enables the plants to draw on mineral nutrients from within the sea-bed.

Occurrence and extent.

Seagrasses tend to occur on soft-bottom substrates in the lower intertidal and shallow sublittoral in the Red Sea and Gulf of Aden. However, Halophila stipulacea and Thalassodendron ciliatum occur down to 20 meters or more.

Soft-bottom habitats suitable for seagrass are relatively rare in the Red Sea. This is particularly the case in the north, because much of the coastline is edged by a narrow reef flat leading to a well developed fringing reef that drops off steeply into deep water.

A general pattern of seagrass distribution is evident in the Red Sea (Ormond et al., 1984a, 1984c, 1985a-d). Most of the species are found throughout the Red Sea. However, only Halophila ovalis, Halophila stipulacea, and Halodule uninervis, are found in Jordanian waters at the extreme north of the Gulf, (Hulings, 1979; Wahbeh, 1980). Thalassodendron ciliatum, Syringodium isoetifolium, Thalassia hemprichii and Cymodocea rotundata are found further south in the Gulf of Aqaba, (Lipkin 1975; Ormond et al., 1984a, 1984c). Cymodocea serrulata and Enhaulus acoroides are not found in the Gulf of Aqaba.

By contrast both Thalassodendron ciliatum and Syringodium isoetifolium occur predominantly in the northernmost part of the Red Sea. T. ciliatum seems to be the commonest or second most common species in the northern Red Sea, but was only recorded at three locations south of Yanbu on the eastern seaboard, and has not been recorded south of Dunganab on the western seaboard. S. isoetifolium although moderately common in the Sinai area (Lipkin, 1976) was relatively uncommon on the northern Saudi coast.

It seems most likely that temperature is the predominant factor contributing to these distribution patterns, although salinity may also be involved.

Relatively limited areas of seagrass in the Red Sea and Gulf of Aden show an indication of being under impact from man. In general it would appear that many of the seagrass beds in the area are monospecific or multispecific climax or pseudo-climax communities and reflect the end of a succession achieved under naturally stressful but predictable temperature and salinity regimes. Despite this there is little doubt that some species are more sensitive than others to natural or man-made impacts, and that the predominance of early coloniser species, such as Halodule uninervis, in areas where other species might be expected to thrive, is probably a good indication of impact of one sort or another in the recent past.

Conservational status.

Seagrasses in the Red Sea and Gulf of Aden appear, generally, to be in good condition. However, rapid development and some associated localised deterioration and destruction of seagrass beds is taking place. This is particularly so along some sections of the Saudi Arabian Red Sea coast. However, the Government of Saudi Arabia is seeking appropriate mechanisms to limit damage to seagrass beds from development particularly through the mechanism of EPPCOM resolutions 3 and 4(a/b) - listed in the section on Conservation and Management Activities.

All current legislation aimed at protecting the marine environment only incidentally results in the protection of seagrass beds.

Human and economic value.

The importance of seagrass is well documented and a brief summary of features is presented below.

- High productivity which supports turtle, dugong, stocks of commercially important fish and invertebrates, and the detrital food chain.

- Shelter for fish and invertebrates some of which are commercially important.

- Substrate for a diverse epiphytic flora and fauna.

- Substrate consolidation.

- Nutrient recycling.

Targeted exploitation.

There does not appear to be much targeted exploitation of seagrass beds. It is possible that some shrimp trawling occurs on them. The turtle exploitation in south Yemen (PDRY) presumbly occurs to a certain extent on the grass beds which are the principle feeding grounds of the green turtle.

The mollusc Strombus tricornis is collected from seagrass beds in the region.

Incidental exploitation.

The only likely incidental exploitation of the grass beds would be that of green turtles and dugongs, both of which feed on the seagrass beds. At least three dugong have been reported to be caught in fishing nets in Djibouti in the last decade, (Robineau & Rose, 1982).

Oil industry.

There is little evidence of damage to seagrass beds in the Red Sea and Gulf of Aden through oil pollution. However, there are many locations where seagrasses occur in shallow/intertidal water where an oil spill would have a significant impact.

Waste discharge.

There is little evidence of damage to seagrass beds in the Red sea and Gulf of Aden through waste discharge.

Direct destruction.

Direct destruction of seagrass beds in the region is limited. Much of this damage has occured in the vicinity of Jeddah through direct infilling, indirect sediment effects, and alteration/blocking of water circulation (Ormond et al., 1984a, 1984b, 1985a, 1985d). The low level of damage to seagrass beds in the Red Sea and Gulf of Aden is in marked contrast to the situation in the Arabian Gulf.

Construction of the Jeddah South Corniche has cut off the water supply to a large lagoon containing seagrass.

Construction of the Jeddah North corniche, particularly in Sharm Obhur, has caused destruction of some small seagrass beds.

The Hatiba 'Island' project north of Jeddah could result in damage to, or destruction of, a large multispecies seagrass bed.

Rocky substrates and shores.

Character.

Rocky substrates are present throughout the Red Sea and Gulf of Aden and throughout the coastal zone. Many of the characteristic features found associated with rocky substrates reflect fluctuating sea-level erosional features.

Supralittoral - Much of the Red Sea coastline (Ormond et al., 1984a, 1985b; Barratt, 1982; Hemming, 1961) consists of raised reef rock that may have been eroded to form coastal cliffs. In some areas of the Gulf of Aqaba spectacular high coastal hills of metamorphosed rock come straight down to the sea. In each case the cliff is typically undercut by half a meter or more at sea-level. The undercut cliff provides a relatively humid area for certain characteristic species.

In addition to the rocky supralittoral a range of other shore types is found in the Red Sea and Gulf of Aden. The nature of the shoreline has significance in determining the route of groundwater seepage and the associated incidence of freshwater dependent vegetation. The nature of the shoreline also determines the location and extent of soft-bottom substrates and their associated communties including mangroves.

- There are extensive areas of ill-defined, low lying, seasonally inundated shoreline along the coasts of the region. These are particularly extensive in the southern Red Sea and support significant numbers of wading birds particularly when inundated.

- Sections of coral sand beach that may be backed by well-developed dunes, mixed sand and gravel hills or gravel dominated hills. Coral sand beaches often support high densities of Ocypode saratan and provide the beach type necessary for turtle nesting.

Intertidal - Reef rock features also occur at, or near, the present sea level. They form the characteristic narrow reef rock flat that often leads to a well defined fringing reef. The reef rock flat often supports growths of micro and macrophytic algae as well as providing shelter for a variety of animals.

Sublittoral - The most spectacular feature associated with sublittoral rocky substrates occurs when these substrates are colonised by coral.

In the southern Red Sea and Gulf of Aden sublittoral rocky substrates are characterised by macrophytic algae rather than corals though corals do occur (Ormond, et al., 1985b; Scheer, 1971). It may be that rocky substrates in parts of the gulf of Aden, for example off Socotra Island in South Yemen (PDRY), reflect the influence of the Somali/South Arabian upwelling and support the unusual stands of macropyhytic algae reported from Oman, (Barratt et al., 1984).

Occurrence and extent.

There is a trend towards a decreasing incidence of rocky substrates throughout the coastal zone in the southern Red Sea. This trend is balanced by an increase in complexity and diversity of soft-bottom habitats. The incidence of low-lying ill-defined shorelines also increases southwards. This trend is probably a consequence of the general geomorphology of the Red Sea and Gulf of Aden. There is a decreasing 'rift' influence on moving down the Red Sea and the width of the continental shelf increases southwards.

Representative examples of most of the shoreline types described above are found throughout the Red Sea and Gulf of Aden and a comprehensive listing of the occurrence and distribution of these coastal types is beyond the scope of this review.

Conservational status.

Much of the shoreline in the Red Sea and Gulf of Aden is in good condition. However, many beaches are littered with rubbish and varying amounts of beach tar. Some beaches near to large cities are influenced by coastal sewage discharge. In addition coastal development, particularly in the northern end of the Gulf of Aqaba, and in the vicinity of Jeddah in Saudi Arabia, is restricting recreational access to suitable beaches and is destroying the existing beach line.

Human and economic value.

Rocky substrates have particular value in that they support a stable substrate for coral and algal growth which, in turn, supports a significant proportion of the coastal fishery of the area. However, the potential level of exploitation of this fishery is limited because trawling is difficult on this type of substrate.

Both rocky and sandy shorelines provide an aesthetic setting for recreation and tourism.

The majority of turtle nesting occurs on sandy beaches.

Low-lying ill-defined seasonally inundated shorelines are a valuable feeding area for migrant and resident wading birds.

Oil industry.

There is severe oiling of beaches in the Gulf of Suez and northern Egyptian Red Sea originating from oil fields in the Gulf of Suez (Wennink & Nelson Smith, 1979; Barratt, 1982; Heathcote et al., 1985). It has been suggested that this oil has had an effect on some turtle nesting in the area, and on the state of some mangroves. In addition there is a potential danger, from a major oil spill/leak, to birds depending for feeding and breeding in the coastal and offshore environment.

Further south the prevailing current/wind causes oil from the Gulf of Suez to be defelected away from the Egyptian coast and towards the Saudi Arabian Red Sea coast. There is a low level of beach tarring along most of the Saudi Arabian Red Sea coast (Wennink & Nelson-Smith, 1977; Ormond et al., 1984a, 1984c, 1985a-d).

In addition some beach oiling may result from tanker discharge/cleaning. For example a boat sinking in Jordanian waters in May 1983 released oil that severely impacted beaches in the vicinity of Haql in Saudi Arabia.

Waste discharge.

Litter : Much of the Red Sea coastline is littered with rubbish (Ormond et al., 1984a-c, 1985a-d; Wennink & Nelson-Smith, 1977). The amount of litter tends to be less in the poorer countries where it is collected for various uses. Much of the litter is discharged from ships at sea. However, litter tends to be left at recreational sites and can be a health hazard.

Sewage : Several of the larger towns discharge primary treated sewage into the sea and this may constitute a health hazard on beaches. In addition many beach chalets etc., discharge sewage directly, or by overflow from septic tanks, into the sea.

Direct destruction.

Note particularly the Jeddah North and South Corniche and other coastal developments near to large centres of population.

Habitat destruction.

Coastal strip halophytes tend to be eroded by vehicle use.

Recreation and tourism.

The recreational and touristic value of beaches is particularly high in the northern end of the Gulf of Aqaba, Egypt and Saudi Arabia. Note particularly plans for development in Jordan (identified earlier). There is great scope for increasing recreational use of the Egyptian coastline. However, it should be noted that much of the Egyptian coastline is mined and under military control.

Most of the towns along the Saudi Arabian Red Sea coast have some sort of a corniche and/or a sandy beach with limited recreational facilities. There is a very high level of recreational use of the Saudi Arabian Red Sea coast particularly in the vicinity of the larger coastal towns. Indeed residents of inland towns like Tabuk, Mecca, and Khamis Mushayt often drive to the coast during holidays.

Recent and current conservation projects.

Note particularly the creation of a new and aesthetically pleasing shoreline in Saudi Arabia associated with the Jeddah North and South Corniches. This development has destroyed much of the existing shoreline and replaced it with an artificial shoreline including sections of sandy beaches. In addition many of the towns bordering the Red Sea have made some limited provision for recreational use of sections of shoreline within their jurisdiction. Often this includes the provision of litter bins and rubbish collection.

Coral Reefs.

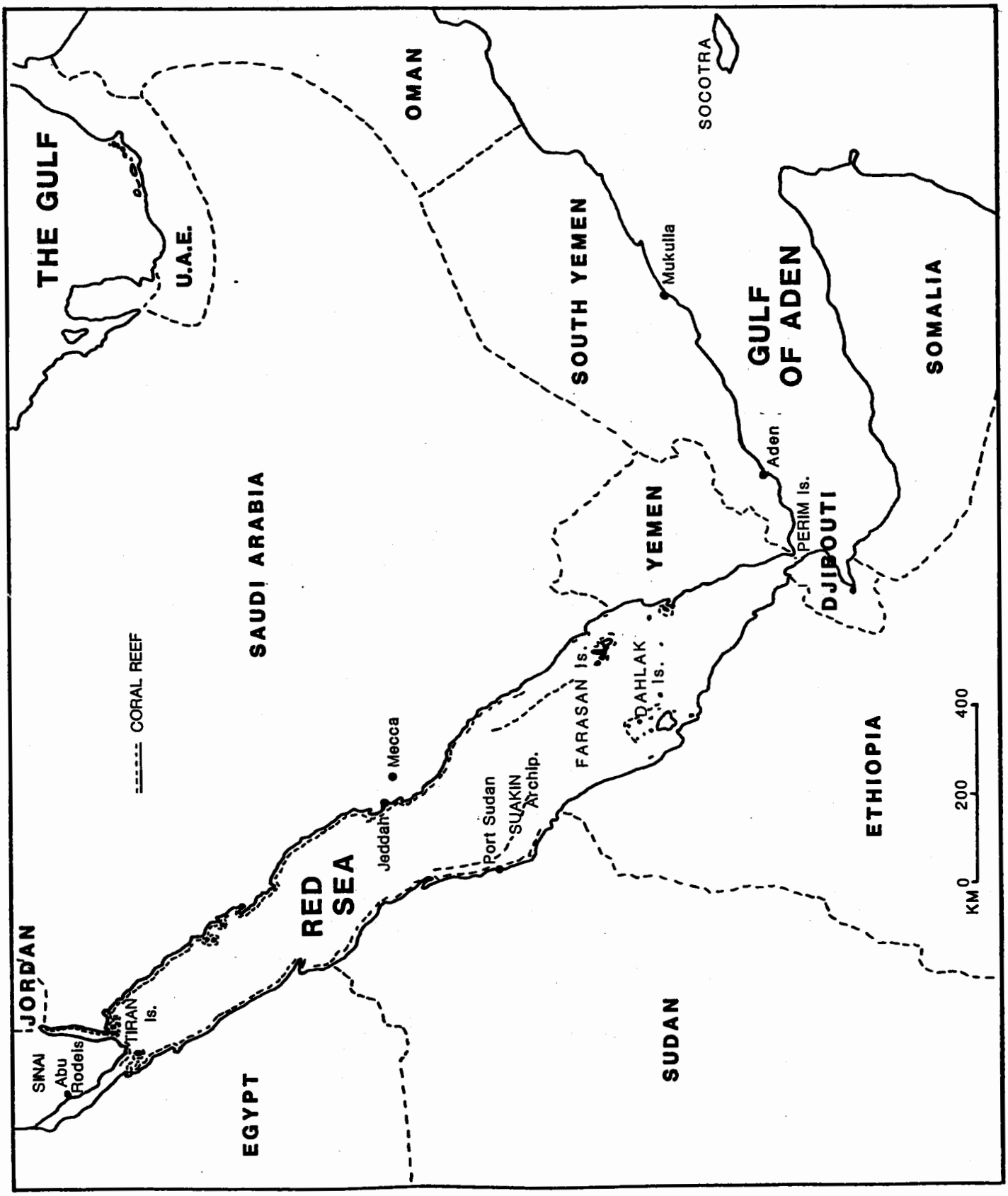
Character.

The most conspicuous shallow water marine habitat in the Red Sea is formed by the extensive coral reefs which fringe much of the coastline and often extend offshore for many kilometers.

Occurrence and extent.

For extensive information on coral reefs in the Red Sea and Gulf of Aden see the Indian Ocean Coral Reef Directory (in press). Fig. 2 shows the distribution of major coral reef areas in the Red Sea and Gulf of Aden.

Figure 2
Distribution of major coral reef areas in the Red Sea and Gulf of Aden region. (Dashed lines near-shore indicate fringing reefs and associated patch reefs. Dashed lines off-shore indicate off-shore complexes of islands, patch reefs, atolls etc.).



There is a strong pattern to the distribution of reefs in the Red Sea following that initially pointed out by Crossland (1907, 1913, 1939) based on observations in Sudan and Egypt, and further described by Mergner (1971), Ormond and Campbell (1971), Bemert and Ormond (1981), Sheppard (1983b), Ormond et al., (1984a, 1985b). The distribution of reefs through the Red Sea can be related to tectonic movements and block faulting of suitable foundations for reef growth. A scheme explaining reef structure and distribution in terms of five block tiers (of varying width down the Red Sea) is suggested by Ormond et al., (1984a).

The resultant geomorphology largely determines the extent of sedimentation and exposure to wave action. These two factors determine the vigour of coral growth, the extent of reef consolidation, the form (i.e. profile) of the upper part of the reef, and the species of coral which come to dominate the coral assemblage. Several types of reef can be encountered.

fringing reefs - adjacent to the shore along most of the coastline.

patch/platform reefs etc. - groups of reefs including patch reefs, platform reefs, submerged reef banks and ring reefs typically lying between 13-15km offshore and arranged in a series - called the barrier system by Crossland (1913). Examples are the Wejh bank, and Farasan bank off Saudi Arabia, the Suakin Archipelago off Sudan, and the Dahlak Archipelago off Ethiopia.

Pillar reefs/atolls - occasional reefs much further offshore (15-20 km) arising from much deeper water and including pillar reefs and atolls - for example deep water reefs off Egypt, Sanganeb Atoll off Port Sudan, and reefs in the north outer Farasan bank off Saudi Arabia.

Structural and species diversity of coral reefs and corals is higher in the Red Sea than in the Arabian Gulf but is lower than that reported from major coral areas in the Indian Ocean. However, the beauty of coral reefs in the Red Sea is world renowned partly because Red Sea waters tend to be clear because there is relatively little freshwater input from the land.

Structural and species diversity of coral reefs in the Gulf of Suez tends to be relatively low with respect to that found in the Gulf of Aqaba and the northern and central Red Sea. This is partly because the Gulf is shallow, turbid, and is at the lower end of the temperature range suitable for coral growth.

Over 150 species of coral are recorded from the northern and central Red Sea (Sheppard, 1983b; Ormond, et al., 1984a, 1985b). There are possibly twice as many discrete reef communities in the Yanbu area of Saudi Arabia as there are in the Gulf of Aqaba (Sheppard 1983b; Loya 1972). Coral species diversity is probably highest in the central Red Sea.

In general terms there is a decrease in the quality and extent of coastal coral reef communities on moving south of about 20°N (Ormond et. al., 1984a, 1985b-d). Wainwright (1965) reports that a survey of the Dahlak archipelago produced a lower than expected coral diversity. Reef quality around the main Farasan islands was relatively low (Ormond et al., 1984a, 1985c). This is partly because the southern Red Sea has a shallower bathymetry and a higher turbidity than the central and northern Red Sea. However, other factors may be involved.

Relatively little is known about reefs in the far south Red Sea and in the Gulf of Aden. Rocky substrates in the coastal area of Saudi Arabia become scarcer and available substrates are increasingly dominated by macrophytic algae. There is no reason to suppose that this trend does not continue southwards. However, Walczak (1977) reports that coral reef environments are abundant in North Yemen (YAR) waters. Ormond (1985) reports that the southwest side of the Isa Peninsula, not far from Salif, probably has the best coral reefs on the North Yemen mainland.

Most of the north Somali (Gulf of Aden) coast is reported either to have no coral reefs or only very weak reef development. However Watson, (personal communication) reports that there are good quality coral reefs along the Somalia north shore. Darwin (1842), does report a coral fringing reef a quarter of a mile offshore at 10°1'N., which extends for four or five miles. Scheer (1971) reports that macrophytic algae, not corals, are a major feature of the sublittoral of Abd el Kuri island near Socotra. Corals are present but are not abundant. Somalia has coral reefs in the Bajuni Archipelago south of the equator.

Conservational status.

The conservational status of coral reefs in the Red Sea is generally good. However, there is localised damage being caused, particularly to fringing reefs near to large towns and cities, by coastal development and increased recreational use.

See the Indian Ocean Coral Reef Directory (in press) for extensive information on the conservational status of coral reefs in the Red Sea and Gulf of Aden. See the section on Conservation and Management Activities in this report for information on legislation relating to coral reef areas.

The order Antipatharia, black or semi-precious coral, is listed in appendix II of CITES which means that an export permit is required for commercial trade. Stony corals were approved for inclusion in the appendix II listing at the April 1985 meeting of the parties.

Human and economic value.

The coral reefs and communities are almost certainly the most economically significant of the marine habitats in the Red Sea. The significance of the reefs for fisheries relates in part to their very high primary productivity. Generally the gross productivity appears to fall within the range of 2,000-5,000 $g.C.m^{-2}yr^{-1}$,(see Lewis, 1977). As a consequence, the standing crop of fish on reefs may reach 5-15 times that in productive North Atlantic fishing grounds, and twice that for managed temperate lakes, (Stevenson & Marshall, 1974).

The corals themselves are partly responsible for the high primary productivity of reefs due to photosynthesis occurring in their symbiotic zooxanthellae. But also important, and perhaps frequently of greater magnitude, is the productivity of the algal lawn, composed of diatoms, filamentous green algae and small red algae, that colonises most of the otherwise bare rocky surfaces of the reef in shallow water, (Walker & Ormond, 1982).

The algal turf is intensively grazed by various types of fish, especially by surgeonfishes (Acanthuridae), parrotfishes (Scaridae), damselfishes (Pomacentriae) and blennies (Blennidae), as well as by echinoids (sea-urchins) (see Randall, 1961; Ogden & Lobel, 1978). The coral, however, remains critical to the fish production of the community both in being responsible for the formation and maintenance of the shallow water substrata on which the algal turf develops and in providing the habitat complexity which may allow dense populations of primary and secondary consumers to survive, despite an abundance of predatory species. Thus both coral and algal components contribute to the high primary productivity which directly or indirectly supports the dense populations of both juvenile and adults of many commercially important fish species.

Reefs may have proved invaluable for education and science, as the large amount of biological research recently undertaken in reef areas suggests.

As a result of their diversity reefs represent a major genetic resource. Many reef animals have been found to contain pharmacologically active compounds which may be of medical value or lead to advances in medical research.

In particular, coral reefs are generally regarded as being of considerable economic and social value for recreation and tourism. The need to protect reef areas used by a developing tourist industry has generally been accepted as a major impetus towards the establishment of marine parks and reserves, and such reserves have now been established in a wide variety of countries.

Targeted exploitation.

- There is a small market for corals for display.
- A number of molluscs, including Trochus dentatus are collected from reefs.
- Coral reefs support a major part of the Red Sea artisanal fishery.

Oil industry.

Oiling of beaches, particularly in the Egyptian Red Sea, is severe. However, there is little evidence for significant deterioration of reefs due to oil pollution in the Red Sea. This may partly be because reef communities are essentially sublittoral and oil floats over them. Reefs in the Red Sea do support a limited amount of coral growth in the intertidal. However, this growth is, perhaps, not as significant as it is in those regions with a higher tidal range. An oil spill will kill off any intertidal coral that it smothers. Coral growth in the sublittoral is unlikely to be affected by an oil spill except in a restricted number of cases where the oil spill is massive and/or the coral is growing in an area where water circulation is limited and the oil is not blown/carried away.

The greatest danger to coral reefs from an oil spill is probably the indiscriminate use of dispersants. Dispersants may either cause the oil to sink onto the reef, smothering sublittoral coral growth, or through their own chemical toxicity pollute the water column and damage, or kill, the corals growing in that column.

Waste discharge.

Coral reefs are particularly sensitive to alterations of water quality and air and water quality discharge standards, and construction likely to alter water flow circulation patterns should take this into account.

Sedimentation.

Coral reefs are very sensitive to a change in sediment load. In reefs bordering countries with high rainfall, changing land use patterns, including deforestation, result in a massive increase of water run-off sediment load. Rainfall in countries around the Red Sea and Gulf of Aden is low so this is not a significant problem. However, rainfall patterns do lead to flash floods in the region and altered land use patterns could have a temporary effect on flash-flood sediment loads.

Sediment problems in reef areas in the Red Sea tend to be associated with coastal development and, if the reef habitat is not destroyed, tend to be temporary in nature. Thus the high level of sediment release onto fringing reefs during construction of the Jeddah north corniche killed many of the corals but there is now evidence for recovery.

Areas of potential concern relate to the discharge of toxic and non-toxic waste materials at sea, see earlier sections.

Direct destruction.

There is relatively limited direct destruction of coral reefs in the Red sea. However, there is locally significant deterioration of coral reefs in the northern Gulf of Aqaba, principally from port related activities such as phosphate loading and accidental spillages, (Fishelson, 1973; Loya, 1975, 1976; Walker & Ormond, 1982) and in the vicinity of Jeddah, Yanbu and Rabigh as a result of coastal development (Ormond et al., 1984a, 1985a, 1985d; Sheppard, 1983b).

Dynamiting of reefs to provide access for seismic exploration for oil is reported from the Egyptian Red Sea. It is reported that there is damage to reefs at Ras Mohammed in Egypt and to Sanganeb reef and the Umbria reef wreck in Sudan through high tourist pressure.

Recreation and tourism.

Coral reefs are of major significance to coastal recreation and tourism in the Red Sea and this is recognised by the Conservation and Management Activities identified earlier.

Recent and current conservation projects.

See the Indian Ocean Coral Reef Directory (in press) for extensive information on conservational activities relating to coral reefs in the Red Sea and Gulf of Aden. See also the section on Conservation and Management Activities, in this report, for information on conservational activities relating to coral reefs in the Red Sea and Gulf of Aden.

Pelagic and Demersal Fisheries

Character.

For all countries bordering the Red Sea and the Gulf of Aden except the Arab Republic of Egypt, most of the fishing is done on a small-scale basis, using traditional crafts, some of which have been motorized. As an example in the Gulf of Aden, South (PDRY), the fleet was composed, in 1978, of 1080 oar/sail hoouris, 689 small sambuks with outboard engines (FAO, 1980a). However, PDRY is proceeding to industrialize its fleet, and at the same date had 13 purse-seiners, 17 modern trawlers plus eleven vessels of a Yemeni/Soviet joint venture. Somalia has also entered into a number of joint ventures, mainly with Italian companies (FAO, 1983a). Somalia is now in the process of reorganising the structure of its fisheries. The South Yemen (YAR) fishery depends primarily on a fleet of 1000 small motorized vessels; a beach-seine fishery for immature sardines and anchovy also exists (FAO, 1976).

Ethiopia's fishery on the Red Sea, is at present mainly at a subsistence level. In 1983, 130 fishing boats were counted, of which less than half were operational, and 22 were motorized (FAO, 1983c). Saudi Arabia's Red Sea fishery is not well developed compared to its Gulf Coast fishery due in part to uneven bottom conditions and the high diversity in fish species (FAO, 1981). About 60% of the boats are dug-out or planked canoes, and most of the rest are 10-15m sambuks. Egypt's fishery is mainly concentrated in the Gulf of Suez, where some 80 purse-seiners and 72 trawlers were in operation in 1980 (FAO, 1980b), as well as 40 motorized launches (10-15m) and 50 non-motorized vessels. In the Red Sea, fishing is mainly done by 25 purse-seiners most of which also engage in some trawling.

For the small-scale sector of the fisheries, hand-lining is mainly used in the Red Sea, exploiting the fish resource of the extensive coral reef habitats. Over 80% of the landings in Sudan result from hand-lining (Sanders and Kedidi, 1981). Shallow-water seins and gillnets are the other main gears used. Beach seines are used in flat and shallow areas of the coast as in Ethiopia, where this method provides most of the catch (Sanders and Kedidi, 1981). In the Gulf of Aden, most of the artisanal fishery is operated by PDRY. Cast nets are used for sardine fishing, hooks and lines for bottom fish and sharks, gill-nets for tunas and seines for beach fishing (FAO, 1980a).

The coastline of the Red Sea is in many areas dominated by coral reefs, which limits operations of modern fishing gears such as trawls and purse-seines. The main areas for those methods are the Gulf of Suez and seine grounds adjacent to the Egypt-Sudan border (FAO, 1980b). In the Gulf of Aden, PDRY has a narrow shelf area, so that the fishery there is geared toward pelagic species.

The monsoon system is a characteristic dominating the whole area. Sharp seasonal patterns in wind and currents provide other constrains to the fisheries, making weather conditions hazardous for small crafts, and causing the availability of different fish species to vary on a seasonal basis (Cushing, 1971; FAO, 1978a, 1978b, 1980a).

Status.

Catch levels have been quite stationary between 1976 and 1981, according to FAO Yearbook (1983b). For most fisheries, actual exploitation level appears to be much lower than the estimated potential. The Ethiopia handline resource seems to be fully exploited and there is little scope for extended exploitation of Egyptian trawling grounds (Sanders and Kedidi, 1981).

Various surveys have been carried on in the late 1960's and in the 1970's in the Gulf of Aden, the main one being the 1975-76 survey of the R. V. Dr Fridtjof Nansen. On the Somali north coast, small pelagics were found to be very scattered. Small scad were found offshore. Demersal biomass was estimated between 67-128,000t, with a maximum during the north-east monsoon (FAO, 1981a). Associated with the same wind-current regime is the appearance of pelagic fishes (sardines, anchovies, mackerel) in inshore waters on the north coast (FAO, 1978b), with the strongest concentrations of sardine schools found off Aden. There is also an annual potential of 20,000t of yellowfin, skipjack and bonito tunas, and 5,000t kingfish (FAO, 1973). The Fridtjof Nansen survey determined that many of the pelagic schools concentrated near the surface, which probably caused an underestimation of the biomass. Trawl fishing yield estimates vary greatly between surveys (see table 4).

In the Gulf of Aden, data of catch and effort are limited to certain fisheries such as tuna, shrimp and deep-sea lobster (FAO 1978b). Improvements in the collection of fishery statistics in other sectors are certainly needed.

Very limited survey work has been done on the pelagic resource of the Red Sea (see Table 4). Seasonal purse-seining is occurring on Egyptian grounds, (October to May), with an annual landing of 16,500t (1979 - 80) composed mainly of horse mackerels, Indian mackerel, round herring and sardinellas. In all other countries of the Red Sea, no commercial fishing by purse seine is undertaken nor has there been any comprehensive survey using this method (Sanders and Kedidi, 1981). However, the pelagic species just enumerated and some tuna species (little and long tail tunas) have been identified as possible target species for a developing pelagic fishery.

Trawling surveys have been done for most countries bordering the Red Sea, mainly to assess shrimp production potential (see Table 4 for demersal catch and potential). The trawl catches are dominated by lizard fish, snappers, elasmobranchs, jacks and mackerels.

Human and economic value.

Figures concerning employment, supply level of fish to the population, total value of landings and value of exports are summarized in Table 5 (over).

Table 4

COUNTRY	LEVEL OF EXPLOITATION PELAGIC (1000 tons)	LEVEL OF EXPLOITATION DEMERSAL (1000 tons)	POTENTIAL YIELD PELAGIC (1000 tons)	POTENTIAL YIELD DEMERSAL (1000 tons)
Somalia (north coast)	Total: 10.00 mostly from offshore operators		40 - 80	10 - 22
Socotra	-	-	40 - 80	10 - 20
South Yemen (PDRY)	44.6	20.4	130 -170	34 - 42 (Fridtjor Nansen, 1975). 80 (FAO survey, 1973).
North Yemen	9.5 (artisanal)	4.0 (artisanal) .28 (shrimp) ? by-catch	10 - 20	5 (non-trawlable grounds). 7.4 (trawlable grounds).
Saudi Arabia	TOTAL 10.2		?	14 - 19
Sudan	.2	.48	?	.03/commercial vessel for shrimp; no assessment for artisanal.
Ethiopia	24	.2 - .3	50* (artisanal) ? commercial	no assessment for trawling; hand-line catch fully exploited.
Egypt	16.5(purse seining) .3 (artisanal)	4.5(trawling) 2.0 (artisanal)	about 26.0 (purse seining); no assessment for artisanal.	about 4.5(trawling) no assessment for artisanal.

* This is a tentative estimate only. Further investigation is needed to ascertain this potential.

Sources: FAO 1981
FAO yearbook of Fisheries, 1983b
Sanders and Kedidi, 1981

TABLE 5

COUNTRY	EMPLOYMENT PRIMARY SECTOR	EMPLOYMENT SECOND SECTOR	PER CAPITA SUPPLY (kg/year)	GROSS VALUE FISHERIES OUTPUT (US $ MILLION)	VALUE EXPORTS (US $ MILLION)
Somalia (1983)	2800 (full) 3600 (occas.)	n.a.	0.2	8.1	7.0
South Yemen (PDRY) (1980)	4906	3777	12.4	38.4	15.2
North Yemen (YAR) (1976)	3578	n.a.	2.1	8.6	0.18
Saudi Arabia (1981)	3250	n.a.	7.6	15.0	1.8
Ethiopia	3780	150	0.1	1.3	negligible
Sudan					
Egypt	n.a. for Red Sea		4.0	25 (total)	1.0 (total)

(Figures from FAO country profiles 1976 to 1983)

For most countries per capita consumption of fish is relatively low. It must be kept in mind that fish consumption occurs mainly in the coastal areas, and that distribution of fish inland is usually very limited. There is thus a scope for expansion of the fishing industry for local consumption. In the case of PDRY expansion can be geared toward exploitation of export products, as the mean per capita supply will probably not increase significantly. In Somalia, most of the catch is presently being imported in dried or frozen form; local demand for fish in this country is very low as 60% of the population is nomadic with traditions in animal husbandry. At the other end of the scale, Egypt has a long tradition of eating fresh fish, although production does not yet meet the demand. With an annual population increase of 2.6%, an increased production and a better utilization of the fish resource are of great importance.

Targeted exploitation.

pelagic fisheries - Purse seining is presently only carried out by Egypt, landing about 16,500t annually. Most of its catch comes from the Gulf of Suez grounds (14,500t), and about 2,000t comes from Foul Bay and along the Southern Coast (Sanders and Kedidi, 1981). The catches from the Gulf of Suez are composed of horse mackerels (60%), round herring (20%), Indian mackerel (6%) and sardinellas (5%). On the southern grounds, sardinellas are dominating the catch (55%), while the Indian mackerel and the horse mackerel account for 20% and 15% respectively.

In the other countries of the Red Sea, the pelagic resource is exploited by the small-scale sector. Composition of the catch varies tremendously from one region to the other, depending on the habitat and on the fishing methods. The catches in Egypt (total about 300t) by seines and small meshed gill nets are composed of the horse mackerels (20%), grey mullets (10%), striped snappers (10%), rabbit fish (8%) and sardinellas (6%). In Ethiopia, beach seine landings (about 23,000t) consist mainly of the spotted herring, anchoveta, grey mullets, jacks and queen fishes. The landings in North Yemen (YAR), by gill netting and trawling, are dominated by Indian mackerel (46%) and Spanish mackerel (19%) in the north, whereas in the south more tunas are found. Sardines and anchovies are caught by beach seine along the entire coast. The total pelagic yield is estimated around 9,500t. The small gill net fishery in Saudi Arabia catches mostly sharks and rays (71%), and various methods in Sudan land shark, grey mullet and giant trevally.

Although South Yemen (PDRY) has a fleet of purse-seiners operating in the Gulf of Aden, 70% of the catch is still taken by the traditional crafts (FAO, 1980a). Sardinellas account for 85% of the total marine landings (55,000t) (FAO, 1983b). Anchovy, Indian mackerel, tuna (mainly Kawakawa: 2,000t in 1982), narrow-barred king-mackerel and shark are the other main species taken (FAO, 1980a; IPTP, 1984). There is little information about the Somali pelagic fishery. The estimated yearly total marine catch, excluding lobster, is around 10,000t (FAO, 1983b).

demersal fisheries - catch levels of demersal resources are indicated in Table 4. Commercial trawling catches in Egypt are dominated by lizard fish (40%); other important species groups are the shrimp (13%), striped snappers (12%), thread fin bream and red mullets (about 5% each) (Sanders and Kedidi, 1981). In the reef fishery, the landings consist of groupers (50%), emperors (25%), breams (7%) and snappers (5%).

No trawlers are now in operation in Ethiopian waters, although trawling has occurred in previous years. Lizard fish and thread fin bream dominated the catch, and shrimp species were found inshore, while red mullet was abundant offshore. Handline catches consist mainly of snappers (57%), groupers (17%), and emperors (15%).

Trawling operations in North Yemen (YAR) are mostly targeted on the shrimp. Demersal fishing with artisanal methods occurs mainly on areas of the shelf not suitable for trawling.

Commercial trawling in Saudi Arabian Red Sea waters started in 1983 with the establishment of a fishing company owned partly by the government, partly by the private sector, (Fish News Int., Dec. 1984). The Red Sea development is based on Japan and fishing operations are aimed at shrimp for export and at fish for local supply. Survey dropline catches were dominated by the sharp-toothed red snapper (49%). Handline catches are a mixture of pelagic and demersal species: mackerels (24%), jacks (15%), red snapper (12%), groupers (9%) grey mullets and emperors (8% each).

Most of the catches in Sudanese waters are a result of handlining in areas adjacent to the offshore barrier reefs. At Port Sudan, the landings mainly include spotted rock cod (15%), red snapper and emperor (about 9% each), and coral trout (4%).

No data on species composition of catch has been found for Somalia.

Although PDRY (South Yemen) has a trawler fleet and a small-scale hook and line fishery, no data have been found on catch composition.

Incidental Exploitation.

Pelagic Fisheries - Pelagic by-catch is difficult to assess in this area, since the fisheries are not targeted toward the exploitation of specific groups of fish. However, certain species are being discarded, due either to a low commercial value or to the lack of market. One instance of this is the shark catch which constitutes about one quarter of the total Egyptian Red Sea catch (FAO, 1982). Development and test marketing of various shark products (skin, meat, etc) has recently been done, and is showing some promise.

Demersal Fisheries - Most of the demersal by-catch is produced by the shrimp trawling industry, as the artisanal sector of the fishery is aimed at a very diverse fauna. See the shrimp fishery section.

Existing Management Policy.

In Somalia, a three-fold approach to fishery development exists (FAO, 1978a) - (1) Rationalization of existing industrial plants; (2) development of the artisanal fisheries; (3) exploitation of deep-sea resources. A marine research station is also being built for research in marine biology, physical and chemical oceanography, marine geology and pollution monitoring.

South Yemen (PDRY) has plans for - (1) the construction of fishing harbours; (2) obtaining some processing plants; (3) the introduction of fibreglass boats and better fishing gear; (4) establish a research and training centre; (5) the introduction of better management techniques. Exploitation of tuna resources is also a priority (FAO 1980a). South Yemen (PDRY) is in the process of building up a trawler fleet for commercial fishing and a fleet of purse-seiners for fish meal. The building of cold stores, ice plants and canning plants is also under way.

The North Yemen (YAR) goal is to provide more fish for local consumption. The government plans to set up fishermen's co-operatives, to build a new fish meal plant, and mainly to operate a training centre by employing international staff to teach locals new methods of fishing and processing. It is felt that such a transfer of technology, as opposed to joint ventures, is fundamental to the development process.

In Saudi Arabia, government efforts to develop the fisheries include the construction of new fishing harbours (FAO, 1981b). Proposals for a marine/brackish water fish farm experimental stations are being implemented near Jeddah. The species selected for farming are fishes fetching high market prices, such as Rabbitfish (Siganids) and Mullets, (FAO, 1980c).

The Egyptian government is attempting to increase the yield from aquaculture. Modification of fishing boats, gear and methods, improvement of marketing and handling, and recruitment and training of fishermen are also on the list of priorities (FAO, 1980b).

In Ethiopia, some basic infrastructure for storage, processing and distribution is now being set up. A fishery research station has been built in 1976 for fish culture experimentation, and there are studies of the fish resource in the Red Sea at Asmara University. An UNDP planning and development project has been started in 1983 for the rehabilitation of the Red Sea Fisheries.

An IOFC development project is underway in the region as a whole, concentrating on upgrading the small-scale fisheries. Its aims are - (1) the development of fisheries technology including aquaculture; (2) the transfer of sccuessful techniques between countries; (3) the improvement of extension and training programmes (IOFC, 1979).

Priority Concerns.

Unlike most other parts of the Indian Ocean, the stocks of fish in this region are still mostly lightly exploited. Current priority concerns are for the expansion and development of the fishery, rather than for conservation and management. There is a need for considerable expansion of such activities as exploratory fishing, and gathering and analysis of landing data. But the most important factor is that the governments of most countries in this area do not have clear-cut policies and programmes to implement these activities.

It has been felt that, in North Yemen (YAR), the training of local people at all levels of the fishing industry (fishing methods, aquaculture, marketing, research) is an essential step for further developments. More efficient methods of fishery and processing are needed for small-scale fisheries without significant cost increases, since fishermen in this sector have a very low income and cannot sustain additional costs.

Priority Recommendations.

Though overfishing is not currently an important issue, experience has shown the need for monitoring of the resource before overfishing is a concern. Attention should therefore be given now to the collection of basic data e.g. catch and effort statistics. The reef habitats are used extensively by the small-scale sector of the fishery. For that reason, studies of reef productivity from a fisheries point of view should be undertaken. These should include comparative work between reefs currently under different regimes of exploitation and unexploited ones. This type of project requires co-operation at the regional level.

Shrimp Fisheries.

Character.

Shrimps are exploited by the commercial trawler industry. However, the importance of shrimp catch in this region is slight compared to the total marine catch. Potential shrimp fishing grounds have been identified in northern shallow waters of North Yemen (YAR), (FAO, 1978a). Most of the trawling operations in Egypt are done in the Gulf of Suez, and most of the Ethiopian shrimp trawling grounds are in nearshore waters between Ras Harb and Ras Darma (Sanders and Kedidi, 1981).

Status.

Shrimp catches have been stationary in the late 1970's and the 80's. Generally this resource appears to be little exploited, mainly for lack of appropriate gear by the small-scale fisheries. Only in Egypt does the demersal fishery exploit the resource near its maximum level. Surveys done in Sudan gave a potential yield figure of 30 tons/vessel, which was considered inadequate for a commercial venture (Sanders and Kedidi, 1981). The potential shrimp catch in North Yemen has been estimated at about 800-1,000 tons per year. A potential of 500t per year of shrimps, lobsters and crabs has been indicated for Ethiopia (FAO, 1983d).

Human and economic value.

Shrimp catches are mostly exported. No separate data for shrimp value have been found.

Targeted Exploitation.

Penaeus semisulcatus is the dominant shrimp species in the Red Sea. In a survey of trawl catches in Sudan, this species accounted for 67% of the shrimp catch, while P. latisulcatus and Metapenaeus monoceros made up 13% and 14% respectively (Sanders and Kedidi, 1981). Other important species are P. japonicus and Metapenaeus ensis.

The present catch levels (FAO, 1983b) are of 6,000 tons in Egypt, estimated 400 tons in Ethiopia and an estimated 28 tons in North Yemen (YAR), 280 tons, also estimated, in North Yemen (YAR). No figure has been found for the Red Sea catch of Saudi Arabia, but most of the shrimp exploitation in this country occurs on its Gulf coast (FAO, 1981b). Catches in other countries are negligible.

Incidental Exploitation.

The trawl fisheries do not usually concentrate their fishing effort on one particular species or group. The section "targeted exploitation - Demersal fisheries" gives details of species composition of the trawl landings and Table 4 provides catch levels. Only the experimental shrimp trawling in Sudan gives details of the by-catch: it included gobies (45% of the by-catch), pony fish (12%), lizard fish (12%), spade fish (9%) and sweetlips (8%). It was considered that this by-catch had no commercial value (Sanders and Kedidi, 1981).

Existing Management Practice.

South Yemen (PDRY) is in the process of building a trawler fleet (FAO, 1978a). The extent to which the effort of this fleet will be directed at the shrimp resources is unknown. At present, for all the countries in the region, management and development plans for shrimp resources have not been separated from those for other fisheries.

Priority Concerns.

The Egyptian trawler fishery in the Gulf of Suez may have already exceeded the sustainable yield level of demersal resources in general and of the shrimp stocks in particular. Nothing is known on the effect of extensive trawling activities on demersal habitats.

Priority Recommendations.

Detailed analysis of catch and effort data is needed to adequately assess the status of the shrimp fishery in the Gulf of Suez. This type of study would provide a basis for management action prior to further expansion of the shrimp fishery. Research on the effects of trawling on the productivity of benthic habitats is also recommended.

Other Crustacea

Character.

In the Red Sea and the Gulf of Aden, the shallow water lobster, Panulirus penicillatus and P. ornatus have been taken in small quanitities for many years by local divers (Fish News Int. October 1983). In 1969, two deep-sea lobster species have been discovered in waters of South Yemen (PDRY), (Peurulus sewelli and P. carinatus). They are abundant at depths of 150-600 meters in the coastal areas of Mahara and Ras Fartuk, and at Socotra Island. New grounds for this fishery have also been found on the north coast of Somalia (FAO, 1978a).

Status.

No trend data are available for the shallow water species. The deep-sea lobster stock in South Yemen (PDRY) is estimated at 3,000 tons (Fish. News Int. October 1983), with an annual potential yield of 500-600 tons of lobsters tails (FAO, 1978a). Yemeni production has dropped in the last 4-5 years, and it is felt that over fishing might be the cause.

Human and economic value.

Deep-sea lobsters are fished for export. No value figures have been found.

Targeted Exploitation.

Commercial production of deep-sea lobsters started in 1971. The annual yield is now of 200-300 tons of lobster tails, which represent 30-40% of total lobster weight (Fish News Int. October, 1983). In Somalia, Panulirid lobsters are exploited, with an estimated catch of 836 MT in 1981 (FAO, 1983b). Level of catch in other countries is not available.

Existing Management Policy.

Alarmed by the decrease in deep-sea lobster production, the Ministry of Fish Wealth in South Yemen (PDRY) has introduced a number of restrictive measures: no more than four large vessels are allowed to fish during the lobster season (November to April), and no fishing is allowed on berried females, (Fish. News Int. October, 1983).

One of Somalia's priorities is to develop its deep sea resources.

Priority Concerns.

In general lobster populations are known to be very sensitive to intensive exploitation. Over-exploitation is likely to be the reason for the decrease in deep-sea lobster production in South Yemen (PDRY). Lobster resources on other deep-sea grounds, such as on the north coast of Somalia should be carefully assessed prior to any increase in fishing effort.

Although it is known that shallow water lobster species are exploited by diving, the level of this exploitation and its effect on the stocks are undocumented.

Priority Recommendations.

A recommended project is the assessment of the deep sea lobster stocks. Present management policies should be observed until more is known on these stocks.

The effect of lobster exploitation in shallow water reefs could be studied as part of a global project on reef productivity (see Pelagic and Demersal Fisheries section).

Marine Mammals

Character.

The cetacean fauna of the Red Sea has not been studied in any great detail, but, from records which are available, it seems that many of the species which occur in the Indian Ocean also occur here. The submarine sill at Bab-el-Mandab which, to a certain extent, isolates the water mass of the Red Sea from that of the Indian Ocean, may also provide a barrier to the movement of some of the deepwater species. In the Gulf of Aden Somalia has been host to one of only two strandings of the most elusive cetacean of all Mesoplodon pacificus, (Azzarolli, 1968), the only other record of which was from Australia. Mesoplodonts are deep water species and so these presumably occur only on the ocean side of the Bab-el-Mandab sill. The only non-cetacean marine mammal present is the dugong, which feeds on seagrass beds.

Status.

The status of most of the marine mammals in this area is unknown. There has never been much exploitation of cetaceans in this area, except off the south eastern coast of South Yemen (PDRY) and the south coast of Oman, where there was a sperm whaling ground in both the last century and the early years of this century (Townsend, 1935). With the introduction of the whale sanctuary in the Indian Ocean, the status of most of the larger species in the Red Sea and Gulf of Aden is presumably secured. The exception in all of this is the dugong. Again, its status is not at all clear, but this area has never supported high densities of these mammals at least in part due to the relatively limited extent of seagrass beds. The exception may be in Djibouti where relatively lush seagrass beds may support a higher dugong population. Robineau and Rose (1982) report one dugong herd of 30 animals, which they state, is the largest ever recorded in the Red Sea.

Targeted Exploitation.

There is no targeted exploitation of marine mammals in this area and Muslim law helps to reduce the likelihood of the development of any such exploitation.

Incidental Exploitation.

There are apparently no records of incidental captures of cetaceans in this area, although clearly these are possible. Species most likely to become caught in nets might be Sousa chinensis, the Indo-Pacific hump backed dolphin, a coastal species known to occur up to Suez, as well as bottlenose and common dolphins, both of which are numerous in coastal waters. Most incidental exploitation is undoubtedly concerned with dugongs, which, although apparently not numerous in this area, are caught throughout their range. Robineau and Rose (1982) provide documentary proof of three such captures.

Oil Industry.

In this area there is clearly some threat to all forms of marine life from the oil industry. To date there do not appear to be any reports of this affecting marine mammals. However, tar balls and oil spills undoubtedly do affect those dugongs, which frequent shallow inshore waters.

Recreation and Tourism.

The tourist potential of marine mammals has not been investigated. The main tourist area is in the northern end of the Red Sea, around Sinai. It is possible that developments here may have affected dugong populations, but this is not known. The fact that fin whale bones have been discovered in the Red Sea (Tomilin, 1957) indicates that at least some of the large baleen whales may occur here, and there is a remote possibility that these might be of interest to the tourist industry.

Existing Management Policy.

None known.

Existing Management Practice.

There appears to be no direct threat to cetaceans in this area. Dugongs are probably taken in small numbers by coastal fishermen.

Priority Concerns.

So little is known of the status of any of the marine mammals in this area, that before any other concerns can be expressed, an attempt must be made to ascertain the numbers of animals and species present. The dugong in particular deserves special attention, as it is probably the only species undergoing any harassment.

Priority Recommendations.

The dugong is threatened throughout its range, and in this relatively under-peopled area very little is known of its status or the threats to existing populations. Clearly the first stage in any conservation plan for dugongs in the area is to survey the area thoroughly, and assess the threats to the dugong population.

Turtles.

Character.

The marine turtles spend the whole of their life in the sea, except when the mature females come briefly ashore to lay their eggs on sandy beaches. The eggs take about two months to hatch when the young dig their way out of the sand and then scramble down the beach to the water. In general marine turtle nesting is concentrated on a restricted number of beaches where conditions are favourable. Hence these breeding beaches are critical to the survival of the species and should be conserved.

Green and hawksbill turtles tend to nest every two or three years but they may nest several times in those years when they do nest (Ross, 1979).

Between breeding seasons green turtles undergo extensive migrations. Ross and Barwani (1981) report that a turtle tagged at Ras al Hadd (Oman) was found in the Red Sea at Assab (Ethiopia); it had migrated a distance of 2,220km in three months. Hirth and Carr (1970) report 5 returns in south Somalia from green turtles tagged in South Yemen (PDRY). The significance of such long distance green turtle migrations to the survival of the Red sea population of this species is not known.

There is even less information about the extent of migration of hawksbill turtles, and Ross (1979) and Frazier (in press) suggest that at least part of hawksbill turtle populations disperse only more locally.

Of the two species which breed in the area the hawksbill is an omnivore (Bustard, 1972), feeding largely on molluscs, jellyfish, crustacea, and also on marine algae, but Phillips and McRoy (1980) report that it feeds on seagrass leaves as a juvenile. It is also reported that hawksbill feed mainly on sponges suggesting that they may be particularly dependent on coral reef areas. The green turtle is fully herbivorous and feeds on various species of seagrass (Phillips & McRoy, 1980) and algae, particularly Sargassum spp., (Ross, 1979).

Occurrence/distribution.

All 5 species of pantropical marine turtles are reported from the Red Sea and Gulf of Aden but only the green and hawksbill turtle are reported to occur and to nest in any significant numbers. Most of the reported turtle nesting in the Red Sea occurs on offshore islands which contrasts with the situation in South Yemen (PDRY), and Somalia. The Red Sea and Gulf of Aden may support internationally significant populations of breeding hawksbill turtles and nesting densities of the green turtle along the coast of South Yemen (PDRY) may make these beaches some of the most important green turtle nesting beaches in the world.

North Gulf of Aqaba - there is no record of nesting in Jordan or the north Egyptian Sinai.

Egypt - There have been limited sightings of green turtles and low levels of nestings reported (Frazier & Salas, 1984), which may be a consequence of the limited available food resource. Hawksbill turtle nesting is reported

from Tiran and Sinafar Islands (Ormond et al., 1984a, 1984c) and from Islands to the north of Hurghada such as Gubal el Sagir and Shadwan (Frazier & Salas, 1984). These authors suggest a figure of 500 nesting hawksbill turtles for the Egyptian Red Sea which is high by world standards.

Saudi Arabia - Ormond et al., (1984a, 1984c) report internationally significant levels of hawksbill nesting from islands in the northern Saudi Arabian Red Sea and from islands in the outer Farasan bank (1984a, 1985c, 1985d). Green turtle nesting also occurs in similar locations. Nesting densities of 100 green turtle females per year are reported from a coastal site just north of Yanbu, (Ormond et al., 1984a, 1985a).

Sudan - Hirth and Abdel-Latif (1980) report some of the highest hawksbill turtle nesting density known anywhere, from Seil al Kebir in the Suakin archipelago.

Ethiopia - Green turtle nesting is reported from the Dahlak Archipelago (Urban, 1970).

Djibouti - Apparently no major breeding sites occur, but turtles reportedly often nest and green and hawksbills are sold in markets, (ref: Interim report, WWF-Netherlands Indian Ocean Sperm Whale study).

North Yemen, (YAR) - Walczac (1977) identified possible nesting areas in North Yemen waters. Ross and Barwani (1981) report that 3 species of turtle (of which only green turtle are identified) nest on Kamran Island in large numbers.

South Yemen (PDRY) - High levels of hawksbill and green turtle nesting are reported from South Yemen (PDRY), (Hirth & Carr, 1970). They report that Ithmun and Sharma beach must be counted as some of the most important green turtle nesting beaches in the world. 10,000 females are reported to nest in South Yemen each year (Ross & Barwani, 1981). Several hundred female hawksbill turtles are reported to nest at Jabal Aziz/Perim each year (Ross & Barwani, 1979). Ehrenfield (1981) reports that Jabal Aziz should be given high conservation priority by reason of its large population size.

Somalia - Kar and Bhaskar (1981) report that several thousand green turtles are likely to nest along the Somali coast.

Conservational status.

The status of turtles in the Red Sea and Gulf of Aden is improving with reference to the level of direct exploitation. Turtles, particularly hawksbill, were much more heavily exploited in the past. However, indirect exploitation and habitat destruction are on the increase and priority should be applied to the protection of turtle nesting and feeding areas.

Nearly all the species of marine turtle are now regarded as threatened species. Hawksbill and green turtles are both regarded as endangered (the loggerhead is regarded as vulnerable), (Groombridge, 1982). Both the hawksbill and the green turtle are also listed in appendix 1 of the CITES Convention (Convention on International Trade in Endangered Species of Wild Fauna and Flora. The BONN convention on the Conservation of migratory species of wild animals includes turtles. See the Conservation and Management Activities section of this report for additional information.

At one time the number of hawksbill turtles, E. imbricata in the Red Sea must have been immense. Present population levels probably reflect this historic exploitation (Hirth and Abdel-Latif, 1980).

It could be argued that E. imbricata in the Red Sea is under pressures not experienced elsewhere in its range because nearly a third of the eggs produced are not viable (Frazier & Salas, 1984).

Egypt - Ross and Barwani (1981) report that all species of turtle are in decline in Sinai. Frazier and Salas (1984) suggest that there is insufficient evidence to determine whether or not there is a current decline in numbers of turtles in the Egyptian Red sea.

Sudan - Hirth an Abdel Latif (1980) report that there was a heavy historic exploitation of turtles in Sudan but that present day exploitation is slight.

Saudi Arabia - Present exploitation of turtles in the Saudi Arabian Red Sea is slight (Ormond et al., 1984a-c, 1985a-d).

North Yemen (YAR) - Walczak (1977) reports that there is little change in the turtle population of North Yemen (YAR) and that the present status of turtles in this country is probably good.

South Yemen - Ross and Barwani (1981) report a high level of exploitation of turtles. They suggest that if this level of exploitation continues the nesting population may be depleted. In addition they report that 40% of green turtle eggs do not hatch (see reference to hawksbill fecundity above).

Somalia - Although exploitation for export may have reduced reproduction levels during the 1960's and early 1970's the turtles in Somalia seem to be less disturbed than those in many other populations (Kar & Bhaskar, 1981).

Table 6. International laws indicating signitories (+) of relevance to turtle protection in the region.

Country	(1)	(2)	(3)	(4)	(5)
Israel	+	+			
Jordan	+				
Egypt	+	+	+		+
Saudi Arabia					
Sudan	+		+		
Ethiopia					
North Yemen(YAR)					
South Yemen(PDRY)				+	
Djibouti			+	+	
Somalia		+			

1. Convention on International trade in endangered species.
2. Bonn convention on conservation of migratory species.
3. African convention on the conservation of nature and natural resources protects turtles but not eggs.
4. In 1980 the Indian Ocean alliance adopted a recommendation for an IUCN project for conserving marine turtles in the region.
5. Fully designated protected area includes protection of turtles.

Human and economic value.

In the past exploitation of turtles for turtle (tortoise) shell was a significant economic factor in the region. However, international legislation, particularly CITES and the BONN convention (see above) has resulted in a reduction in export markets and exploitation of wild populations (Mack et al., 1981). Re-creation of an export market based on the aquaculture of specimens from the wild is not considered to be acceptable from a conservation viewpoint at this time.

Turtles are exploited at a low subsistence level and are generally incidental to other catches. They also have a cultural, scientific, and educational value that should not be underemphasised.

Targeted exploitation.

There is evidence for high historic exploitation of turtles in the Red Sea and Gulf of Aden in the last 100 years particularly to provide turtle shell (Frazier & Salas, 1984; Hirth & Abdel-Latif, 1980).

Hirth and Carr (1970) refer to indefinite plans to build a fishmeal factory at Sharma (a major green turtle nesting beach in South Yemen (PDRY) and this may result in direct exploitation of this turtle population. For example Ross and Barwani (1981) report that 800-4,000 turtles were exploited per year in South Yemen (PDRY) during the period 1964-1974 (4,000 in 1970) and a minimum of 400-700 in 1973. However, in the late 1970's there has been a general decline in direct exploitation of turtles in the region (Mack et al., 1981) as reflected by export/import figures. Small numbers of turtles are exploited for sale as souvenirs, for example in Egypt, (Barratt, 1982). Some human communities collect eggs and turtle meat for food at a low level throughout the Red Sea and Gulf of Aden and particularly in South Yemen (PDRY). This type of fishing pressure is likely to increase as development proceedes and more people use the coastal zone.

In Somalia the turtle pupulations are less well known. Chelonia mydas, again, is thought to be the only common species. Concentrated nesting has been recorded, and Frazier (1981) has estimated that several thousand might be likely to nest in Somalia as a whole. Rich seagrass pastures are presumed to support resident populations of green turtles. In the late 1960's and early 1970's turtle populations are known to have been exploited for export, but the populations are less disturbed here than in many places, even though there are no reserves or legal protection, (Frazier, 1981).

Overall, exploitation of sea turtles by humans in this region is at a relatively low level. People living in all the coastal areas are known to make use of turtle eggs, but nowhere is this an organised or systematic exploitation. Adult turtles are little affected, except in South Yemen (PDRY), where hundreds, or thousands of adults are taken for meat export. Protection of sea turtles is helped by Muslim laws concerning their consumption. However, Ross and Barwani (1981) have pointed out that the current large populations are unlikely to remain so under any sustained commercial exploitation for local consumption or for export, not least because the turtle productivity of the area is thought to be relatively low as sub-optimal conditions exist for all species.

Incidental exploitation.

A great cause for concern at this moment in time is the increase in indirect exploitation of turtles as coastal development takes place.

fishing - there is little information on the incidental capture of turtles in the Red Sea and Gulf of Aden but it is probably limited (Hillestead et al., (1981). A system for reducing incidental capture of turtles during trawling is suggested (Seidel & McVea, 1981). Dynamiting for fish may incidentally kill off some turtles (Frazier & Salas, 1984).

fertility - Hirth and Carr (1970) report that some 40% of green turtles on South Yemen (PDRY) beaches do not hatch. Frazier and Salas (1984) report that nearly 30% of hawksbill turtles in the Egyptian Red Sea do not hatch and suggest that this may be due to some unknown stress.

predation - Hirth and Carr (1970) report high levels of predation of young turtle/eggs by feral dogs. Ormond et al., (1984a, 1985a) report predation of young turtles/eggs by foxes in Saudi Arabia.

development - coastal development and associated lighting may inhibit breeding and confuse young turtles when they break out of the nest (Witham, 1981). One possible area of concern is the green turtle nesting beach near Yanbu in Saudi Arabia (Ormond et al., 1984a, 1984b, 1985a). In addition development can cause direct habitat destruction of nesting beaches and feeding areas and effects of oiling and oil exploration, (see below).

Oil industry.

There are a wide range of potential impacts to turtles likely to result from a major oil spill in the Red Sea or Gulf of Aden. At the present impacts are fairly limited/localised.

Explosions associated with seismic exploration for oil may incidentally kill turtles (Frazier & Salas, 1984).

Crude oil is reported to cover Gubal el Sagir which is said to be the best hawksbill turtle nesting beach in the Egyptian Red Sea outside of Shadwan (Frazier & Salas, 1984).

Waste discharge.

Consumption of plastic bags may be a problem as has been reported for leatherback turtles Dermochelys coriacea (Oryx, April 1983, p. 96.). Beach littering by plastic bags etc. is extensive in the Red Sea and Gulf of Aden.

Birds.

Character.

Most of the birds to be found around the shores of the region, on the shore itself, and further inland, are Palaearctic in distribution and occur in other parts of Europe and/or north Asian land masses (Mackworth-Praed & Grant, 1957; Harrison, 1982; Jennings, 1981). This is particularly true of the common waders most of which are the same species, though they may occur in lower numbers, as are found on the European, Mediterranean, and Atlantic coasts. Some of these species are in their wintering range in the Red Sea and Gulf of Aden whilst others are migrants on passage from northern Eurasia to eastern and southern Africa.

By contrast the seabirds are all Indian ocean and tropical species some of which occur throughout the region whilst the range of others extends only a certain way north.

Occurrence and extent.

For further information on the occurence and distribution of seabirds in the Red Sea and Gulf of Aden see Gallagher et al., (1984). Sixteen species of seabirds breed on islands and coasts in the region, and one other may do so as well, of these sixteen species of seabird six species and four sub-species are endemic to the region.

The seabirds of the Red Sea and Gulf of Aden appear to be divided into three separate groups. One group contains widespread tropical species. A second smaller group comprises northern Indian Ocean species found only on the coasts of Arabia, northern east Africa and, perhaps north-western India. In this group just one or two species appear to be effectively endemic to the Arabian area - the White eyed gull, Larus leucophthalmus being the principal example. The sooty gull, Larus hemprichii, the brown noddy, Anous stolidus plumbeigulans, the white-cheeked tern, Sterna repressa, Saunders' tern, Sterna saundersi, and the crab plover, Dromas ardeola are restricted to the Red sea and northern Indian Ocean. The third group of which the Caspian tern Sterna caspia is the best example, comprises widespread, though not necessarily common, species occurring in both temperate and tropical latitudes.

White-eyed gull - Larus leucopthalmus is endemic to the coast of north-east Africa and parts of Arabia. The species is at its geographic limit in the Egyptian Red Sea (Heathcote et al., 1984). However, observations (Moore & Balzarotti, 1983; Ormond et al., 1984a) suggest that it may have a more northerly than southerly distribution in the region. Clapham (1964) reports colonies of the white-eyed gull from the Dahlak archipelago, Ethiopia. So far as it is known the white-eyed gull breeds only in the Red Sea and Gulf of Aden (Tuck & Heinzel, 1978; Gallagher & Woodcock, 1980).

The white-eyed gull is a candidate for future Red Data book treatment, (Collar and Stuart, 1985). Its endemism to the area merits great emphasis. A full account is given in Cramp and Simmons, (1983).

Sooty-gull - Larus hemprichii is endemic to the coast of north-east Africa and parts of Arabia, (Heathcote et al., 1984). Ormond et al., (1984a, 1984c, 1985a-d) report the sooty gull to be fairly common in the Red Sea waters of Saudi Arabia. They report the first breeding record for Saudi Arabia from Al Hala island in the Farasan bank. However, fledged juveniles were seen throughout the region and there is evidence to suggest that breeding is not uncommon in the region. Clapham (1964) reports colonies of the sooty gull from the Dahlak archipelago, Ethiopia. A full account of the incidence of sooty gull in the region is given in Cramp and Simmons, (1983).

White-cheeked tern - Sterna repressa is endemic to the northern Indian Ocean area, occurring only in the Red Sea, Arabian Gulf, northern East Africa, and western India. The white-cheeked tern is a common breeding summer visitor to both the Red Sea and Arabian Gulf (Jennings, 1981; Moore & Balzarotti, 1983; Basson et al., 1977). 200-500 breeding pairs are reported from the adjoining coasts and islands off Hurghada in the Egyptian Red Sea (Heathcote et al., 1984).

Saunders' tern - Sterna saundersi breeds in the Red Sea, Arabian Gulf, Arabian Sea, East Africa and North West India (Gallagher & Woodcock, 1980). It is one of the less common terns in the region.

Crab plover Dromas ardeola - this species nests by burrowing into the ground. 20-40 pairs are reported breeding on islands off Hurghada in the Egyptian Red Sea (Heathcote et al., 1984).

A number of other species have significance because they are notably abundant and breed regularly in the region.

There is the Osprey Pandion haliaetus. Osprey are noted for high density (c. 50 pairs) on Tiran and adjacent islands in the northern Red Sea (Safriel et al, in press). Ormond et al, (1984a, 1984c, 1985a-d) report on the widespread occurrence of Osprey and Osprey nesting in the Saudi Arabian Red Sea region.

The Sooty Falcon, Falco concolor, has its breeding restricted to the Middle East though it winters in southeast Africa and Madagascar. Several records of breeding populations have appeared in the literature; from the Dahlak archipelago in Ethiopia, (Clapham, 1964); from the Egyptian Red Sea, (Barratt, 1982; Heathcote et al, 1984); and from the Saudi Arabian Red Sea, (Jennings, 1981; Ormond, et al, 1984a).

It is also worth identifying the African collared dove Streptopelia roseogresea, and the brown booby, Sula leucogaster, (Ormond et al., 1984a), in the category identified above.

The Spoonbill, Platalea leucorodia is recorded as breeding in the Red Sea, (Heathcote et al, 1984; Ormond et al, 1984a; Collar and Stuart, 1985). The species has not been reported breeding regularly elsewhere in the African Western Palearctic region.

The Red Sea Cliff Swallow Hirundo perdita was described only last year from a single specimen killed at a light on a reef near Port Sudan. Its breeding quarters are unknown and it is unlikely to be specifically associated with the marine or littoral environment, (Fry and Smith, 1985).

The Northern Bald Ibis Geronticus eremita is reported to use mangroves for roosting in the Red Sea region, (Collar and Stuart, 1985).

Coastal wetlands along the Red Sea and Gulf of Aden support large numbers of resident and migrant waders and may well have international significance for a number of species. Finally a number of birds of prey (in addition to the Sooty falcon) follow passerines through the Red Sea and Gulf of Aden on their annual migration.

Conservational status.

There is virtually no information on the conservation status of birds in the Red Sea and Gulf of Aden region. However, there is no reason to suppose that it is not good except for certain migrant raptors. Nevertheless, several birds found in the area have international significance and efforts should be made to protect them. This is especially the case for those species that are easily disturbed during nesting since the level of disturbance is likely to increase as coastal development leads to increased use of the coastal zone. Gallagher, et al. (1984), suggest that the brown booby and bridled tern may be threatened in the region.

For further information on National and International regulations of relevance to the conservation of birds in the region see the section on Conservation and Management Activities in this report.

Human and economic value.

As can be seen several birds are endemic to the region and, therefore, have international conservational significance.

Most of the birds of the region have relatively little commercial value. Resident doves and migrant passerines are trapped for food and, perhaps most significantly, there is a great deal of money to be made from trapping, and selling for falconry training, certain species of migrating birds of prey as they pass through the region.

Birds have value as indicators of the state of the environment and this is particularly the case for those birds at the top of the food chain.

Targeted exploitation.

Resident doves and migrant passerines are trapped for food. Certain species of migrant predatory bird are trapped for training in falconry. In the former case exploitation may well increase as coastal development leads to increased human use of the coastal zone. In the latter case an increase in exploitation is likely to be catatrophic to the population.

Oil industry.

There is limited evidence of significant damage to bird populations at this time from oil pollution. However, most birds in the area are directly, or indirectly, dependent on the sea and coastline for feeding and breeding. Heathcote et al., (1984) suggest that a large oil spill affecting nesting areas could have a catastrophic effect on several breeding birds and could seriously reduce or eliminate some species.

Waste discharge.

There is evidence to suggest that sewage discharge into coastal lagoons in some regions actually improves the densities of wading birds (Ormond et al., 1982a, 1982b, 1984a, 1984b). However, these areas are also likely to be polluted and this may have possible side effects on the birds. Several species of birds (particularly the gulls) feed on the extensive piles of uncovered rubbish that are associated with many towns in the region.

Habitat destruction.

See the section on mangroves. A number of birds breed in mangrove in the region most notably the pink backed pelican (Pelecanus rufescens) (Jennings et al., 1982). An even greater number roost and shelter in the mangroves. A number of cases are reported of deterioration of halophytes on offshore islands in the Farasan bank in the Saudi Arabian Red Sea (Ormond et al., 1984a, 1985c, 1985d). Several species of birds, particularly the brown noddy, brown booby, and bridled tern, use these halophytes for nesting.

Cephalopods

Targeted Exploitation.

Commercial fishing of cuttlefish by Japanese trawlers started in 1967 in all coastal waters between Oman and Somalia, then became concentrated along the coast of South Yemen (PDRY), (Hotta, 1983). Four species are found, the most abundant being Sepia pharaoni (95%). The other species are S. savignyi, S. prashadi and Sepella inermis. The total catch of cephalopods increased from 500 tons in 1972 to 4,000 tons in 1977 (Sato and Hartanata, 1983) but sharply decreased thereafter to 2,200 tons in 1980 due to drop in catch per unit effort.

South Yemen (PDRY) is also engaged in cuttlefish exploitation under a South Yemen (PDRY)/USSR joint venture. In 1981, its total cephalopod catch was estimated at 9,619 MT. Egypt also has a small cuttlefish fishery in the Red Sea, with total catches fluctuating slightly around the 1981 figure of 184 MT (FAO, 1983b).

CONCLUSIONS AND RECOMMENDATIONS

General.

The environment of the Red Sea and Gulf of Aden is, as yet, in relatively good condition. This situation can generally be attributed to the low human population in the coastal zone.

However, as the region is exploited for its mineral resources and its real estate, and as the pace of urban and industrial development continues to accelerate, there are increasing indications of significant deterioration. Most of this deterioration is avoidable provided that appropriate national and regional "conservation with development" plans are formulated, monitored and enforced.

The fundamental question is whether it matters if the environment deteriorates as a result of development. The answer is 'yes', because the prime objective of development is the improvement of the quality of human life and this becomes increasingly difficult in a deteriorating environment.

Priority Concerns

National.

General	-	Provision of trained personnel. Provision of monitoring/enforcement facilities.
Jordan	-	Effects of coastal development and associated impacts: Phosphate. Sewage. Tourism.
Egypt	-	Impacts due to: Oil pollution. Increasing tourism. Militarisation of coastal zone.
Saudi Arabia	-	Habitat and Resource loss due to: Development of sharms and mersas. Increasing coastal population and expansion of residential areas. Recreational use of the coastal zone. Possible effects of deep sea mining.
Sudan	-	Effects of: Intensification of fishing. Tourism. Oil Exploration. Possible effects of deep sea mining.

Ethiopia	-	Absence of environmental safeguards due to military/political situation. Famine in part of country requires the rational development of the fisheries on a sustainable basis.
Djibouti	-	Effects of oil exploration/development.
North Yemen (YAR)	-	Effects of: Intensification of fishing. Tourism. Unplanned coastal development.
South Yemen (PDRY)	-	Management of fisheries on a sustainable basis.
Somalia	-	Management of fisheries on a sustainable basis. Effects of intensification of fisheries on critical habitats and key species.

Regional.

Ratification of regional conventions and international agreements concerning:

Oil Pollution.

Deep sea mining.

Dumping at sea.

Development of existing regional trust funds for the environment in which national contributors recognise the disparity in wealth between countries in the region and the importance of regional funding for national conservation activities since these activities will maintain the general environmental quality of the region as a whole.

Recommendation for Action

General/Regional

Pursue ratification - of the Jeddah Convention of 1981 and develop its recommendations.

Fund national and regional activities - needed to meet the obligations identified in the regional conventions within the framework of the Regional Seas Programme.

State of environment report - initiation of a 5-yearly state of the marine environment report.

National

Jordan
- Develop the proposed plan for the Aqaba coastal zone incorporating the establishment of marine park and reserve areas.
- Initiate an environmental impact assessment scheme for coastal zone activities.
- Develop, monitor and enforce air and water quality standards.
- Continue to develop public awareness/educational programmes to identify the Aqaba region as a national recreational area with nationally significant biological resources.

Egypt
- Continue with the designation of protected areas and the training of personnel for monitoring and enforcing regulations within each protected area.
- Develop, monitor and enforce environmental standards for oil exploration and transport.
- Develop public awareness of the economic value of conserving the region for national and international tourism.
- Identify the location and extent of critical marine habitats along the Egyptian Red sea coast.
- Develop a comprehensive marine resources data base.
- Develop a comprehensive coastal zone management plan.

Saudi Arabia
- Pursue the ratification of the various EPCOMM resolutions and follow up the programmes identified by those resolutions.

Sudan
- Continue developing fisheries potential on a sustainable long term basis.
- Continue developing local expertise/facilities in marine sciences.
- Pursue the establishment of Sanganeb as a test case marine national park to identify the requirements for conserving this and other important national sites.
- Identify the location and extent of critical marine habitats along the Sudanese Red Sea coast.
- Develop a comprehensive marine resources data base.

Ethiopia
- Continue developing fisheries potential on a sustainable long term basis.
- Identify the location and extent of critical marine habitats along the Ethiopian Red Sea Coast.
- Initiate further development of the Dahlak archipelago as a protected area.
- Develop a comprehensive marine resources data base.

Djibouti
- Initiate an environmental impact assessment scheme for coastal zone activities.
- Develop, monitor and enforce environmental standards for oil exploration and transport.
- Continue developing local expertise/facilities in marine sciences.

North Yemen (YAR)
- Continue developing fisheries potential on a sustainable long term basis.
- Continue developing local expertise/facilities in marine sciences.
- Identify the location and extent of critical marine habitats along the North Yemen Red Sea Coast.
- Develop a comprehensive marine resouces data base.

South Yemen (PDRY)
- Continue developing fisheries potential on a sustainable long term basis.
- Continue developing local expertise/facilities in marine sciences.
- Develop a strategy for the management and conservation of sea turtles in the region.
- Identify the location and extent of critical marine habitats along the Coast.
- Develop a comprehensive marine resources data base.

Somalia
- Continue developing fisheries potential on a sustainable long term basis.
- Continue developing local expertise/facilities in marine sciences.
- Identify the location and extent of critical marine habitats along the Somali coast of the Gulf of Aden.
- Develop a comprehensive marine resources data base.

Project Recommendations

Recommendations are presented for six projects, all of regional significance, but to be carried out within particular national waters. They have been identified either to highlight the overwhelming urgency of certain projects which may already have been proposed and/or established under regional or national programmes, or to indicate particular important or strategic gaps in work, where a project or projects established under broader international sponsorship could make a major contribution towards, or otherwise serve to stimulate, the resolution of priority environmental problems.

Marine resource and critical habitat surveys - Somalia, Sudan, North Yemen (YAR), South Yemen (PDRY), Ethiopia.

There is an increasingly urgent need to undertake broadscale surveys to determine the exact extent and status along the coasts of Somalia, Sudan, North Yemen, South Yemen and Ethiopia of renewable marine resources (essentially demersal fisheries) and of critical habitats i.e. coral reefs, seagrass and algal beds, mangrove stands, islands, etc, which are essential for fisheries management and/or for species conservation. Urban and industrial development of the coasts of the region is proceeding with increasing speed, necessarily involving loss of natural habitat. Yet for these areas insufficient information exists to allow the importance of particular sites or areas to be assessed either individually or in relation to the distribution of resources and habitats along the whole coast of the country or region. Given this information it should be possible to plan developments to avoid the areas of habitat of special value for fisheries or conservation, tourism or recreation, education or science. This data should also assist in planning the use and management of the coastal zone and of its renewable resources.

Such survey work has now been undertaken in Saudi Arabia, and also in Jordan and northern Egypt; comparable surveys should be regarded as an important priority for North Yemen, South Yemen, Ethiopia and Sudan, and especially for Somalia - the northern centre of which has a diverse and abundant marine flora and fauna of which almost nothing has been documented scientifically.

The Management of Reef Fisheries and Resources - Egypt, Saudi Arabia, Sudan.

As in other parts of The Indian Ocean Region, a topic of increasing urgency is the management of reef fisheries and resources to provide an optimum sustainable yield of fish, shellfish and other invertebrates, while retaining a habitat which is both productive and of value for recreation, tourism, conservation and science. In the nothern parts of Egypt, and close to centres of population in other countries of the Red Sea and Gulf of Aden stocks of commercial reef fish (e.g. Serranids, Lutjanids, Lethrinids) are already noticeably reduced by intense fishing, and it seems likely that in some areas optimum sustainable yields may already have been reached or surpassed. Little if anything is known, especially in this region, of what optimum fishing effort may be, or of how growth and recruitment and composition of stocks may be influenced by fishing pressure.

It is recommended that research should be undertaken to compare the fish stocks of comparable heavily-fished and lightly-fished reefs using visual censoring techniques, paying particular attention to numbers, size, species composition and recruitment and the relationship between visually apparent stock and catch rate. Ideally potential catches should also be linked to primary and secondary productivity of reef areas.

The project should also involve consideration of how fisheries' management policy might be developed to achieve optimal use of reef resources through cooperation and collaboration with fishermen, villagers, and tribal and local authorities in each area.

It is suggested tha such a project might involve comparative studies in Egypt, Saudi Arabia and Sudan, or be undertaken in any one of those countries.

Baseline and Management Surveys of Potential Management and Conservation Areas (Marine Parks and Reserves) - Egypt, Saudi Arabia.

It is recommended that support should be given to proposals for baseline surveys of areas already identified as candidate sites for marine parks or reserves. Such surveys do not necessarily need to be exhaustive, but should be sufficiently detailed as to provide reliable identification of:

extent - of coastal and sublittoral habitats,

significant species - the commoner and other significant species of flora and fauna,

and

management situation - actual and potential management problems within each candidate area. This is required to confirm appropriate justification for the official establishment of park, reserve or management areas, and to develop effective management guidelines for each area.

It is recommended that such surveys should be undertaken, so far as possible, using relatively standardised methods which will allow comparison between different sites on a region-wide basis. Methods should be designed to allow the survey data to serve as baseline data against which future possible changes in flora and fauna, due for example to local or regional pollution or other impacts, can be measured.

Such projects are the relevant follow up activity to marine resource and critical habitat surveys of the type proposed as the first project recommendation above, elements of which have alrady been completed in Egypt and Saudi Arabia. Consequently, baseline and management studies of special areas of the type proposed here might be expected to follow on from the broader scale survey (the first project recommendation above) proposed for Sudan, Somalia, North Yemen, South Yemen and Ethiopia.

Ecology and Management of Turtles - Saudi Arabia, Somalia, South Yemen, Sudan.

A major population of Green Turtles is known to exist still in the Gulf of Aden, and islands of the Red Sea are known to be the nesting grounds for significant numbers of Hawksbill turtles as well as some Green Turtles. These turtle populations although originally smaller may now be less depleted than any others in the Indian Ocean Region. Consequently it is recommended that urgent attention should be given to study and management of these populations.

It is recommended that under the aegis of the Regional Seas Programmes a cooperative project should be established involving:-

reproducing population - estimates of the total numbers of turtles breeding in the Red Sea and Gulf of Aden.

migrations - estimates of the extent of movement of turtles between different areas, e.g. for breeding and feeding.

impacts - monitoring of impacts effecting the turtle populations, in particular egg collecting, taking of nesting females etc.

management - the establishment of routines for enforcing protection of these species (combined if advisable in a few instances with exploitation of major stocks on a sustainable long-term basis).

The 'Turtle Ecology and Management Project' might be established by identifying in each country officers responsible for the conservation and management of turtle stocks, and by supporting their activities by the appointment of a 'Turtle Conservation Specialist' to act as a regional consultant (e.g. on a part-time basis). It is recommended that the work of national officers would benefit from particular support being given to allow them to travel between countries of the region so as to cooperate in, and gain experience and training from, field work (surveys, enforcement) in neighbouring countries under the advice of the regional consultant.

Monitoring of the Extent and Effects of Oil Pollution - Egypt, Djibouti, Saudi Arabia, Jordan.

In view of:-

- the extent of oil pollution in the Gulf of Suez and the northern Egytian

Red Sea,

- the importance of the Red Sea and Gulf of Aden as an inter-national shipping lane for the transport of oil,

- the enclosed and hence vulnerable situation of the Red Sea.

It is recommended that a regional project be established to promote the monitoring of oil spills and of oil pollution in the region. In particular the project should seek to promote the enforcement of standards for limiting the release or spillage of oil and oil products.

Full support is given to the proposal that under the aegis of the regional seas programme an office should be established to:-

coordinate oil pollution monitoring - coordinate monitoring of water, sediment and tissue hydro-carbon levels at monitoring stations throughout the region.

assist in oil pollution studies - assist member nations with studies of impacts due to severe oil pollution

coordinate surveillance - coordinate surveillance by ship, aircraft and satellite, within national and international waters

establish enforcement procedures - establish agreed procedures for enforcement of national laws and international regulations, and the prosecution of offending individuals, companies or departments.

develop cooperative oil spill contingency plans - development of procedures for international cooperation in the event of a major oil spill occuring in national or inter-national waters.

Cooperation in legislation for the Marine Environment.

It is recommended that those nations within the region which are still developing comprehensive environmental protection regulations and legislation for the establishment of marine and coastal reserves or national parks, might greatly benefit and be saved much time and expense by drawing upon the experience of those countries which have already or nearly established such legislation. This applies in particular because the language (arabic) is common to many of the countries of the region.

In addition, regional environmental protection would greatly benefit from the standardisation, so far as is practicable, of standards of emmissions and discharges in particular, and all regulations pertaining to environmental management and protection in general.

It is proposed that under the Regional Seas Programme a project should be established to pass all relevant agencies in member states copies of proposed or actual environmental laws and regulations from other member countries or other relevant sources and to assist member states in formulating legislation which can be enacted to cover their own territories at the earliest possible opportunity. In particular in some countries (e.g. Saudi Arabia) considerable

effort has been directed towards developing discharge and emmission standards and other regulations appropriate to the conditions and circumstances of the area, and it seems very likely that these same standards and regulations could be adopted with little modification by all the countries of the region.

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