



UNITED NATIONS ENVIRONMENT PROGRAMME

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

UNEP Regional Seas Reports and Studies No. 64

Prepared in co-operation with



IUCN

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 Caribbean 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.

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