Strategic Action Programme
for the
Red Sea and Gulf of Aden

Country Reports

Regional Organization for the
Conservation of the Environment of the
Red Sea and Gulf of Aden

PERSGA

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The documentation for the Strategic Action Programme includes three complementary publications: (a) Strategic Action Programme – Volume 1 – Main Report, published in 1998; and (b) Strategic Action Programme – Volumes 2 and 3 – Supporting Studies. This is Volume 2, the Country Reports, for Djibouti, Egypt, Jordan, Saudi Arabia, northern coast of Somalia, Sudan and Yemen. Volume 3 (in two parts) will contain the Navigation Risk Assessment and Management Plan and the Assessment and Status of Living Marine Resources and Their Management. The Strategic Action Programme has also prepared a wall map that shows major environmental features of the PERSGA Region.

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Preface

The Strategic Action Programme for the Red Sea and Gulf of Aden (SAP) has been developed by the countries of the Region, in cooperation with the Global Environment Facility and its implementing agencies, the United Nations Environment Programme, the United Nations Development Programme, and the World Bank; a regional financial institution, the Islamic Development Bank; and the Region's own environmental organization, the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden—PERSGA.

The documentation for the SAP includes three complementary publications: (a) Strategic Action Programme, Volume 1–Main Report; and (b) Strategic Action Programme, Volumes 2 and 3–Supporting Studies. This volume includes Country Reports for Djibouti, Egypt, Jordan, Saudi Arabia, northern coast of Somalia, Sudan and Yemen. Volume 3 contains a Navigation Risk Assessment and Management Plan and the Assessment and Status of Living Marine Resources and Their Management.

Development of the SAP in general, and these supporting studies in particular, is the result of a collaborative process, during which national experts have cooperated through extensive consultations and dialogue. In 1995 and 1996 a series of national workshops was held to finalize the Country Reports and to develop priority actions required by each country to address the environmental threats identified. As a result, these reports serve as the first diagnostic tool for the SAP in analyzing issues of regional, national and local significance, and in recommending actions to protect the Region's environment and natural resources. The reports provide a foundation of information for the SAP, and their priorities and recommendations are being realized through SAP implementation.

The Red Sea and Gulf of Aden contain some of the world's most important coastal and marine environments and resources. As part of the ongoing activities of PERSGA, the status of all coastal and marine ecosystems of the Red Sea and Gulf of Aden will be updated periodically, along with recommendations for their future management.

Although the Red Sea is still one of the least ecologically disturbed seas relative to other enclosed water bodies, it is in increasing jeopardy. Nowhere is this better exemplified than in the coral reef habitats of the Region. There is a great variety of reef types in the Red Sea and Gulf of Aden with unmatched biodiversity and structural complexity. The diversity of corals is

greater than anywhere else in the Indian Ocean, and the number of species that are confined to the Red Sea and found nowhere else is extremely high.

In 1997 and 1998 the climate phenomenon known as the El Niño/Southern Oscillation (ENSO) caused a rise in sea surface temperatures in many areas of the world that was unprecedented in recorded history. As a result of this high water temperature within tropical regions, many coral reefs of the world suffered coral bleaching—caused when coral colonies become stressed and expulse their symbiotic algae. Coral reefs of the Red Sea Region were also significantly affected. In the Gulf of Aden, extensive coral bleaching with high mortality was observed on reefs near the islands of Socotra in May 1998.

In response to this series of environmental impacts, the Saudi Arabian National Commission for Wildlife Conservation and Development, with co-sponsorship from PERSGA, hosted an International Symposium on the Extent of Coral Reef Bleaching in February 2000. The proceedings from this conference will be used to revise, where appropriate, priority actions for the conservation of coral reefs and associated coastal and marine habitats in the Region. Future versions of these Country Reports will reflect such updates so that they may continue to serve as a solid information base for effective action.

Abbreviations and Acronyms

ABD	Aden Bunkering Department (Yemen)
ACPM	Cooperative Association of Marine Fisheries *(Association de Coopératives des Pêches Maritimes)* - Djibouti
ARA	Aqaba Region Authority (Jordan)
CEO	Chief Executive Officer
CFC	Coastal Fishing Corporation
CFCL	Canadian Fishery Consultants Ltd.
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNE	National Committee for the Environment *(Comité national de l'environnement)* (Djibouti)
CNS	Comprehensive National Strategy (Sudan)
COOPI	Cooperazione Internazionale (Italy)
CZM	Coastal Zone Management
DAM	Directorate of Maritime Affairs (Djibouti)
DANIDA	Danish International Development Assistance
DAP	diammonium phosphate
DATE	Directorate of Land Management and Environment (Djibouti)
DEP	Directorate of Stock-farming and Fisheries (Djibouti)
DJF	Djibouti Franc
DGIS	Directorate General for International Cooperation (Netherlands)
DNV	Det Norske Veritas
DWT	Dry Weight Tonnage
EAP	Environmental Action Plan (Egypt)
EEAA	Egyptian Environmental Affairs Agency
EEZ	Exclusive Economic Zone
EFZ	Economic Free Zone
EGPC	Egypt General Petroleum Company
EIA	Environmental Impact Assessment
ENSO	El Niño/Southern Oscillation
EPC	Environment Protection Council (Yemen)
EPCCOM	Environmental Protection Coordinating Committee (Saudi Arabia)
EU	European Union

FAO	Food and Agriculture Organization of the United Nations
FI	Fisheries Investment Corporation (Yemen)
FRC	Fisheries Research Center (Sudan)
FZA	Free Zone Authority (Yemen)
FZD	Free Zones Department (Sudan)
GAEAP	Gulf of Aqaba Environmental Action Plan, Jordan
GAFRD	General Authority for Fish Resources Development (Egypt)
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIA	General Investment Authority (Yemen)
GIS	Geographic Information System
GMDSS	Global Maritime Distress and Safety System
GNP	Gross National Product
GOE	Government of Egypt
GRP	Glass Reinforced Plastic
GRT	Gross Register Ton
GTA	General Tourism Authority (Yemen)
GTZ	Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation Agency)
HCENR	Higher Council for the Environment and Natural Resources (Sudan)
hp	horsepower
HF-DSC	High Frequency Distress and Safety Communication
ICZM	Integrated Coastal Zone Management
IFAD	International Fund for Agricultural Development
IMO	International Maritime Organization of the United Nations
INMARSAT	International Mobile Satellite Organization
ISERST	Institut Supérieur d'Etudes et de Recherches Scientifiques et Techniques (Djibouti)
ITU	International Tanker Union
IUCN	World Conservation Union
JEA	Jordan Electricity Authority
JPMC	Jordan Phosphate Mines Company
JSS	Jordan Standard Specifications
LE	Egyptian Pound
MAH	Ministry of Agriculture and Hydraulics (Djibouti)
MARPOL	International Convention on the Prevention of Pollution from Ships
MAW	Ministry of Agriculture and Water (Saudi Arabia)
MB	Motor Boat
MCTT	Ministry of Commerce, Tourism and Transportation (Djibouti)
MEMAC	Marine Emergency Mutual Aid Center (Djibouti)
MEN	Ministry of National Education (Djibouti)
MEPA	Meteorology and Environmental Protection Administration (Saudi Arabia)
MFW	Ministry of Fish Wealth (Yemen)
MOFNE	Ministry of Finance and the National Economy (Saudi Arabia)
MOT	Ministry of Tourism (Egypt)
MP	Marine Park
MPA	Marine Protected Area
MPAM	Ministry of Port and Maritimes Affairs (Djibouti)
MSRRC	Marine Science and Resources Research Center (Yemen)
MSY	Maximum Sustainable Yield
mt	metric tons

MTC	Maritime Training Center (Yemen)
MTT	Ministry of Transports and Telecommunications (Djibouti)
NCFM	National Corporation for Fish Marketing (Yemen)
NCICZM	National Committee for Integrated Coastal Zone Management (Egypt)
NCSFM	National Corporation for Services and Fish Marketing (Yemen)
NCWCD	National Commission for Wildlife Conservation and Development (Saudi Arabia)
NEAP	National Environmental Action Plan
NECFISH	Northeast Coast Fishing Enterprise (Somalia)
NFC	National Forests Corporation (Sudan)
NGO	Nongovernmental Organization
NIOF	National Institute of Oceanography and Fisheries (Egypt)
NPK	nitrogen-phosphorous-potassium fertilizer
NWCFD	Northwest Coastal Fishery Development Project (Somalia)
ODA	Office of Development Aid
ONTA	National Office of Tourism and Crafts (Office National du Tourisme et de l'Artisanat – Djibouti)
PAID	International Autonomous Port of Djibouti (Port Autonome International de Djibouti)
PCMA	Public Corporation of Maritime Affairs (Yemen)
PDRY	People's Democratic Republic of Yemen
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
PPA	Project Preparation Advance
RCC	Rescue Coordination Center (Sudan)
RCC	Rescue Coordination Center (Yemen)
RCJY	Royal Commission for Jubail and Yanbu (Saudi Arabia)
REDWG	Regional Economic Development Working Group (Jordan)
RSU	Red Sea University (Sudan)
SAP	Strategic Action Programme for the Red Sea and Gulf of Aden
SCECO	Saudi Consolidated Electricity Company
SFZ	Sudan Free Zone
SIFP	Sudan Integrated Fisheries Project
SMCC	Sudan Marine Conservation Committee
SOFISCO	Socotra Fisheries and Sea Foods Company (Yemen)
SWCC	Saline Water Conversion Corporation (Saudi Arabia)
TDA	Tourism Development Authority (Egypt)
TEU	Twenty-foot Equivalent Units
TS	Technical Secretariat (of the EPC – Yemen)
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WAJ	Water Authority of Jordan
WRI	World Resources Institute
WTO	World Tourism Organization
YAR	Yemen Arab Republic
YFC	Yemen Fishing Corporation
YR	Yemeni Riyal

Country Report

Republic of Djibouti

Introduction

The Red Sea and Gulf of Aden represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism. This narrow band of water shared by a number of coastal states is also an important shipping lane linking the world's major oceans. While large parts of the Region are still in a pristine state, environmental threats—notably from habitat destruction, over-exploitation and pollution—are increasing rapidly, requiring immediate action to protect the Region's coastal and marine environment. To this end, a Strategic Action Programme (SAP) has been prepared through a continuous, consultative and cooperative process among the coastal states, coordinated by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA).

The SAP is a programmatic approach to the development of country based regional environmental projects, providing and benefiting from linkages with ongoing regional seas initiatives and major international waters projects. This will assure a concerted approach to transboundary problems, and the realization of regional and global benefits. The SAP has been prepared by a Task Force including PERSGA member states, the Islamic Development Bank, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. Financial support has been provided by the countries of the Region, the Global Environment Facility (GEF) and selected donor organizations. The GEF has approved support for implementation of the SAP, which will be complemented by funding from a variety of international and domestic resources.

The present country report provides background information to the SAP process at the national level. It is based on information from publications and reports, listed at the end of this document, and a rapid assessment survey by the authors of this report.

Background

Djibouti, at the juncture of the Red Sea and the Gulf of Aden, has a surface of 23,200 square kilometers and a coastline about 370 kilometers long. The northern coast between the Eritrean border and Ras Bir faces the narrow Strait of Bab-al-Mandab. It is mainly shallow and sandy with a few rocky outcrops such as Ras Siyyan and Kadda Gueini, and two large estuaries at Khor Angar and Godoriya that are fringed by mangroves. On a shallow

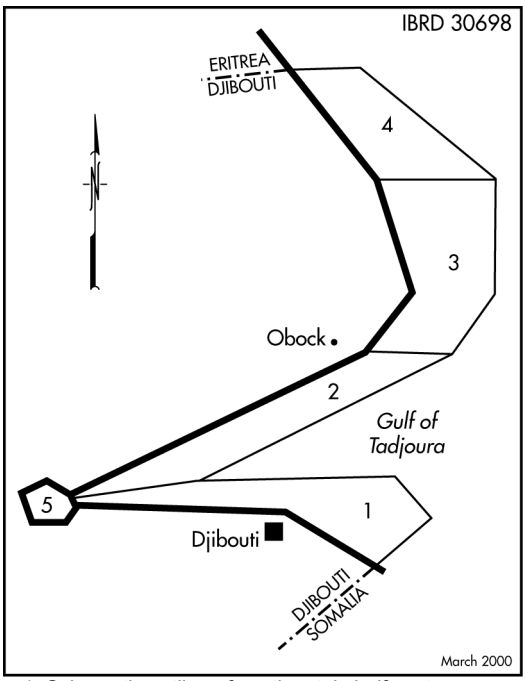

Figure 1. Schematic outline of continental shelf sectors.
Sector 1 corresponds to the southern shore of the Gulf of Tadjoura;
Sector 2 corresponds to the northern shore of the Gulf of Tadjoura;
Sector 3 extends from the north of Sector 2 to Ras Siyyan;
Sector 4 extends from the north of Sector 3 to the Eritrean border;
Sector 5 corresponds to the Ghoubbet al-Kharab region.
(From Künzel and others, 1996).

rocky platform east of Ras Siyyan, the Sept Frères archipelago is surrounded by coral reefs. Most of the coastline of Djibouti lies along the narrow Gulf of Tadjoura, an east-west oriented trench with a maximum depth of 883 meters (Laughton and others, 1970). A shallow, narrow opening separates it from the semi-enclosed basin of Ghoubbet al-Kharab, which has high salinity rates and coral reefs of low species diversity. Ghoubbet al-Kharab is 200 meters deep. Both the Gulf of Tadjoura and Ghoubbet al-Kharab basin are fringed by mountains and cliffs, interspersed with sand and cobble beaches. At the entrance of the Gulf of Tadjoura, north of the town of Djibouti, a vast reef plateau forms the base of the islands of Musha and Maskali, which are surrounded by extensive coral reefs. The southeastern coast between the capital and Loyada at the Somali border is rather shallow and sandy with several estuaries (see Map of Djibouti at end of volume). This area lies in a zone of upwelling nutrient-rich water, where coral reefs are poorly developed. The national marine territory covers a surface of approximately 10,000 square kilometers, of which 2,563 belong to the continental shelf which has a medium width of 8 kilometers. It is relatively wide to the north and south but rather narrow in the Gulf of Tadjoura. For fisheries purposes, the continental shelf is subdivided into five sectors, as shown in Figure 1 (Künzel and others, 1996). Along much of the coastline, the continental slope is generally steep and descends rapidly several hundred meters. No perennial freshwater stream reaches the sea, but some temporary wadis may discharge large amounts of freshwater after torrential rains.

Djibouti lies in a hot and semi-arid zone. Mean air temperatures vary between 25°C in winter and 35°C in summer. Annual rainfall is between 50 and 215 millimeters, averaging 130 millimeters. Hydrographic conditions are influenced by the monsoon. During the summer months, northerly winds prevail and the southwest monsoon moves surface waters of the Gulf of Aden into the Arabian Sea; these are replaced by outflowing waters from the Red Sea. During the northeast monsoon, between October and May, this current is reversed and surface water flows in the opposite direction. For most of the year, surface salinity is about 36.5 ppt, but when the surface water flows out from the Red Sea, it may increase to 38-39 ppt (Edwards, 1987). Mean surface water temperatures vary between 25°C and 29°C. In March, a thermocline lies at depths of 60-85 meters. During the hot season, this thermocline ascends, followed by an explosive increase in primary productivity. Relatively high turbidity generally limits coral growth to the upper 15 to 25 meters, although corals

have been reported below 35 meters (Anon., 1985).[1]

In 1993, Djibouti had an estimated 557,000 inhabitants, 75 per-cent of whom live in the capital. The average annual growth rate is 4.9 percent. The expatriate community varies between 10,000 and 15,000 people. In addition to the capital, there are two towns in the coastal area: Tadjoura and Obock. Fifty-one percent of the population is below the age of 20, and average life expectancy is 49 years. The gross national product (GNP) in 1993 was USD448 million, and in 1991 the gross domestic product (GDP) was DJF67,078 million (=USD379 million). Owing to prevailing ecological conditions in the Saharo-Sahelian zone, the importance of renewable resources in the local economy is very minor. Agriculture, animal breeding and fisheries contribute only some 2.2 to 2.4 percent to the national income. With an average annual income of about USD15 million, the international port of Djibouti contributes significantly to the national economy. Coastal and marine tourism is still in its infancy.

Coastal and Marine Resources

The major economic sectors in the coastal zone are maritime transport and port-related activities. Fisheries and tourism play a limited role, although subsistence fisheries are locally important, and their potential is yet to be fully exploited.

LIVING RESOURCES

At present, there are about ninety artisanal fishing boats operating in Djiboutian waters (Künzel, 1996). Most of them are small, open boats of 6 to 8 meters in length, powered by outboard engines, with three crew members. Some 15 percent of the boats are equipped with inboard engines. Those boats are 10 to 14 meters long and carry a crew of five fishermen. The small boats do one-day trips while the larger boats usually go out to sea for four days. The number of departures varies seasonally, with a maximum of 438 departures in May and a minimum of 187 in February. There are generally no professional fishermen; most fishing activities are carried out at the subsistence level and effort is generally low.

The majority of fish is caught by hook and line. To a lesser extent gill nets and throwing nets are used. Lobsters, of minor importance, are collected by divers. Landed catches consist almost entirely of large fish that fetch high prices on the market. Fish is marketed fresh and there is no processing of any relevance. An estimated 1,000 to 1,500 people are employed in the fisheries sector. Some 75 percent of all catches are landed at Boulaos in the capital area. There are a few other small landing sites, of lesser importance: Escale (5 percent), Tadjoura (5 percent) and Obock (10 percent). The landing site at the Club Nautique is used entirely by sport fishermen, accounting for 3 percent of the landings. The remaining 2 percent are used by the fishermen for their own consumption. A new fish collecting system was set up in the 1980s. During this period, 90 percent of the fishermen landed their catch on the premises of the "Association Coopérative des Pêches Maritimes" (ACPM, Cooperative Association of Marine Fisheries). The fish landed are grouper, *Epinephelus chlorostigma* (23 percent), Spanish mackerel, *Scombero-morus commerson* (14 percent), red snapper, *Lethrinus lentjan* (13 percent), antak or crimson jobfish, *Pristipomoides sp.* (12 percent), bonito, *Katsuwonus pelamis* (5 percent) and jacks, *Carangoides bajad* (4 percent). Other species are of lesser importance. Once a significant number of fishermen stopped using the ACPM landing site (see below), the statistical data gathering system then in use was no longer representative. A new system was established by a project of the German Agency for Technical Cooperation (GTZ). Scales

1 For updated descriptions and impacts to the coral reefs and associated habitats for Djibouti, refer to Wilkinson, 2000, pp 35-54.

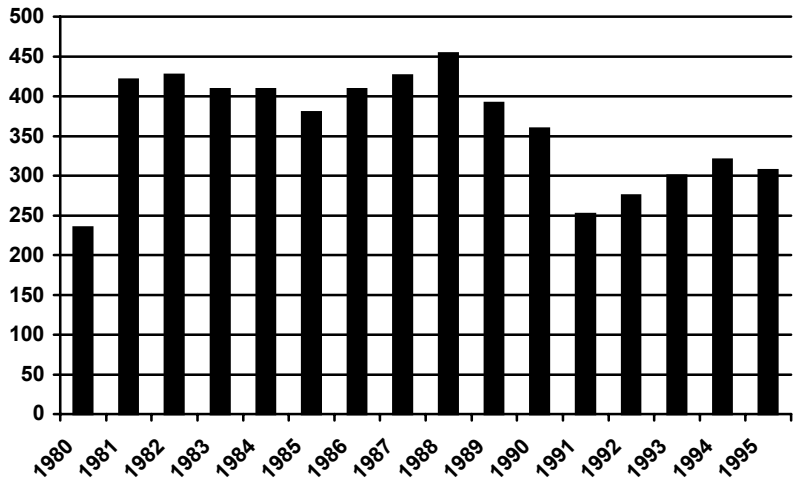

Figure 2. Estimated national fish production between 1980 and 1995, in mt
Sources: 1980-1984 landings at ACPM; 1985-1994 FAO 1994; 1995 Künzel and others 1996

were set up at the principal landing sites for statistical purposes.

National fisheries production increased from 236 metric tons in 1980 to 409 metric tons in 1984 and 454 metric tons in 1988. Between 1988 and 1991 the rate of increase slowed. A weak marketing structure for fisheries products created a bottleneck for the entire sector. From 1991 to 1994, production decreased dramatically. In 1991, due to unrest in the north of the country, it was as low as 252 metric tons (see Figure 2). Monthly production is highest in May, June and September. Between 1986 and 1990, when production was fairly stable, the highest yields were recorded in May (44,522 kg) and the lowest in February (25,110 kg).

The main species inhabiting the waters of Djibouti have been the subject of several studies (FAO, 1984, Boulhel, 1988, Abbès, 1989, Beurier, 1992, Darar, 1996). The most recent and by far the most extensive one was conducted within the framework of a project titled "Evaluation of Fisheries Resources and Exploitable Yields in Djibouti" which was funded by the Federal Republic of Germany and jointly executed by the Directorate of Animal Husbandry and Fisheries and the GTZ. A total of 192 fish species were recorded during this project which estimated the biomass and the potential Maximum Sustainable Yield (MSY) of commercially exploitable fish species in the continental shelf areas of Djibouti (Table 1). The data were used to assess the optimal exploitation rates of fisheries resources and to set the annual production at such levels as to promote maximum fish stock bioproductivity (Table 2).

Following experimental trawls, it was determined that the mean annual biomass of

Table 1: Summary of Biomass of Demersal Fish Resources of the Djiboutian Continental Shelf (in mt)

Groups of demersal species	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6
Small demersal species I	1,860	375	865	195	450	3,744
Small demersal species II (Leiognathidae)	8,566	50	6	3	0	8,625
Large demersal species I	515	225	3,897	2,197	206	7,039
Large demersal species II (Balistidae)	186	66	2,249	1,222	0	3,724
Rays and sharks	475	337	634	279	106	1,832
Other demersal species	1,307	844	618	297	63	3,129
Total for each sector	12,909	1,897	8,269	4,193	825	28,093

Table 2: Maximum Sustained Yield (Yopt) of Djiboutian Fish Resources, calculated according to biomass and natural mortality (M)

Group of demersal and pelagic species	Biomass (Binf, in mt)	M (per year)	Yopt (in mt)
Small demersal species I	3,744	1.0	1,872
Small demersal species II (Leiognathidae)	8,625	2.0	8,625
Large demersal species I	7,039	0.5	1,760
Large demersal species II (Balistidae)	3,724	1.0	1,862
Other demersal species	3,129	0.7	1,095
Total demersal species	26,261		15,214
Small pelagic species	56,000	1.0	28,000
Large pelagic species	18,500	0.5	4,625
Total pelagic species	74,500		32,625
GRAND TOTAL	100,761		47,839

Sources: Künzel and others, 1996; Anon., 1981; Sanders and Morgan, 1989

demersal fishes was 28,000 metric tons. This results in a potential annual yield of 15,000 metric tons. However, 10,000 metric tons are species of the families Leiognathidae (ponyfishes) and Balistidae (triggerfishes), which are of little economic use. Of those species which are economically important, the annual yield could be increased from a present level of 200 metric tons to approximately 1,300 metric tons. There are significant differences in the spatial distribution of demersal fishes: Sector 1 is largely inhabited by small demersals, of which 67 percent are Leiognathidae. Sectors 3 and 4 are dominated by large demersals, of which 50 percent are of commercial value and the remaining 50 percent are Balistidae.

Stocks of small pelagic fish were estimated based on the results of a cruise of the RV Fridtjof Nansen in the Gulf of Aden in 1981. The assessment of large pelagics is based on samples taken by FAO on the continental shelf of Somalia, Yemen and Oman. The biomass of small pelagics, which include important food fish such as sardines *(Sardinella longiceps),* anchovies *(Thryssa baelama),* and mackerel *(Scomber japonicus),* is about 56,000 metric tons. Stocks of large pelagics are estimated at 18,000 to 19,000 metric tons, the most important species being Spanish mackerel (*Scomberomorus commerson*), tuna (*Thunnus tonggol*) and barracuda (*Sphyraena* spp.). According to conservative estimates the potential mean annual yield of pelagic fish is about 32,000 metric tons, of which about 4,600 are commercially important species. The Indo-Pacific sailfish *Istiophorus platypterus*, whose length can exceed 3 meters, is common in the area. It is not landed by the artisanal fishermen, but is much sought after by sport fishing enthusiasts.

These data will allow Djibouti to manage fisheries appropriately and to take advantage of this resource in order to meet the country's nutritional and economic needs. An increase in fishing efforts, both in quality and quantity, will be necessary, including greater numbers of fishing boats and the use of more advanced fishing technology. The present ban on the use of trawls, however, should continue. Table 3 shows the development plan for the period from 1996 to 2000, during which total annual catches of large demersals and large pelagics could increase from 400 to 4,500 metric tons.

Boulhel (1986) estimated the Maximum Sustainable Yield of sharks at 70 metric tons and lobsters at 10 metric tons. Shrimp, crabs, oysters and cephalopods are exploited sporadically, while various mollusks, sea cucumbers and seaweed are currently not exploited at all.

Barratt and Medley (1988) studied the potential of exploiting tropical marine fish in Djibouti for the aquarium trade. They concluded that there is a substantial market for good quality Red Sea and Western Indian Ocean fish. The USA, Hong Kong,

Table 3: Development Plan for 1996-2000. Summary of annual production (in mt) envisaged for the exploitation of demersal and pelagic fish resources

Fish Resources	Potential Maximum Sustainable Yield	1995: Current small-scale fisheries production	Projected production for food consumption	Projected production for export	Total Production
Large demersal species	1,800 ± 30%	200	500	800	1,300
Large pelagic species	4600 ± 30%	200	500	2,700	3,200
Total		400	1,000	3,500	4,500

Germany, Japan and other European countries were identified as the main export markets.

An operation license was granted in 1992 to a private company, despite the lack of a legal framework regulating this type of fishing activity. With the help of Sri Lankan workers, it would appear that 150 to 300 aquarium fishes are collected weekly to be exported to Japan and the United States. It is difficult, under current conditions, to assess the impact of this ornamental fish collection activity on the coral reef ecosystems.

Technical and Socio-economic Organization of the Fisheries Sector

Traditionally, only subsistence fisheries existed in Djibouti. The introduction of the Programme for the Development of Artisanal Fisheries, initiated in 1980, resulted in a substantial growth of this sector. Before 1980 there were only fifty fishermen, mainly of Yemeni origin. They used wooden boats 4 to 6 meters in length with very limited loading capacity. These boats, which had no engines, allowed only for subsistence fishing.

In the framework of the development programme, fishermen were supplied with fishing gear, outboard engines and fibreglass boats. Ten years after the completion of the programme, in 1990, the number of active fishermen had increased significantly. However, the average age of fishermen used to range between 40 and 55 years, and a rejuvenation of the production crews became an imperative for the development of the sector. To this end, a training center for professional fishermen was created in 1991 with support from the International Fund for Agricultural Development (IFAD). Unfortunately, extra-sectoral events have interfered with the successful implementation of training activities. A rehabilitation programme is currently underway, with a view to revitalizing fishing activities in the northern areas of the country.

The majority of fishermen ply the same fishing areas and their range of operation is very limited, although the winter monsoon extends the range of larger boats. During the period from November to March, they exploit resources in the waters next to the Somali border. But no matter where the fishing takes place, 90 percent of the catches are landed in Djibouti town, because of the lack of markets in other coastal towns.

Fishermen in Djibouti do not have any alternative employment opportunities. This is the result on the one hand of the conservative attitude of this community and on the other hand the limited possibilities existing in the agricultural sector. Fishing is their only available activity. The fishermen do not have access to formal credit. Informal credit from fish traders or from the fisherman's family is a possible source of financing. Fishing strategy adapts to the requirements of the market, which means they catch those fish species which sell locally. Unfortunately, consumers in Djibouti largely restrict their consumption to three species: Spanish mackerel (season-

ally), blackspot snapper and jack. As far as the fishermen's income is concerned, the figure varies according to the number of each fisherman's departures to sea and his social status, that is, whether he is a boat owner or a crew member.

The fishermen who participated in the programme were able to increase their income slightly. However, none of the fishermen kept accounting records; Table 4 was compiled from their verbal statements. All fishermen interviewed regarding social issues stated that they would like to benefit from social security and pension.

Table 4: Comparison of Fishing Operations of Two Types of Boats (7-meter and 10-meter boats go out to sea for 1 and 4 days respectively)

	Seven-meter Boat	Ten-meter Boat
Fuel expenses	DJF 6,000	DJF 6,800
Ice expenses	DJF 1,000	DJF 4,000
Food expenses	DJF 3,666	DJF 12,000
Total catch weight	300 kg	950 kg
Total catch value	DJF 45,000	DJF 142,000
Net catch value	DJF 35,334	DJF 119,700

The other operators working in the sector are fish traders and retail dealers. It should be noted that these operators did not receive any assistance from the programme. This accounts for a weakness in the marketing structure, which has been a major obstacle to the development of the fisheries sector in recent years. Mention should be made of the gradually increasing presence of Djiboutian women in fish marketing. Their activities are focused on the sale of fresh fish in disadvantaged neighborhoods.

The primary tasks of the ACPM were fish marketing and the sale of ice and fuel to the fishermen (Bjoerklund and Walter-Dahnert, 1983). It was regarded as a state-owned organization and was managed by civil servants. At the time of this writing, the ACPM no longer exists and the marketing activities at the landing site of Boulaos were entrusted to a private operator.

NON-LIVING RESOURCES

Included in this category is the sea sand from the supra-littoral zone as well as the salt and brine of Lake Assal which, in theory, can be exploited. There are no natural gas or oil exploration activities in the national maritime area of Djibouti.

MARITIME TRANSPORT

Maritime transport is a major commercial sector in Djibouti. Since the reopening of the Suez Canal, activities at Djibouti Port have developed rapidly. The port offers container handling facilities at two berths of a total length of 400 meters with a depth of 12 meters alongside the quay. It handled 65,000 TEU (Twenty-foot Equivalent Units) in 1993 and 70,000 in 1995. Besides container handling, the port's activities include merchandise import and export, oil tanker traffic and transshipment. During the last decade, the Port Authorities have undertaken important investment programmes to upgrade facilities at Djibouti port in order to increase competitiveness. The port gets direct calls by ships coming from Europe and East Asia. Containers from Djibouti are transshipped to the Southern Red Sea, the Gulf of Aden and East Africa. A 780-kilometer railway links Djibouti with Addis Ababa and goods to and from Ethiopia are shipped via Djibouti. The income of the International Autonomous Port of Djibouti ranges between USD14,124,300 and 16,949,200, which is a very important contribution to the national economy. Table 5 provides more detailed data on the extent of maritime transport activities in Djiboutian waters.

Table 5: Total Vessel Stops (number and tonnage) at PAID between 1991 and 1994

Class of vessel	1991		1992		1993		1994	
	No	GRT	No	GRT	No	GRT	No	GRT
Conventional	325	2,709,415	333	2,650,801	311	1,941,289	309	2,236,970
Multi-purpose	13	196,493	5	66,973	1	9,844	0	0
Container ship	171	1,861,018	248	2,914,677	320	3,736,546	275	3,486,208
Roro	130	1,832,360	76	998,645	69	721,767	61	639568
Barge-carrier	17	445,864	11	285,861	17	430,238	14	372,937
Bulk carrier	1	30,249	0	0	0	0	0	0
Oil tanker	98	2,186,154	78	1,301,509	82	1,142,841	85	1,241,985
LPG tanker	42	368,052	38	326,446	4	31,098	4	30,629
Passenger ship	8	60,747	10	79,806	9	83,234	17	101,596
Fishing vessel	68	54,466	68	69,403	68	47,612	74	36,890
War ship	224	700,544	136	594,186	98	393,955	92	511,385
Other	67	113,550	90	206,220	68	141,694	45	53,137
Coaster	44	20,383	30	13,926	21	10,629	27	12,440
Total	1,208	10,579,295	1,123	9,508,453	1,068	8,690,747	1,003	8,723,745

MARINE AND COASTAL TOURISM

Marine tourism is still at an embryonic stage in Djibouti, although in the past European tourists visited Djibouti from October to March, mainly to dive at the Sept Frères Islands. The contribution of marine tourism to the national economy is insignificant. The National Office for Tourism and Crafts offers some sixty huts for rent and the private sector provides transportation for tourists. The reefs near the capital are frequently visited by local tourists, above all by members of the expatriate community. There is no monitoring of their activities and the resulting pressure on the reefs is high.

Legal and Institutional Framework

Conscious of the importance of protecting the marine environment and fighting all forms of pollution, Djibouti adheres to a number of international conventions:

- The International Convention for the Prevention of Pollution of the Sea by Oil (London Convention) of 1954 (amended), made applicable through Law no. 64/83 of 25 August 1983, approving the four international conventions on maritime navigation.
- The London Convention of 1971 on the international compensation fund (approved by Law 94/AN/89 2/ L of 7 November 1989).
- The London Convention of 1973, amended in 1978, and its four annexes (approved by Law 94/AN/89 2/ L of 7 November 1989).
- The Brussels Convention of 1969 on Interventions on the High Sea (approved by Law 94/AN/89 2/ L of 7 November 1989).
- The United Nations Convention on the Law of the Sea (approved by the Law of 11 June 1985).
- The Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement of all Forms of Hazardous Wastes within Africa (1991).
- The United Nations Convention on Biological Diversity (1992).
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (1992).
- The United Nations Framework Convention on Climate Change (1992)

At the regional level, an agreement was signed by Yemen, Djibouti and Somalia on 27 March 1990 concerning the establishment of a sub-regional center to combat oil pollution in the Gulf of Aden.

The Marine Emergency Mutual Aid Center, with oil spill response facilities, is based in Djibouti. Yemen and Djibouti are currently negotiating a bilateral agreement regarding the use of the equipment. On 20 January 1986, Djibouti and Somalia signed a bilateral fishing agreement.

The economic and social orientation law of 1990-2000 (Law 150/AN/91 2º L of 10 February 1991) and the orientation plan for economic and social development projects of 1991-1995 (Law 207/AN/92 2º L of 14 May 1992) demonstrate the government's commitment to make the protection of the environment one of its priorities. In addition, Djibouti adopted a set of legal texts regulating exploitation and providing for protection of the marine environment.

The present fisheries legislation was drafted before independence, with the exception of some useful but insufficient general provisions which are part of the Code of the Maritime Administration. These are, among others, articles 148, 149 and 220 to 225 enacted by Law 212/AN/82, and articles 16 to 19 of Law 52/AN/78 of 18 January 1979. According to these regulations, certain fishing techniques, such as the use of explosives and poisons, are prohibited. They determine the conditions for the exploitation of fishing resources, including fishing zones and closed seasons. They also include sanctions for violations.

The national regulations on the protection of the marine environment include provisions on marine pollution, protection of endangered species and the creation of protected areas. Regulations on the prevention of and fight against marine pollution (Table 6) include:

Table 6: National Laws and Regulations pertaining to Coastal and Marine Resources and Environments

Legal Text	Effective date	Institution concerned
Order 72-1363/SG/CG establishing Musha Territorial Park	1972	DAM
Law 76-599 on pollution caused by ships	1976	DAM
Law 76-600 on pollution caused by combustion	1976	DAM
Order 77-038/PR on registration of pleasure boats	1977	DAM
Law 52/AN/78 article 16-19 regulating fisheries	1979	DAM
Decree 80-062/PR/MCTT on the protection of the marine fauna and sea-bottom and establishing the South Maskali Islands Integral Reserve	1980	MCTT
Law 9/AN/82 on oil pollution	1982	DAM
Law 212/AN/82 regulating fisheries	1982	DAM
Law 64/AN/83 approving four international conventions regarding maritime navigation	1983	DAM
Law 137/AN/85 on oil pollution	1985	DAM
Regulation 84-0969/PR/PM on pleasure boating safety	1984	DAM
Decree 85/103/PR/AG on Marine Protected Areas	1985	DAM
Ordinance 86-042PR/PM regulating abandonment of ships	1986	DAM
Regulation 86/0717/PR/MCTT on camping huts on the beaches and islands	1986	ONTA
Decree 88-013/PR/PM on the organization and coordination of actions at sea taken by the State	1988	DAM
Law 65/AN/89 banning the import of toxic, radioactive and polluting waste	1989	DAM
Decree 89-085/PR/PM on passage of foreign vessels	1989	DAM
Law 94/AN/89 approving adherence to four international conventions on marine water pollution	1989	DAM
Decree 90-0105PR/AE establishing a Contingency Plan in the event of accidental marine pollution	1990	DAM
Decree 89-085/PR/AE on actions in the event of oil spills	1990	DAM
Order 90-0534/MPAM regulating navigation in order to prevent accidental marine pollution events	1990	DAM
Order 90-0534/MPAM on the passage of foreign vessels	1990	DAM
Decree 91-018/PR/MPAM establishing a Directorate of Maritime Affairs	1991	MTT

- Law 76-599 of 7 July 1976, enacted by order 675/SELAG of 21 July 1976 on pollution by ship and aircraft, as well as accidental marine pollution.
- Law 76-600 of 7 July 1976, enacted by order 676/SELAG of 21 July 1976 regarding pollution by incineration operations.
- Law 52/AN/78 of 9 January 1979 on the territorial sea, the contiguous zone, the Exclusive Economic Zone (EEZ), maritime borders and fishing excise.
- Laws 9/AN/82 of 15 September 1982 and 137/AN/85 1º L of 27 July 1985 on oil pollution.
- Law 64/AN/83/1 L of 25 August 1983 approving the four international conventions regarding maritime navigation.
- Law 137/AN/85/1 L of 27 June 1985 prohibiting illegal oil discharge by ships under Djiboutian flag outside the territorial waters.
- Ordinance 86-042/PR/PM of 6 May 1986 containing regulations on actions to be taken in case of abandonment of ships, which poses a threat to the environment within territorial waters.
- Decree 88-013/PR/PM of 14 February 1988 concerning the organization and coordination of actions at sea taken by the State.
- Law 65/AN/89 2/L of 3 April 1989 banning the import into national territory of toxic, radioactive or polluting industrial wastes or residues.
- Law 94/AN/89/1 2/L of 7 November 1989 approving adherence to the four international conventions regarding the pollution of marine waters.
- Decree 89-085/PR/AE of 29 September 1990 providing for the implementation of a Contingency Plan in the event of accidental pollution by oil spills.
- Decree 89-085/PR/PM of 29 June 1989 and order 90-0534/MPAM of 11 June 1990 concerning passage of foreign ships through territorial waters in order to prevent pollution and dumping of hazardous wastes.
- Decree 90-0105PR/AE of 29 September 1990 concerning the Contingency Plan applicable in the event of a critical situation caused by accidental marine pollution in Djibouti.
- Order 90-0534/MPAM of 11 June 1990 regulating navigation in Djiboutian waters in order to prevent accidental marine pollution.
- Order 90-0534/PR of 10 June 1990 regulating navigation in Djiboutian waters in order to prevent accidental marine pollution.
- Decree 91-018/PR/MPAM of 10 February 1991 creating a Directorate of Maritime Affairs and establishing the respective competencies of its departments.

With regard to protection of endangered species, Djibouti is signatory to CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Decree 80-62/PR/MCTT of 25 May 1980 provides for protection of the sea bottom and marine fauna. The capture of marine mammals and turtles is illegal, as is the trade in or export of these animals, the collection of turtle eggs, and spearfishing.

Marine Protected Areas (MPAs) are currently restricted to the Territorial Park of Musha and the "Integral Reserve of South Maskali". The Park of Musha was first established by Order 72-1363/SG/CG of 20 September 1972, which prohibits the collection of corals and mollusks. Subsequently, Decree 80/062/PR/MCTT of 25 May 1980 extended the protection to the Maskali Reserve; this decree was amended by Decree 85/103/PR/AG of 28 October 1985 to strengthen the conservation approach applied in these areas. Only ar-

tisanal fishing of edible species is allowed in these zones. See Table 7.

Table 7: Coastal and Marine Protected Areas in Djibouti

Protected Area	Surface	Year	Major habitats and significant species	Manage-ment	Global Recognition
Musha Territorial Park	ca 10 km^2	1972	Coral reefs and rich reef associated fish and invertebrate fauna, mangroves	Low	None
Integral Reserve of South Maskali Islands	ca 3 km^2	1980	Coral reefs and rich reef associated fish and invertebrate fauna	Low	None
Sept Frères Islands and Ras Siyyan	TBD	Proposed	Group of 6 rocky islets and cove with mangroves at junction of Red Sea and Gulf of Aden, coral reefs and rich reef associated fish and invertebrate fauna, sea bird nesting sites	None	None
Godoriya Mangrove	TBD	Proposed	Large-size mangroves, *Avicennia* and *Rhizophora*, rich fauna	None	None

The following regulations provide for the protection of the coastal zone:

- Order 86-0717/PR/MCTT of 14 June 1986 concerning waste from camping activities on the islands and beaches.
- Ordinance 77-038/PR of 8 October 1977 requiring registration of all pleasure boats.
- Order 84-0969/PR/PM of 7 July 1984 on the safety of pleasure boating and beach activities.

The following institutions are directly involved in the use and management of coastal and marine areas and resources:

- Ministry of Agriculture, Livestock and the Sea:
  - ◊ Directorate of Stock-farming and Fisheries (DEP): in charge of protection of marine fauna and flora as well as conservation of the sea bottom in Djiboutian waters.
- Ministry of Transport and Equipment. This Ministry is responsible for the management of port affairs, the management of the International Autonomous Port of Djibouti (PAID), maritime navigation, safety at sea and the fight against oil pollution. It consists of two Directorates:
  - ◊ Directorate of the International Autonomous Port of Djibouti: in charge of managing the PAID.
  - ◊ Directorate of Maritime Affairs (DAM): in charge of prevention and prohibition of all violations of national and international legislation concerning marine pollution and maritime traffic, as well as protection of territorial waters and shores. A Commission on Fauna and Flora has also been established under this Directorate. The Commission is in charge of marine biodiversity conservation.
- Ministry of Commerce and Tourism:
  - ◊ National Office for Tourism, Arts and Crafts (ONTA): in charge of protection of sites and the environment.
- Presidency of the Republic:
  - ◊ Institute of Higher Studies, Scientific and Technical Research (ISERST): in charge of conducting environmental assessment studies and safeguarding sea fauna and the sea bottom.

- Prime Minister:
  - ◊ Direction de l'Aménagement du Territoire et de l'Environnement (DATE, Directorate of Land Management and Environment); in charge of elaborating national environmental policy and ensuring its implementation, including adoption of a National Environmental Action Plan (NEAP); also provides the Secretariat for the Comité technique de l'environnement (Technical Committee for Environment).
- Interministerial Coordination:
  - ◊ Commission on the Protection of Marine Fauna and the Sea Bottom: according to a decree of 5 March 1983, this Commission is presided by the Director of the Maritime Administration.
  - ◊ National Council of the Sea: according to a decree of 5 July, this Council is presided by the Prime Minister.

Threats to the Environment

A number of comprehensive scientific studies of the coastal and marine environment are underway. Although parts of the coasts and territorial waters are still in a largely pristine state, the few studies that have been completed show that in several areas there are alarming signs of degradation and threats are increasing rapidly (Table 8). Anthropogenic pressure is particularly high in the vicinity of the capital.

Table 8: Threats to the Coastal and Marine Environment and Resources

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Habitat Destruction					
Coastal development	Dredging and filling, destruction of coral reefs	Urban, industrial and port development	Inadequate environmental planning, limited use of environmental assessment	Localized, near capital area	Severe
Mangrove destruction	Deterioration of mangrove habitat, decreased fish and shrimp catches, reduced water quality	Grazing by camels, wood collection,	Lack of management and awareness, lack of enforcement of regulations, lack of alternative fuel, damming of wadis	Most mangrove areas, especially those in the vicinity of capital	Moderate to severe
Damage to coral reefs	Loss of coral habitat and decline in reef associated fauna	Anchor damage, ship grounding,	Poor navigational control systems, lack of moorings,	Localized, throughout the area,	Low to moderate
Damage to coral reefs by visitors	Coral breakage, decline in reef associated fauna	Trampling of shallow reef flats, breaking of corals, collecting of marine souvenirs, anchor damage	Lack of management and law enforcement, lack of environmental awareness	Localized, especially reefs near Djibouti Port and Musha and Maskali areas	Moderate to severe
Living Marine Resources					
Potential overfishing of game fish	Decrease in average size	Fishing efforts beyond MSY, use of spearguns	Lack of surveillance and enforcement of existing regulations	Localized, especially in capital area, and MPAs	Severe
Illegal shark fisheries for foreign shark fin market, by foreign vessels	Decline in shark stocks, bycatch of turtles, dolphins and finfish, damage to reefs from nets	Increasing fishing effort, use of nets in shark fisheries, high profits	Lack of surveillance and law enforcement	Throughout the area	Severe

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Catches of turtles and collection of turtle eggs	Decrease in nesting populations	Need for subsidiary food supply, sales to restaurants and sales of turtle shells to tourists	Lack of public awareness, lack of alternative food sources, lack of enforcement	Throughout the area	Severe
Navigation and Maritime Risks					
Navigation risks	Risks of ship collisions and grounding	Limited navigational devices and poorly separated traffic	Complex navigational hazards, heavy maritime traffic	Throughout the area, particularly near the port ,	Moderate
Marine vessel sewage	Localized marine and beach pollution	Discharge from ships	Inadequate on-board treatment, lack of port reception facilities	Throughout the area	Moderate
Ship discharge of solid waste	Solid waste on shoreline, in mangrove areas and coral reefs	Discharge of solid waste from ships	Inadequate disposal facilities, inadequate surveillance and enforcement, lack of port reception facilities	Throughout the area	Moderate
Petroleum Development and Transport					
Small oil spills (< 20 mt)	Beach contamination, damage to coastal and marine biota	Discharge of ballast and bilge water, discharge of waste oil, bunker oil spill	Lack of reception facilities at the port, inadequate control, lack of enforcement	Localized, throughout the area	Moderate
Medium oil spills (20-100 mt)	Beach contamination, damage to coastal and marine biota	Discharges from terminals, small accidents at sea	Inadequate control and monitoring of procedures, equipment and personnel, inadequate training	Localized, throughout the area	Moderate to Severe
Potential large oil spills and disasters (> 100 mt)	Destruction of coastal and marine habitats and biota, devastation of beaches	Rupture of oil tanks in collision or wreckage	Insufficient tanker safety specifications, poor navigation aids	Localized, throughout the area	Severe
Urban Development					
Surface and groundwater use	Excessive exploitation of surface and groundwater for municipal use, saltwater intrusion into coastal aquifers	Excessive pumping of groundwater	Allocation of water resources with inadequate concern for water conservation, inadequate maintenance of distribution systems	Localized, capital area	Moderate to severe
Discharge of untreated or insufficiently treated sewage	Groundwater impacts, eutrophication and alteration of marine environment, threats to public health	Lack of sewage treatment plants, lack of maintenance of existing plants	Inadequate pollution control regulations, monitoring and enforcement	Localized, capital area	Severe
Disposal of solid waste	Damage to coastal and marine life, deterioration of aesthetics	Improper garbage disposal	Lack of adequate waste disposal regulations and enforcement, lack of a waste management system, inadequate public awareness	Localized, capital area	Low to moderate
Surface and groundwater use	Excessive exploitation of surface and groundwater	Excessive pumping, inadequate concern for water conservation	Poor regulation of water resource exploitation	Localized, industrial areas	Low to moderate
Disposal of waste oil	Soil and groundwater pollution	Improper disposal of used motor oil	Lack of proper oil disposal and recovery options, lack of effective regulations and enforcement	Localized	Low

HABITAT DEGRADATION AND DESTRUCTION

Habitat destruction as a result of coastal development remains rather localized, concentrated in the capital area. The construction and expansion of the port installations resulted in severe pressure on coral reefs.

Mangroves are deteriorating rapidly along much of the coast of Djibouti, resulting in reduced water quality and a decline in fish and shrimp catches. In the absence of alternative affordable energy sources, mangrove wood is used as fuel. Mangrove foliage is also collected by animal breeders to be used as forage. As a result of several years of drought, an increasing number of nomads together with their camels moved into the coastal zone. In some areas, the camels are browsing heavily on mangroves. West of the capital, where there used to be very extensive mangroves, some stands have been completely destroyed and the remaining ones are severely threatened. In this area mangrove destruction must be considered a priority issue. Of eight mangrove areas investigated in a recent study, two were classified in good condition; two in good condition but locally exploited; one as partially degraded; two as degraded; and the one at Gaan Maan as severely degraded (see Figure 3 for details).

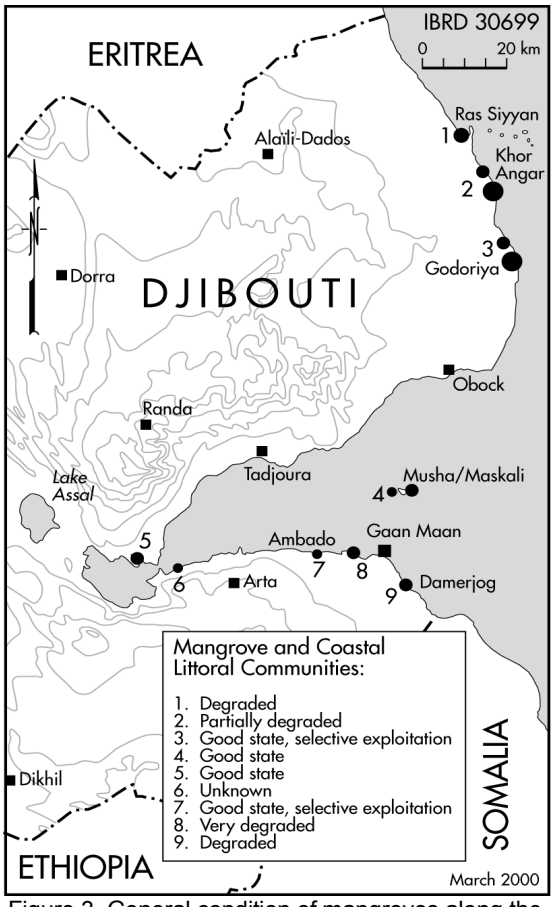

Figure 3. General condition of mangroves along the shorelines and on islands
Source: Rapport national Environnement, Djibouti 91

Physical damage to coral reefs, resulting in a loss of coral habitat and decline of reef associated fauna, is very severe near the capital and in the Marine Protected Areas of Musha and Maskali. Reefs in other areas are affected to a lesser extent. Reefs near the port of Djibouti, which were once flourishing, are being rapidly degraded from siltation. In popular recreational areas, such as the reserves of Musha and Maskali and near Khor Ambado, corals are severely damaged by visitors. Anchor damage is obvious. The collection of corals and reef associated invertebrates and the use of spear guns, although illegal, continue on a large scale. Signs of reef degradation in the Bab-al-Mandab have also been reported, which may possibly be attributed to heavy ship traffic (see also comments in Sheppard and Wells, 1988). Kinner (1987) visited twenty-three reef areas throughout the country and assessed their ecological status. He classified nine as satisfactory, all in the western part of the country, three as medium, four as bad, and eight as disastrous (see Figure 4). In some reef formations, there are signs of coral die-off without obvious reason and this phenomenon needs urgent investigation. It should be noted that increased occurrence of *Acanthaster planci* is reported to have been observed in 1992 in some areas.

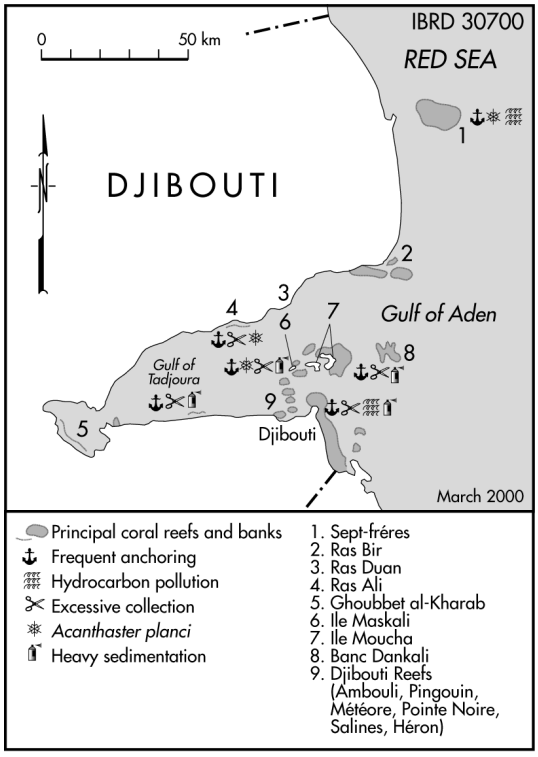

Figure 4. Djibouti coral reefs: General status and locally degraded sites identified in 1989-90
Source: Rapport national Environnement, Djibouti 91

OVER-EXPLOITATION OF LIVING MARINE RESOURCES

As explained above, fisheries play a minor role in Djibouti and the living marine resources are largely under-exploited. Djibouti is the only country in the Region that has reliable data on its fish stocks and Maximum Sustainable Yields (MSY), allowing for sound fisheries management. Still, there are certain areas near the capital where over-exploitation does occur. They are located near Doralé, Khor Ambado, Arta Plage and the islands of Musha, Maskali and Waramous. The pressure on these areas is due to a combination of extensive sport fishing and artisanal fishing activities. These are at the same time the areas where reef destruction is most severe (see above).

Shark resources are being depleted because of illegal shark fishing by foreign fishermen for the foreign shark fin market. Sharks are caught by hook and line, or nets, damaging coral reefs. The fins are cut off, often while the shark is still alive, and the carcass is thrown back into the sea. Bycatch, including turtles, dolphins and finfish, are discarded, almost invariably dead. The extent of illegal shark fishing activities in Djiboutian waters is not known.

Illegal capture of marine turtles and the collection of turtle eggs is rather widespread. Turtle meat, oil and eggs are an important source of subsidiary food for artisanal fishermen and the shells are sold to tourists. Cetaceans and dugongs are also present in Djiboutian waters (Robineau and Rose, 1982, 1984) and are occasionally captured accidentally in fishing nets.

NAVIGATION AND MARITIME RISKS

The extensive coral reef formations at the entrance to the port pose problems to navigation. These navigational hazards combined with heavy maritime traffic and limited navigational devices result in increased risks of ship collisions and grounding. Marine vessel sewage and ship discharge of solid waste pose additional threats. Because of the limited waste reception facilities at the port, ships dispose of their waste offshore.

IMPACT OF PETROLEUM DEVELOPMENT AND TRANSPORT

There is a constant threat of oil spills along the entire coastline of Djibouti. Oil may leak from oil terminals and tankers, causing chronic pollution in the intertidal zone. Considering the prevailing currents and winds, oil pollution may occur in almost any part of the coast, at least at certain times of the year. Tar balls originating from passing ships are often found on the beaches of Djibouti. The port area is particularly threatened by oil spills. A spill of 20 to 25 metric tons was reported by the port in 1980 and two minor spills of 2 to 3 cubic meters occurred in 1981 and 1985. The Sept Frères islands are at risk because of their proximity to major shipping lanes.

The construction of a refinery is planned at Doralé/Saline-Ouest. If implemented, this project will pose a major threat to the rich coastal and marine habitats and biota of the area. A conflict of interest with fisheries development in the area would also arise.

IMPACT OF INDUSTRIAL ACTIVITIES

Allocation of limited freshwater resources with inadequate regard for water conservation and water supply systems affects surface and groundwater reserves. The deep aquifer supplying water to the city of Djibouti is being over-exploited, resulting in the intrusion of saltwater into coastal aquifers. In an arid zone with constant shortages of freshwater, such problems are serious. Industrial activities, however limited, are concentrated in the capital area where the chronic release of industrial pollutants, most of which reach the sea untreated, results in a decline in water quality. Outdated, inadequate technology and equipment and a lack of enforcement of existing regulations are the main reasons for this situation. At present, these problems are localized.

IMPACT OF URBAN DEVELOPMENT (SEWAGE AND HOUSEHOLD WASTE)

At present, only one sewage treatment plant is operational; all others are broken down. The discharge of untreated or insufficiently treated sewage from households, industry, slaughterhouses and hospitals results in chronic pollution. Constant pollution is also caused by discharge from rainwater collectors, effluents from the power plant and oil industry, and pumping of sewage from septic tanks directly into the sea. These activities create risks for water resources, alter the marine environment and pose a serious threat to human health. Solid waste is dumped on the shore, causing damage to coastal and marine life and deteriorating aesthetics. The main cause is a lack of efficient waste collection and disposal systems. A general lack of public awareness is compounding the problem. In addition, there are no installations to treat the runoff from the household waste dump site in Douda. In Djibouti, these problems are largely restricted to the capital area.

Recent, Current and Planned Environmental Initiatives

At present the number of environmental initiatives in Djibouti is rather limited. The most important ones are summarized in Table 9:

- In 1990 a sub-regional Contingency Plan for the Gulf of Aden was developed (Anon., 1990). An Oil Spill Response Center, MEMAC, was established for Djibouti, Yemen and Somalia.
- In 1992 the Maritime Administration issued rules for the management of Marine Protected Areas. The exploitation of reef associated species was strictly regulated.
- New fisheries regulations were introduced in 1994 with a view to ensuring the sustainable development of this resource.
- In 1996 Djibouti became a signatory to the Convention on Biological Diversity.
- Between 1993 and 1996, UNDP conducted a series of seminars on environmental management and sustainable development.
- Between 1993 and 1996, the DEP completed a joint project with GTZ to assess fishing resources and determine sustainable production levels in Djibouti.
- In September 1996, the DATE elaborated the National Environmental Action Plan.
- In 1997-1998, the GFM will formulate a National Biodiversity Strategy.
- The Ministry of National Education is expected to introduce a component for "Environmental education and

Table 9: Recent, Current and Planned Environmental Initiatives, Programmes and Projects

Programme / Project	Period	Budget (in USD'000)	Implementing Agency
Sub-regional Contingency Plan for the Gulf of Aden	1990		DAM
Establishment of a sub-regional oil spill response mutual aid centre for Djibouti, Yemen and Somalia	1990	702	DAM
Development of regulations on Marine Protected Areas	1992	20	MAH, FAO and GTZ
Development of regulations on the exploitation of reef associated species	1992	20	MAH, FAO and GTZ
Development of regulations on fisheries activities	1994		MAH
Accession to Convention on Biological Diversity	1996		MAH
Seminar on environmental management and sustainable development	1993-1996	20	UNDP
Project for the evaluation of fisheries resources and exploitable yields	1993-1996	200	MAH and GTZ
National Environmental Action Plan	1997	442	DATE and UNDP
Environmental education and awareness raising	1997		MEN
National Biological Diversity Strategy	1997-1998	560	GFM

awareness" in primary and secondary school curricula. A public awareness was conducted in 1997 and an environmental education manual will be produced.

Priority Actions

The priority actions identified for Djibouti are summarized below (see Table 10):

- It is recommended to develop a national maritime law, revise existing legislation and strengthen mechanisms to enforce applicable regulations relating to the management of coastal and marine areas and resources.
- A management programme should be developed for the existing Marine Protected Areas (Parc Territorial de Musha, Réserve Intégrale de Maskali-Sud). A feasibility study for the establishment and management of additional MPAs should be conducted. These additional protected areas might include the Sept Frères Islands, Ras Bir and the mangrove of Godoriya. The Sept Frères Archipelago should be included in the UNESCO Programme on Man and the Biosphere.
- A National Integrated Coastal Zone Management Plan is urgently needed. Institutions involved in the management of coastal and marine resources and law enforcement entities need strengthening.
- It is recommended to launch an initiative to rehabilitate damaged coral reefs and mangroves. Monitoring, protection and management programmes should be developed for these habitats.
- A regulatory framework and a programme for visitors to coral reef areas should be developed, including guidelines and moorings for boats.
- A comprehensive fisheries management plan should be developed and should also consider marketing issues.
- A turtle protection and management programme should be developed and implemented.
- A stock assessment of the reef fish population should be made and a man-

agement programme developed and implemented for collection of ornamental fish.

- A programme for development of the fishing community should be initiated, including a poverty alleviation programme.
- A review should be made of current navigation charts, hydrographic resurveys should be undertaken and updated charts prepared for key areas along shipping routes and in the vicinity of key ports.
- Improvements should be made to strengthen monitoring of vessels passing through the territorial waters of Djibouti, communication with vessels and maritime communication systems, in particular at Bab-al-Mandab.
- A regional response plan to fight oil pollution in the Gulf of Aden should be developed; the sub-regional anti-pollution center should be reactivated (including training of the contracting parties' staff, together with drills).
- A feasibility study should be undertaken for development of port reception facilities.
- Installations for collection and treatment of wastewaters should be urgently upgraded.
- Solid waste management and disposal in coastal areas should be upgraded.
- Establishment of a marine biology department and training of Djiboutian personnel in marine biology are recommended.
- An environmental database containing information on living resources should be established and a risk assessment on major pollutants threatening Djiboutian marine ecosystems should be conducted.

Table 10: Priority Actions

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Legislation	Development of national maritime law and revision of related laws	National	Legal framework	**
Environmental management	Strengthened enforcement of legislation related to management of coastal and marine areas	National	Capacity building Technical development	***
Environmental management	Development and implementation of management plan for Marine Protected Areas (Parc Territorial de Musha, Réserve Intégrale de Maskali–Sud)	Local	Legal framework Management information Management programme	***
Environmental management	Feasibility study for conservation and management of additional Marine Protected Areas (including Iles des Sept Frères, Ras Bir, Mangrove de Godoriya)	National Local	Legal framework Management information Technical development	**
Environmental management	Preparation and implementation of a Coastal Zone Management Plan, mangrove management plan and coral reef management plan	National	Legal framework Capacity building Planning framework	**
Habitat conservation	Rehabilitation of coral reefs from damage by visitors	National Local	Legal framework Management information Management programme Public awareness	***
Habitat conservation	Rehabilitation of mangroves from damages caused by landfilling and camel grazing; identification of alternative sources of fuel	National Local	Legal framework Management information Management programme	**

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Tourism management	Development of a framework and programme for visitors to coral reef areas, including guidelines for boats and moorings	National Local	Legal framework Management programme Technical development Public awareness	***
Living marine resources	Development and implementation of fisheries production and marketing plan, based on results of recent stock assessments	National	Management information Production programme	**
Living marine resources	Development and implementation of turtle protection and management programme	National Local	Enforcement Management information Management programme Public awareness	**
Living marine resources	Stock assessment of reef fish population, development and implementation of management programme for collection of ornamental fish	Local	Legal framework Management information Management programme	*
Community development	Development and implementation of poverty alleviation programmes in fishing communities, including provision of basic fishing gear	National Local	Feasibility studies Technical assistance Technical development	***
Navigation risk	Review of current navigation charts, conduct of hydrographic re–surveys and preparation of updated charts for key areas along shipping routes and in vicinity of key ports	Regional National Local	Capacity building Technical development Management information	**
Navigation risk	Improved navigational aids and radio communication, especially along major shipping lanes	National Local	Capacity building Technical development	*
Petroleum development and transport	Revision and implementation of Oil Spill Response Contingency Plan in the framework of the Marine Emergency Mutual Aid Center (MEMAC) in Djibouti	National Local	Capacity building Technical development	**
Industrial development	Preparation of feasibility study and development of port reception facilities	Local	Feasibility study Capacity building Technical development	**
Urban development	Upgrading of wastewater collection and treatment in coastal areas, especially Djibouti town	Local	Feasibility studies Capacity building Technical development	***
Urban development	Upgrading of solid waste management and disposal in coastal areas, especially in the vicinity of Djibouti town	Local	Feasibility studies Capacity building Technical development	***
Institutional strengthening	Establishment of a marine biology department and training of marine biologists and marine ecologists	National	Capacity building Technical development	***
Applied research	Development of database for biological resources and environmental information; establishment of a monitoring programme to support operations and enforcement activities	National	Management information	***

* = important / ** = very important / *** = extremely important

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Country Report

Arab Republic of Egypt

Introduction

The Red Sea and Gulf of Aden represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism. This narrow band of water shared by a number of coastal states is also an important shipping lane linking the world's major oceans. While large parts of the Region are still in a pristine state, environmental threats—notably from habitat destruction, over-exploitation and pollution—are increasing rapidly, requiring immediate action to protect the Region's coastal and marine environment. To this end, a Strategic Action Programme (SAP) has been prepared through a continuous, consultative and cooperative process among the coastal states, coordinated by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA).

The SAP is a programmatic approach to the development of country based regional environmental projects, providing and benefiting from linkages with ongoing regional seas initiatives and major international waters projects. This will assure a concerted approach to transboundary problems, and the realization of regional and global benefits. The SAP has been prepared by a Task Force including PERSGA member states, the Islamic Development Bank, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. Financial support has been provided by the countries of the Region, the Global Environment Facility (GEF) and selected donor organizations. The GEF has approved support for implementation of the SAP, which will be complemented by funding from a variety of international and domestic resources.

The present country report provides background information to the SAP process at the national level. It is based on information from publications and reports, listed at the end of this document, and a rapid assessment survey by the authors of this report.

Background

Egypt is a large country with a relatively long portion of Red Sea coastline (about 1,800 kilometers, see Map of Egypt at end of volume). The estimated annual population growth rate is about 2.3 percent, which means that the population will double in about 32 years (DANIDA, 1995). Population growth is propelling the Egyptian government to take measures to reduce pressures on the country's limited natural resources.

The Red Sea has a surface area of about 44,000 square kilometers. It extends southeast-northwest between 12°N, 43°E and 30°N and 32°E. It. Near latitude 28°N the Red Sea branches to form two gulfs, the shallow Gulf of Suez and the deep Gulf of Aqaba. The Gulf of Suez extends about 255 kilometers with a width of 17-45 kilometers and a maximum depth of about 83 meters (Admiralty Charts, 1985). The bottom morphology of the Gulf of Suez is smooth in general; soft sediments have restricted development of coral reef in almost all the Gulf. The Gulf of Aqaba by contrast is shorter (200 kilometers) but much deeper, reaching about 1,850 meters in the central basin (Friedman, 1985). Its width ranges from 25 kilometers in the south to 16 kilometers in the northern parts. On almost the entire coastline of this gulf, the coastal fringing reef grows luxuriously, varying in width from 10 to 100 meters depending on the slope gradients at the shelf edge.

The Egyptian coast of the Gulf of Aqaba is formed mainly of uplifted fossilized corals followed by a sandy area varying in width and surrounded in most cases by mountains. In contrast, the Gulf of Suez coast is mainly sandy, interrupted in certain areas by small rocky formations. The rest of the Egyptian coast of the Red Sea is similar to that of the Gulf of Aqaba. It runs parallel to the chain of mountains from Suez in the north to Halaib in the south. The Egyptian Red Sea coastline frequently protrudes in the form of rocky headlands referred to along the whole region as Ras. The coastline and outlying fringing reefs are incised at irregular intervals by creeks (drowned stream valleys) known as Sharms.

The greatest developed corals on the Egyptian Red Sea coast occur at the tip of Sinai peninsula at Ras Mohammed, and between Ghardaqah and Safaga. The deep water of the Main Trough (about 1,000 meters) extends right up to the southern tip of the Sinai peninsula and continues to the south to 15°N. In the Hot Brines Region, where the depth is more than 2,000 meters, water temperatures can reach up to 60°C. Salinity is greater than 300 parts per thousand, and the water is rich in trace metals. Twenty hot brines have been discovered to date, ten of which face the Egyptian coastline.

The air temperature in the Egyptian part of the Red Sea ranges between 6°C to 39°C in the north and between 13.5°C to 42°C near the Sudanese border (Morcos, 1970). The northern part of the Red Sea receives about 25 millimeters of rain per year during the six months between September and March, while the rest of the coast is virtually rainless, receiving an occasional shower of a few millimeters every several years. Such low rainfall is accompanied by low humidity for most of the year, except for periods in winter when it reaches about 70 percent in the south.

Given the very high evaporation rates (200 centimeters per year in the Gulf of Aqaba and 235 centimeters per year in the south) and the lack of freshwater input, the Red Sea could be considered the most saline water body in direct contact with world oceans. Salinity ranges from 38 parts per thousand to 42 parts per thousand from south to north, and reaches about 43 parts per thousand in the Gulf of Suez due to high evaporation rates and the extensive salt layers below the bottom.

The tide range on the Egyptian coastline varies between 0.6 meters near the mouth of the Gulf of Suez to about 0.9 meters in the south (Edwards, 1987). The mean sea water level amplitudes are greater in the northern Red Sea than the south, reaching about 12 centimeters at Suez during winter months (Morcos, 1970). Detailed descriptions of Red Sea currents have proven to be difficult (Edwards, 1987), but in general the fundamental movements follow the winds, such that the northerly wind in summer drives surface water south for about four months at a velocity of 12-50 centimeters per second while in winter the flow is reversed, push-

ing water into the Red Sea from the Gulf of Aden.

The situation at the Suez Canal is different, since the canal connects two completely different water bodies (Red Sea and Mediterranean Sea). During most of the year, the water current flows from the Red Sea into the Mediterranean through the canal whereas during August and September, Mediterranean water reaches the Red Sea as a surface current. The salinity in the canal results less from the gradual mixing of water from both seas than from the effects of the Nile water inflow into canal lakes and the high evaporation rates in the Bitter Lakes (Soliman and Morcos, 1990).

The Egyptian Red Sea coast in general has very limited freshwater resources due to its geographical location in the arid sub-tropical region. Groundwater resources along the coast depend mainly on rainfall in certain areas (20-160 millimeters per year). Such areas are characterized by coastal palm groves (Fouda, 1992). Many of the flat coastal plains receive water through wadis during the rainy season in summer but a considerable amount of this water goes to the sea and the rest is stored underground. On the northern part of the Egyptian Red Sea coast at the Gulf of Aqaba, most of the population depends on desalination plants (UNEP, 1985).

The coastline of the Egyptian Red Sea extends about 1,805 kilometers. The longest part of the coast belongs to the Red Sea Governorate (about 1,080 kilometers) and the smallest to the Suez Governorate (220 kilometers). The South Sinai Governorate includes about 225 kilometers on the Gulf of Aqaba and 280 kilometers on the Gulf of Suez. The map in Figure 1 shows the Egyptian coast of the Red Sea and the boundaries of the different Governorates.

The population inhabiting the coastal area of the Egyptian Red Sea is concentrated in a number of cities on the coastline and a few scattered villages in between these cities. In the past most of the inhabitants of the Red Sea coast were originally of two tribes (known as Ababda and Bisharia), while the rest of the population belonged to the upper Egypt emigrants who moved there via the few roads connecting the coast with the Nile valley.

Fishing and sea trading were historically the two major activities in the area. Since exploitation of new resources and activities such as oil, ports and tourism began in the early 1960s, many new settle-

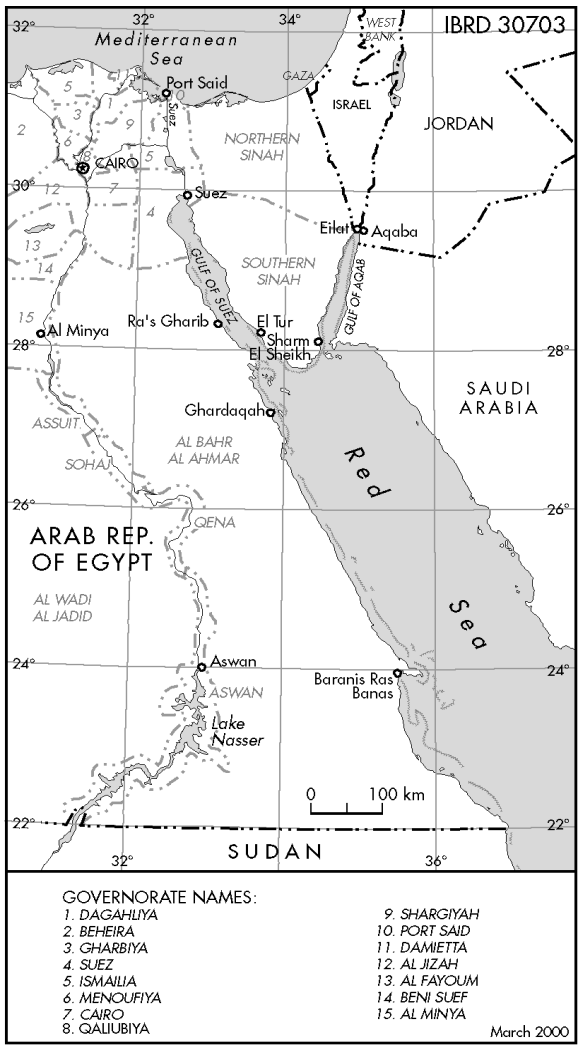

Figure 1. Map showing the Egyptian coast of the Red Sea and the boundaries of the different Governorates

ments have appeared on the coast. There now exist more than twenty-five urban centers scattered along the coast; they vary from a small town with limited harbor facilities to very sophisticated areas such as Aqaba, Suez, Ghardaqah and Sharm El Sheikh. Most of these urban centers are connected via a road network along the coast and have adequate accessibility to the interior. In addition to land travel, Egypt relies on sea transport to connect it with adjacent countries (for example Jeddah-Suez). There are several airports, some of which provide international travel in support of the tourist industry (for example Sharm El Sheikh, Ghardaqah and the proposed Marsas-Alam).

The level of industrialization in most of the coastal area is relatively low (with specialized facilities that include an oil refinery at Suez, fishing, phosphate mining at Safaga, etc.). Thus the coastal region is a focal point of development and construction for commercial, fishing and recreation activities. If growth continues, the population of the urban centers is expected to double approximately every 10 years, and with it the problem of urban waste disposal will grow as well. Table 1 summarizes the population and settlement data of the Egyptian Red Sea coast.

As of 1995, Egypt's GDP was about USD29 billion or about 98 billion LE. It had a total population of 59 million, with a GDP per capita of 1500 LE. The growth rate of GDP was between 6 percent and 7.5 percent. The main economic sectors are agriculture (20 percent of GDP); indus-try (28 percent); trade, finance and insurance (35 percent).

The population is growing at the rate of 2.4 percent per year (DANIDA, 1995). Projected population by the year 2025 ranges from 85 to 96 million (UNEP, 1988).

Relevant economic activities include:

- Agriculture (restricted to Suez Canal region).
- Industry (also along Suez Canal, Gulf of Suez where oil is the main source, phosphate mining in Safaga and El Hamrawan).
- Fisheries/aquaculture (Suez, Sharm El Sheikh and Ghardaqah and Shalateen).
- Tourism/recreation (Gulf of Aqaba, Ain Sukhna, Ghardaqah, and Safaga).

Table 1: Population and Settlements on Egyptian Red Sea Coast

Governorate	City	Population	Major Activities
South Sinai	Nuweiba	15,000	Port, Tourism
	Dahab	10,000	Tourism
	Sharm El Sheikh	20,000	Tourism, Port, Fishing
	El Tur	30,800	Tourism, Port , Fishing
	Abu Rudees	7,000	Oil Fields
Total of South Sinai Governorate		*82,800*	
Suez	Ras Sudr	5,000	Tourism
	Suez	440,000	Port, Fishing, Industry
	Sukhna	500	Tourism
	Zaafrana	1,200	Tourism
Total of Suez Governorate		*446,700*	
Red Sea	Ras Ghareb	5,300	Oil Fields, Industry
	Ghardaqah	46,050	Oil , Fishing, Tourism, Port
	Safaga	11,000	Mining, Port, Fishing
	El Quseir	22,000	Fishing , Mining, trade
	Marsa Alam	1,700	Mining , Fishing
	Abu Ghsoon	2,000	Mining
	Shalateen	1,000	fishing , camel trade
Total of Red Sea Governorate		*89,050*	
Grand Total		**618,550**	

Source: Governorate information centers

Coastal and Marine Resources

The marine resources of the Egyptian Red Sea coast can be classified under three sectors—living resources, non-living resources and human activity. The following section summarizes the various types of resources found along the Egyptian coast of the Red Sea.

LIVING RESOURCES

Coral Reefs

The coastal fringing reef protects coastal areas against wave action and storms, helps to prevent erosion and contributes to the formation of sandy beaches and sheltered harbors. The distribution and development of reef building corals are restricted by several parameters, in particular water temperature, sediment load, salinity, and light intensity. Such factors combined make the Gulf of Aqaba more suitable habitat than the Gulf of Suez for coral reef growth (Ormond and others, 1984).[1]

Seagrasses

Although seagrass distribution on the Egyptian Red Sea coast has not been mapped there have been some studies (Den Hartog, 1970; Lipkin, 1975-77; Aleem, 1979). The size of the seagrass bed increases southward along the coast, which is attributed principally to the wider and shallower shelf, as well as the greater prevalence of unconsolidated sediment.

Seaweed

Several areas with hard substrate are dominated not by corals but by macroalgae (seaweed). This may also occur in areas of shallow corals, forming what is known as an "algal lawn" comprised mainly of small green and brown or red algae. The seaweed in the Red Sea shows a strong seasonal pattern of growth, but given the large number of species recorded (500 species, Papenfaus, 1986) a considerable number are always present. The algal lawns in some reefs have standing stocks of approximately 25 grams dry weight per square meter, with a production rate of up to 20 grams dry weight per square meter per day. These rates are highly affected by both temperature and depth. Seaweed is an important source of food for many marine organisms; recently many species have been proven to have a pharmaceutical value as well (Bhakuni, 1990, Salah El-Din, 1994).

Mangroves

The mangroves on the Egyptian coast of the Red Sea are represented by two species *Avicennia marina* and *Rhizophora mucronata*. The former is the most common, while the second species is only recorded near the Egyptian-Sudanese boarder (Kassas and Zahran, 1967, Zahran, 1977). In general the mangroves of the Red Sea receive less attention than any other habitat despite the fact that they represent the northernmost limits for mangroves in the Indo-Pacific area (28^{o} N).

The productivity of the Red Sea mangroves is generally low, although few quantitative studies have been attempted (Por, 1975; Dor and Levy, 1984; Crossland and others, 1987). Gross productivity of the poorly developed stands in the Northern Red Sea is probably less than 1 kilogram carbon per square meter per year, while in the southern areas of the Egyptian coast it may be at or below 5 kilograms carbon per square meter per year (Ormond and others, 1986; Sheppard and others, 1992).

Fishes

The distribution of fishes in the Red Sea is not homogeneous; many species are found only in the north and central part including numerous endemic ones, particularly amongst dottybacks, wrasses and damselfishes (Sheppard and others, 1992). At present most of the Egyptian Red Sea coast is probably under-fished, a function more of low human population density and poor

1 For updated descriptions and impacts to the coral reefs and associated habitats for Egypt, refer to Wilkinson, 2000, pp 35-54.

communications than deliberate conservation.

Other Animals

The Egyptian Red Sea coast is occupied by a large and diverse number of marine animals that share resources and space, although their harmony may be affected by human interference during exploration of the coastal plains. The marine mammals in the Red Sea include two main classes: the dugong, which occurs in rather low densities throughout the area, and the cetaceans. Other marine mammals recorded from the Red Sea include the Killer whale, False Killer whale, Risso's dolphin, Plumbeous dolphin, Spotted dolphin, Bottle-nosed dolphin and Rough toothed dolphin.

Marine turtles are prominent among Red Sea fauna; all four pan-tropical species have been recorded from the area (Frazier and others, 1987). They include the hawksbill turtle, green turtle, Leatherback turtle and Loggerhead turtle (Frazier and Salas, 1984). The hawksbill turtle is the most common species in Egyptian waters followed by the green turtle. The areas on shore where the turtles choose to nest are limited to a small number of sites in South Sinai and a few spots on the south Red Sea coast. Many turtles are reported to lay their eggs on offshore islands.

The Red Sea is an important route for the Palearctic bird migration and a wintering ground for shore and water birds. Among the most commonly seen birds on the coast of the Egyptian Red Sea are the Gulls, Terns, Herons, Osprey and Boobies, who feed in the more productive shore water and nest in offshore bays and on small islands. Some of the bird populations are large enough to be of global significance, but with the increase in human activities on shore breeding populations may be in danger of disturbance.

Wetlands

The most common type of wetlands on the Red Sea coast are intertidal mud flats which can be found on the Gulf of Suez side of Sinai and the large area at Wadi Kid in the Gulf of Aqaba which extends about 15 kilometers. In the south there are a few scattered mud flats especially at the openings of large Wadis such as Wadi El Jimal. These mud flats provide shelter, feeding and breeding grounds for many species, such as crustaceans, which in turn serve as food for birds.

Tidal pools, characterized by high salinity and temperature, low oxygen content, and fine particle soft bottom, are generally found in bay and sharm areas. They can be as large as a hundred meters. Such pools are considered a nursery for fish fry, which enter during high tide and spend the low tide feeding on plankton.

Salt marshes are commonly found in low-lying areas near the shore, where saltwater is close to the surface. These marshes are dominated by three or four plant species (for example *Halocnemon strabilaceum, Zygophyllum album*). Reed swamps are limited to areas with freshwater sources (for example Wadi El Jimal, Ain Mossah). They are dominated by *Phragmites australis* and *Typha domingensis*. Both types of coastal vegetation are used by migratory as well as resident birds as resting and nesting sites.

NON- LIVING RESOURCES

This section investigates development trends which, if uncontrolled, may lead to degradation of marine and coastal biodiversity. The main issues are oil and natural gas exploration; and coastal energy development.

Oil and Natural Gas

Extraction of oil and natural gas may pose a threat to the Red Sea coast. Although Egypt's oil industry is concentrated on both sides of the Gulf of Suez, oil exploration is now moving out into the Red Sea. The Egypt General Petroleum Corporation (EGPC) is in the process of leasing major blocks of the sea for oil and gas exploration. If oil is extracted, new risks for the

marine environment and new demands for development sites along the coast will arise.

The potentially disastrous impact on the tourism industry of oil spills from a major leak or accumulation of small leaks during operations is a threat to both tourist developments and to marine ecosystems. This issue calls for development of a national Contingency Plan by the Egyptian Environmental Affairs Agency (EEAA) for the protection of the coastal area from the threats of oil pollution, which will be discussed in more detail later in this report. Disputes over land ownership led the Tourism Development Authority (TDA) and EGPC to negotiate an agreement to allocate the coastline between the two organizations and to establish rigorous requirements for environmental assessment of all projects.

New Types of Coastal Energy

The only station for use of coastal energy on the Egyptian Red Sea is located in Ghardaqah. This station belongs to the Ministry of Electricity and Power and is still in a pilot phase. It is a first attempt to use wind power to generate electricity. In a coastal area that is growing as fast as Ghardaqah such a station would solve many problems. In the near future this experimental station could generate sufficient electricity for desalination, tourism villages and other activities along the coast.

The other source of coastal energy of considerable economic importance is the coastal sabkha-evaporate. An ancient source of principal salts, the sabkhas of the Red Sea coasts contain halite, sylvite, polyhalites, gypsum, anhydride, dolomite and other carbonates. The production of such salts depends not only on evaporation but also on many biological processes by microorganisms. The development of such an energy system along the coast of the Red Sea could be of great benefit to the country, but very little information is currently available about this subject, making this source of energy almost invisible.

HUMAN ACTIVITIES

Fisheries

Today large population centers have sprung up along the coasts, and the fishing industry is moving into a more sophisticated phase, raising the need for scientific assessment and management of limited fish stocks (Head, 1987).

Total fish production in Egypt amounts to 407,000 metric tons annually, covering 74.1 percent of the country's annual consumption. In terms of value, domestic fish production contributes 10 percent of the total agriculture production of the country. Of the gross national work force of Egypt, 5 percent are involved in fisheries.

Sea fisheries contribute 22.4 percent of the total annual production. The Red Sea fisheries are the major source of marine fish in Egypt. The recorded fish catch of the Red Sea for 1995 was 47,300 metric tons, representing 11.6 percent of the total fish production (including aquaculture) and 13.7 percent of total fisheries. The sale value of the landed catch in Red Sea ports was 161.3 million LE in 1995.

The main fisheries activity in the Egyptian Red Sea takes place in the Gulf of Suez. In 1995, 24,331 metric tons, representing 51.44 percent of the total fish landed by the Egyptian Red Sea fleet, were caught in the Gulf of Suez. The catch of the Egyptian Red Sea proper comes next, with a total landing of 17,806 metric tons. These together add up to 42,140 metric tons and 89.09 percent of the landed fish. The rest of the landed crop is recorded from Ghardaqah, Halaib and the ports of the Gulf of Aqaba.

Commercial fishes of the Red Sea include 27 species. Out of these, five species constitute 48.23 percent of the catch, with a total of 22.79 thousand metric tons annually. Crustaceans (shrimp and crabs) amount to 10,812 metric tons annually, representing 22.87 percent of the total landing. Major pelagic and demersal fish

represent 23.84 percent and 24.05 percent of the landed fish respectively.

Statistics for the total fish catch of the Red Sea over the last five years show a sharp increase in 1993 followed by a gradual drop in 1994 and 1995 (Table 2). The recorded peak in 1993 is known to have been the result of a dramatic increase in the catch of Indian mackerel, mackerel and sardine that took place that year.

Table 2: Variations in Red Sea Fish Catch 1991-1995

Year	Catch in metric tons
1991	41,935
1992	43,349
1993	50,900
1994	48,342
1995	47,257

Source: GAFRD information center

Fish production activities of Egypt including those of the Red Sea are regulated by the General Authority for Fish Resources Development (GAFRD) of the Ministry of Agriculture. The fishing fleet of the Red Sea consists of 606 motorized units and 932 sail and oaring boats. These are registered in six fishing ports in the Gulf of Suez, Gulf of Aqaba and the Red Sea. The number of motorized Red Sea fishing vessels decreased gradually over the last five years to 76 percent of that recorded in 1990. The power of the fleet, on the other hand, has increased over the same period to a total of 160 thousand horsepower (212 percent increase). This was mainly to allow fishing in more distant waters, especially in the southern Red Sea.

Gear used in Red Sea fisheries includes trawling, purse seine, hook and line and gill nets. The hook and line boats are the most numerous, with a total of 896 vessels of which 289 are motorized. The motorized boats are generally equipped with medium to small horse powered engines and more than 63 percent are below 50 horsepower. The majority of hook and line boats are registered to work in the Gulf of Suez, for a total of 631 units, of which 230 are motorized. The hook and line units of the Gulf of Suez represent 70.4 percent of the total number of hook and liners in the Red Sea and the motorized group represents 9.92 percent of the total horsepower of the Red Sea fleet. The rest of the units are registered in Ghardaqah (162), El Quseir (107) and Dahab (40).

Trawlers are second in number (234 vessels) and are mostly equipped with engines with a minimum horsepower of 150 and a maximum of 1500. The majority of trawlers (69 percent) are equipped with 400-600 horsepower engines and 10.3 percent have more than 1000 horsepower. Total horsepower of the registered trawlers is 117,730, representing 73.8 percent of the total horse power of the Red Sea fleet. All the Red Sea trawlers are registered in Suez, but only 78 are allowed to fish in the Gulf of Suez and the rest in the southern Red Sea.

Purse seiners are all registered in Suez except a single vessel in Ghardaqah, for a total of 83 units. The horsepower of these units ranges from 150 to 800 with 59 percent of the units at 300 to 500 horsepower. The total horsepower of purse seiners is 29,025 representing 18.1 percent of the total power of the Red Sea fleet.

Approximately 17,000 people are employed in the fisheries sector in the area. The majority works in hook and line fisheries, followed by trawling and purse seiners, with the remainder involved in other activities. About 79.1 percent of fishermen are registered in Suez. Ghardaqah comes second, followed by El Quseir, El Tur, Dahab and other towns.

The GAFRD strategy for 1997-2017 has a targeted increase in fish catch of 70 thousand metric tons. It is hoped that this goal can be reached assisted by stock surveys to assess resources using two research vessels supplied through the Japanese foreign assistance program. Two potentially serious problems facing countries bordering the Red Sea and Gulf of Aden are increasing pollution (mainly in the Gulf of

Suez) and degradation or loss of nursery areas. Both could cause declines in yield.

Tourism

Tourism, generally concentrated in the coastal areas, plays a major role in Egypt's economic activities. The main tourist attractions are national parks (for example Ras Mohammed), sand beaches at the Gulfs of Suez and Aqaba and the warm coastal climate from Ghardaqah southward. At present tourism is somewhat affected by marine pollution and occasional accidental oil spills such as one in 1982. However, the primary effects of coastal tourism include, in particular, inadvertent coral breakage by divers (Hawkins and Roberts, 1996); other types of habitat damage; and collection of souvenir species. Secondary effects include a range of impacts from hotels and other infrastructure needed to support an expanding tourist industry (Sheppard and others, 1992).

After oil and foreign remittances, tourism represents Egypt's most important source of revenue. It has and will continue to be a key contributor to national income growth, foreign exchange earnings, employment generation, regional development and population redistribution (TDA, 1995). Tourism has been the fastest growing sector of the Egyptian economy over the last five years, reaching its peak during the first half of 1992. Between 1985 and 1996, the number of international arrivals grew on average by 13.2 percent per year, from 1.3 million in 1985 to 3.4 million in 1996. Over the same period, tourism growth throughout the world increased at an average annual rate of 5.9 percent (TDA, 1996).

The development of the tourist industry in Egypt has been actively encouraged by the Government of Egypt (GOE) in the last decades. Although international tourism has been almost exclusively oriented toward Egyptian antiquities, concentrated in Cairo, Luxor or upper Egypt, coastal tourism first developed on the Mediterranean coast for the domestic market. Twenty years ago, the Red Sea coast began to attract international attention among SCUBA divers due to the quality of coral reefs and underwater life. The all-year pleasant climate, the rich marine environment and the proximity to tourism markets of Europe have provided incentives to develop the Red Sea coast for mass tourism. Market demands studies for the South Sinai where facilities have become only recently available, have revealed a dramatic rate of growth in foreign tourism of 42 percent per year.

The past twenty years have also witnessed a major shift in the tourism industry towards private sector development. The Ministry of Tourism had a special interest in developing the Red Sea coast and Sinai and declared both as high priority areas for coastal tourism development. At the same time the Red Sea Governorate adopted a master plan for Ghardaqah that vastly extended the uses proposed for tourism, especially tourist villages along the coast (about 40 kilometers).

The South Sinai Governorate had a plan for development of coastal cities including Sharm El Sheikh, Dahab and Nuweiba cities. Development was concentrated on Sharm El Sheikh, where almost all the coast has been used for tourist villages.

Rapid and loosely controlled development around the towns of Ghardaqah and Sharm El Sheikh has been undertaken with minimum land use planning. Land was subdivided into relatively small, narrow-fronted lots and allocated for tourism development in an almost continuous belt along the coast. Such continuous development has literally made the beaches inaccessible to the general public. It also drastically changed these coastal cities from nice, calm and secluded places to semi-urban, intensively developed areas. Together with limited knowledge of coastal and coral reef ecological systems, lack of pollution control and enforcement procedures, uncontrolled development has led to

rapid deterioration of coral reefs and loss of the natural tourist attraction of the area.

The Egyptian tourism sector has been reconstructed to improve its efficiency and ability to provide guidance and assistance to investors to make their participation successful and profitable. Accordingly, a national strategy for Egypt's tourism development programme has been formulated, and priority areas and projects identified. Among these, several areas on the coast of the Red Sea and south Sinai Peninsula have been selected, for development as major tourist centers and preliminary planning and feasibility analyses have been prepared for them (Sultan, 1992). Large scale development will be required, not only in terms of basic physical infrastructure, but also in terms of new settlements and the attendant social services needed to house and service new population clusters. The tourist related work force employed in South Sinai, for instance will be approximately 30,000 of which 50 percent will be in direct services (for example catering, reservations, recreation, shopping, etc.). A total of about 40,000 beds are planned to accommodate projected tourist developments by the year 2005, when the number of tourists is expected to reach five million per year. The estimated cost of tourist establishments (hotels and tourist villages) for the Red Sea and South Sinai is expected to be within the range of 3 billion LE, most of which will be spent on infrastructure. In addition, a comprehensive master plan for the establishment of a chain of marinas, serving sea yachts, pleasure boats and floating hotels is being studied in conjunction with international firms (TDA, 1995). The facilities are to be established along the Red Sea coast and the estimated development for Phase 1 of the marinas is in the magnitude of USD50 million.

Transport and Settlements

Ports and settlements are another potential source of pollution. From north to south the coast of the Red Sea has major ports at Nuweiba, Suez, and Safaga, and a number of minor ports at Sharm El Sheikh, El Tur, Ras Gharib, Ghardaqah and El Quseir. Several minor marsas located along the coast are suitable only for small and medium size boats such as Marsa Breaka, Marsa Abo El Darag, Marsa Om Ghaig, Marsa Alam, and Abou Ghossoun, in addition to the military base at Baranis Ras Banas.

Nuweiba is the major port of South Sinai, located near the far end of the Gulf of Aqaba. The city is relatively small (2000 inhabitants, mostly fishermen) but since the opening of the port a gradual increase in population has been noted, most of whom are working in the port and tourism.

Suez City is one of the major ports of Egypt; it includes a transportation port in addition to a fisheries port (Ataka) and a petroleum port at El Zitaiah. Suez is the major link between Egypt and South Asia and is considered the eastern gate to Egypt. It is also the major source of Red Sea fish for the country. In addition, the petroleum industry depends on the Suez ports for export of Gulf production.

Safaga is a town of 11,000, linked to El Quseir and to Qena in the Nile valley by road and rail transportation. The Safaga port is mainly used for export of phosphates produced at the El Hamrawan plant some 50 kilometers further south. It is also used for import of raw materials for the Aluminum Complex at Naga Hamadi. The port is therefore a considerable source of marine pollution, as is the site of the El Hamrawan plant and settlement.

El Quseir is the next town south and has a population of 21,000. Its port is smaller than that of Safaga and is used for export of El Hamrawan phosphates to a lesser extent and also for fishing and transporting potable water to Marsa Alam and southern coastal settlements. To the south of El Quseir there is Marsa Om Ghaig, and Marsa Jebel El Russas, which is used for water storage tanks for Marsa Alam, 15 kilometers to the south. Marsa

Alam itself is a settlement of some 1000 to 2000 persons, connected by road to Idfu in the Nile valley and having a minor marsa for fishing and tourist boats. Although its activities are currently limited, Marsa Alam has potential for future growth. Further south by 70 kilometers, Abou Ghossoun contains some mining activities, a minor settlement of 2000 and a small fishing marsa. The military base of Baranis Ras Banas has a naval base at the Baranis bay as well as an air base at Ras Banas, which can potentially be used as a civil airport. Between Baranis and Halaib at the Sudanese border there are a few small fishing settlements (100 to 200 persons) living in shacks away from the coast.

It should be noted that the growth of port activities as well as settlements supporting the increasing population endangers marine life and tourist activities. Proper planning and control procedures are needed to regulate these activities and to minimize conflicts.

Legal and Institutional Framework

This part of the report encompasses the institutions concerned with management of the coastal and marine environment and resources.

MINISTRY OF TOURISM AND TOURISM DEVELOPMENT AUTHORITY

The Ministry of Tourism (MOT) is the main authority dealing with tourism in Egypt. MOT is divided in four parts dealing with planning and development; regulation of tourism services, administration, and financial and legal affairs. Like many other ministries, MOT suffers from overstaffing, low motivation and inadequate technical capacity. MOT operates in an ad hoc and bureaucratic manner. The decision making process is highly centralized, not only because of the system, but also because of the lack of technical capacity in the various management levels.

In recognition of these deficiencies, MOT is being streamlined to strengthen its technical expertise in support of a private sector-led tourism development strategy, to be competitive with neighboring countries and to protect the unique cultural and natural resources in Egypt from environmental degradation. The first step was the creation of the TDA in September 1991. The TDA draws principally on private sector and academic expertise to assist MOT in planning for the development of Egypt's tourism resources and guiding and promoting increased private investments in the sector. These changes are expected to provide a stronger institutional framework for coherent, private sector oriented and environmentally sound tourism development.

TDA was established with a Board of Directors chaired by MOT and 16 other members representing the public and private sectors, and a Managing Director. The Board of Directors is the supreme authority for setting policies concerning TDA's activities, for approval of TDA's work programme and annual operating and capital budgets, for making decisions on allocating land and giving development rights to private sector developers in areas designated as tourism zones, for approving cost recovery policies for tourism related services, and for contracting loans for TDA. The initial by-laws of TDA have been approved. As TDA activities grow, it is expected that these by-laws would be suitably amended and enlarged to reflect growing environmental concerns and experience gained in the implementation of its policies.

The Chief Executive Officer (CEO) of TDA is appointed by Presidential decree. At this stage of TDA's operations the CEO is assisted by an Adviser with broad based experience in tourism and a Financial Adviser. The TDA is organized into a number of functional departments. The Technical Department has three units: Planning and Project Preparation, Environment, and Project Implementation. The Environment Unit consists of two well-qualified university based consultants. TDA is a small organization and intends to remain so with a

small number of high caliber staff on a permanent basis and will contract out specific tasks to outside consultants as much as possible.

EGYPTIAN ENVIRONMENTAL AFFAIRS AGENCY

According to the Law of the Environment (Law No. 4 for the year 1994) the EEAA was established within the Prime Minister's Cabinet, and replaced the Agency established by Presidential Decree No. 631/1982 in all rights and obligations. The EEAA has a public juridical personality and is affiliated with the competent Minister for Environmental Affairs.

The Agency formulates the general policy and prepares the necessary plans for protection and promotion of the environment. Also, it follows up the implementation of such plans in coordination with the competent administrative authorities. The Agency is the competent national authority for strengthening environmental relations between Egypt and other countries, and the regional and international organizations. Also, the Agency recommends the necessary legal procedures to join regional and international conventions related to the environment, and prepares the necessary draft legislation and decrees required for implementation of these conventions. ICZM, protection of water environment, Environmental Impact Assessment (EIA), environmental monitoring networks, management and supervision of natural protectorates are among the areas regulated and addressed in the different articles of the Law of the Environment. This represents a significant strengthening for EEAA and reflects the government's determination to give environmental protection much more serious attention than in the past. The law establishes an environmental branch in each Governorate for which EEAA will provide technical supervision. Recruitment of significant numbers of additional staff is intended for EEAA, along with establishment of the International Cooperation Unit to assist EEAA in negotiations with donors on the National Environmental Action Plan (NEAP) and related policy and project implications.

In order to effectively implement the EAP, further strengthening of EEAA's role is needed, and should focus on the following: effective powers to coordinate environmental activities of government agencies; development of an integrated monitoring and information system; key role in EIAs; expansion of the protected areas system including management capability; and enforcement of environmental standards and requirements. To ensure that the above transpires, the GOE intends to provide strong political backing and increased human and financial resources.

The NEAP was prepared in early 1991 to strengthen the management of environmental affairs in Egypt, and was presented in an International Donor Conference in Cairo in 1992 in cooperation with the World Bank. At the outset, it was recognized that environmental management is complex and multi-sectoral in nature. Therefore it was considered important to involve sectoral ministries, research and educational institutions, as well as NGOs in a truly national effort to prepare an action plan for improved management of Egypt's environment.

RED SEA COASTAL GOVERNORATES

The Egyptian coast of the Red Sea is under the supervision of three Governorates, the Red Sea, Suez and South Sinai. Although responsibilities and powers are centralized in sectoral ministries, the Red Sea coastal Governorates have a budget for administration and social and economic development at the provincial level. The Governor controls the local administrations in the Municipalities of the major cities, and has the responsibility for coordinating activities of different ministries within the Governorate.

However, the Governorates have limited technical staff and are therefore weak on implementation and particularly enforc-

ing regulations. It is necessary to strengthen the capacity of the Governorates in planning and management of development along the coast. An environmental unit is being established in each Governorate to work under the guidance of EEAA as a branch office of the Agency. This local level of environmental monitoring and control and enforcement must be made effective if coastal zone management goals are to be realized. Professional and technical staff must be attracted to work in the Governorates by defining increased responsibilities and clear procedures for the work of the local environmental offices.

EGYPTIAN GENERAL PETROLEUM CORPORATION

The EGPC is the government agency responsible for oil and gas exploration and controls the activities of international oil companies. New exploration licenses for a large number of offshore blocks are due to be issued soon. It is anticipated that gas is more likely to be found than oil. The EGPC has developed an oil spill response capability in Ras Ghareb on the Gulf of Suez, approximately 100 kilometers north of Ghardaqah, and is also considering establishing another oil spill response station in Ghardaqah to be tested during October 1996. Petroleum exploration and operation companies operating in the Gulf of Suez are required to have oil-combating capability. But contingency planning, decisional hierarchy and communication networks are inadequate to provide a rapid and integrated response capability. The available equipment is only suitable for tackling small spills in relatively good weather.

TDA and the EGPC have reached an agreement on allocating parts of the Red Sea coast for development of either oil or tourism and some areas for mixed use. The agreement places requirements on oil exploration companies to carry out EIAs and respect the environment. Although not involved in the agreement, EEAA supports the arrangements and has ultimate responsibility for ensuring that oil and gas exploration and exploitation have no adverse impacts on the marine environment.

THE NATIONAL COMMITTEE FOR INTEGRATED COASTAL ZONE MANAGEMENT

Directly after the Law of the Environment was issued in 1994, the EEAA initiated action for establishment of a National Committee for Integrated Coastal Zone Management (NCICZM). The ministerial decree establishing the committee was issued in 1994 and amended in 1996. It included 16 members representing EEAA (2), Ministry of Public Works and Water resources (1), Ministry of Housing (2), Ministry of Agriculture (1) Ministry of Maritime Transportation (1), Ministry of Tourism (1), Ministry of Planning (1), Ministry of Scientific Research and Technology (1), Ministry of Defense (1), Ministry of Local Government (1), Ministry of Electricity and Energy (1), National Water Research Center (1), and NGO representatives (2).

The main objectives of this committee are to:

- Draft and approve general guidelines for all activities, including the EIA.
- Coordinate all coastal activities among the competent authorities in order to put integrated coastal zone management into effect.
- Ensure that all activities in the coastal area have contingency arrangements.
- Find a balance between the proposed development activity and the carrying capacity of the ecosystem, with a view to sustainable use of available resources.
- Ensure active participation in drafting and preparing the ICZM plan.
- Approve programmes and plans aiming at restoring and rehabilitation of coastal ecosystem under stress.
- Study and evaluate all major projects to be executed in the coastal zone.

- Coordinate and specify mandates for different authorities in the coastal area.

One of the most promising products of this committee is the framework for an Egyptian ICZM programme, which produced the first document in December 1996 with the help of DANIDA (Denmark) and DGIS (Netherlands). This document included an identification of the coastal zone, a complete description of Mediterranean and Red Sea coasts of Egypt and the results of the Ghardaqah Workshop held during May 1995.

Other Agencies and Institutions

A number of other government agencies are responsible for the protection of the marine environment. In addition to the EEAA, the following are identified in the Environmental Law as being involved in the management of the Red Sea and Egypt's coast line: Port and Light House Authority, Suez Canal Authority, Suez Port Authority, GAFRD and the General Organization for Coastal Protection.

Other agencies may be identified by Ministerial decree as having powers and responsibilities for marine environmental matters. Concerned agencies are responsible for carrying out enforcement under their own jurisdictions. No structure currently exists to connect these agencies together to deal with problems. Laws and regulations are overlapping, unclear, lacking detail, or absent. Fines are too low and resources for monitoring and enforcement are inadequate to provide an effective deterrent against pollution by ships, or activities of other public and private interests that cause damage or destruction to marine ecosystems. Each agency has its own priorities determined within the organization, rather than according to an integrated strategy for conservation of Red Sea natural resources.

The National Institute of Oceanography and Fisheries (NIOF) has a major research center in Suez and another research station at Ghardaqah. It belongs to the Ministry of Scientific Research and has been investigating fish and corals around Ghardaqah for more than 70 years. This institute is also concerned with fisheries research in the Red Sea area.

A number of Universities have established research centers with teaching facilities and laboratories for the marine and coastal environment. For example, the Suez Canal University has a research center in Sharm El Sheikh doing research on different aspects of marine life in the Red Sea. The University Campus at Assiut has plans to establish a marine research center at El Quseir on the coast. Such centers are a potential resource for undertaking survey and monitoring work during the next years, but lack of proper equipment and financial support is the main obstacle to carrying out their research.

Agreements, Laws and Legislation for Protection and Management of the Marine Environment

The Red Sea is under the legal stipulations of:

- Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment and its Protocol concerning Regional Co-operation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1982).
- The International Convention for the Prevention of Pollution of the Sea by Oil, London 1954 and its Amendments.
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar 1971.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES, Washington 1973.
- Convention on Biological Diversity 1992.

- United Nations Convention on the Law of the Sea, that Egypt has ratified by Presidential Decree.
- The International Convention for the Prevention of Pollution from Ships (1973 and 1978). Egypt adhered to the Convention by Presidential Decree. No. 152/1986.
- The international Agreement on the Civic Responsibility on Oil Pollution, signed in Brussels in 1969, to which Egypt has adhered by Presidential Decree. No. 478/1988.
- The African Agreement for the Conservation of Nature and Natural Resources (Algiers 1988), ratified by Egypt.
- Public Law No. 72/1968 on the Protection of Sea Water against Oil Pollution.
- The Ministry of Defense's Decree No. 56/1962 on the Cleanliness of Ports and Territorial Waters, in compliance with the Public Law No. 280/1960 regulating Ports and Territorial Waters.
- Presidential Decree No.1948/1965, establishing a standing committee for the Prevention of Marine Pollution with Oil, amended by the Decree No. 691/1972.

In 1983, the Egyptian Conservation Law No. 102 set up the legislative framework for establishment of protectorates. There are two protected areas that include coral reefs and mangrove stands along the coast—Ras Mohammed Marine National Park (including Tiran and Sinafir Natural Reserves) and Jebel Elba Conservation Area.

The first unified Egyptian Law of the Environment was passed in February 1994 (Law No. 4/1994). This law defines the role of EEAA as an overall coordinating authority with specific responsibilities for setting environmental standards, ensuring compliance with these standards, preparing master plans for environmental management in cooperation with other relevant authorities, establishing a national monitoring network, implementing pilot projects and compiling and disseminating environmental information. This law also specifies legal and economic enforcement instruments including permitting procedures and the establishment of environmental funds.

Threats to the Environment

Egypt has recently established important interests along the Red Sea. Egypt earns about USD1 billion annually from approximately 20,000 merchant ships and smaller tankers sailing through the Suez Canal and the Egyptian economy has benefited recently from oil and tourism revenues along the Gulf of Aqaba as well as the rest of the Red Sea coast.

The current exploitation of natural resources is causing great economic and ecological changes. The coastal zone in Egypt is undergoing rapid and uncontrolled economic development, which results in intensified environmental problems. Conflicting human interests are taking a toll of the region's natural resources. In particular, the oil and tourism industries are a source of environmental problems that pose a serious threat to achieving sustainable development.

The nature and magnitude of pollution problems in the Red Sea do not necessarily follow trends elsewhere in the world. In particular, the enclosed nature of the Red Sea in conjunction with the limited water exchange with the Indian Ocean considerably reduces the potential for dispersion of pollutants. Much of the input of contaminants is to geographically localized areas around urban and industrial developments. More widespread and general contamination may be expected from the considerable and probably increasing ship traffic through the Red Sea to and from the Suez Canal, or from super tanker traffic to and from oil terminals.

OIL AND GAS

Oil and gas exploration on the Egyptian coast of the Red Sea is concentrated in the Gulf of Suez area. The construction of the Trans-Suez pipeline with a terminal at Ain Sukhna contributed significantly to pollution in the northern part of the Gulf. The main sources of offshore oil are the oil fields in the central Gulf of Suez at Ras Gharib and Ras Shoukeir on the western coast and Abu Rudees and Abu Zenimah on the eastern coast of the Gulf. Largely as a result of ineffective and inefficient operation of equipment, illegal discharge of dirty ballast water from tankers and lack of supervision, small spills may occur on a monthly basis, allowing small quantities of oil to drift to shore in this area and the adjacent waters. Expansion of oil exploitation increases the possibility of major spills such as that of 1982 when 75 percent of the Egyptian Red Sea coast was blanketed with oil, affecting the intertidal and sub-tidal marine habitat.

The other oil related threats to the marine environment are the seismic explosions during oil exploration. This type of test causes a great deal of damage to the reef in the area, and with the extension of oil exploration activities further to the south the danger will spread to the reefs of the areas (Fouda, 1983).

The number of oil fields in the main production area at the Gulf of Suez has increased during the last few years to about thirty-seven fields. In addition, twenty-three separate oil wells are operational. Each of these fields can be considered a possible source of oil pollution at any given time. Monitoring for leaks and spills from these fields is lacking. Due to the shallow nature of the Gulf and to the currents, the spread of any major spill in this area will have an enormous effect on marine habitats.

The total production of oil fields in Egypt is about 44,226 metric tons as of the last year reported (General Petroleum Corporation report, 1994). The production on the Red Sea coast at the Gulf of Suez and the coasts of Sinai was about 88.8 percent of total oil production (39,311 metric tons). This represents a considerable percentage of the Egyptian economy through export (USD2.35 billion per year). Current investment in oil production is about LE 5,854,308,000, with an interest rate of 14.3 percent. A very small amount of this money could be used to construct monitoring stations along the coast, and/or for early warning units, which would benefit other industries threatened by such pollution as well.

SEWAGE AND SOLID WASTE

The greatest single input from urban contributions to the sea is sewage. Sewage (treated and untreated) is usually discharged to, or just below, the intertidal zone via pipelines, and is thus mostly a coastal problem. The composition of sewage varies considerably, but major effects reported in the scientific literature result from increased nutrient and suspended solid loading or from human health problems associated with coliform bacteria on recreational beaches. More widespread although less significant contributions of sewage result from ship traffic and offshore platforms.

In addition to sewage, considerable amounts of garbage (especially plastic containers) also enter the sea from urban and recreational areas and from ship traffic and offshore platforms. When combined with oil pollution, solid waste can seriously inhibit clean-up operations. During the last year the problem of solid waste disposal has attracted the attention of some organizations, for example in Ghardaqah during the last flooding. The study of this problem will take several months and it may be years before a solution is found due to lack of proper funding and experience in this field.

INDUSTRIAL EFFLUENTS

On the Egyptian coast of the Red Sea inputs of phosphate, manganese and bauxite

minerals, through loading onto ships, are major pollutants. In the Safaga area and at shipping ports in the Gulf of Aqaba, death of corals was observed to be four to five times greater in the area of phosphate spillage than in a control area (Walher and Ormond, 1982). This type of pollution is not taken into consideration by Egyptian authorities and its effect on the marine environment has never been evaluated. Among the industrial wastewater inputs are desalination effluent, fertilizer plant effluent, such as urea in Suez, and refinery and other industrial effluent containing heavy metals. Elevated concentrations of lead, mercury and copper in bivalves and fish have been reported around some industrial areas.

LANDFILLING

Land reclamation, landfilling and coastal road construction also affect shore zones and nearshore waters. Apart from loss of sea area, sediment loading affects coastal habitats in a similar manner to dredging. At least part of a motorway construction on the Red Sea coast from Suez to Halaib follows the shoreline, causing some damage to the reef flat lagoons. Any further construction of this type could cause serious losses to coastal habitats. Tourism may also produce both direct and indirect effects on coastal resources and is currently growing rapidly on Red Sea coasts, in particular around the Gulf of Aqaba and Ghardaqah. Construction of coastal hotels and roads may result in similar problems to those noted immediately above. The increased numbers of people produce more sewage requiring disposal, and discharges diminish the quality of the very amenities that attract tourism in the first place, that is, the clean beaches and spectacular underwater reefs. Dredging, land reclamation, blasting and jetty construction may all cause localized effects, and subsequently during operation the discharge of effluents may cause local or more widespread problems. Two other activities with impact on marine life are collection of marine organisms, which in the long run will cause loss in diversity, and small boat usage, which can degrade corals through improper anchoring (Fouda, 1990).

SEDIMENTATION

Sedimentation is the settling out onto the seabed or shore of significant quantities of silt, sand or other materials put into suspension in the marine environment by various agents including human activities. It is possibly the major cause of damage to marine habitats throughout the tropics. Unfortunately, because sedimentation is not readily perceived as a form of pollution, and because silt and sand are major natural constituents of the seabed and shore, the damage that sedimentation can and is causing in the marine environment is rarely appreciated, by developers, government officials or the general public.

Sedimentation problems are quite obvious in the Ghardaqah area, where many the hotels and recreational facilities have altered the shoreline through landfilling, channel cutting, etc. Although dredging is rarely required, the practice of landfilling along the coast is becoming more prevalent, and this damages or destroys coral and seagrass communities.

COASTAL CONSTRUCTION WORK

Coastal construction work can include the construction of harbors, jetties, and residential or industrial sites on the intertidal or immediate supratidal zone. These activities can result in direct destruction of coral communities, seagrass beds, mangrove stands, mud flats, halophyte vegetation or other natural habitats. Such damage is not yet extensive in the Red Sea area, but it is occurring with increasing frequency, mainly around the major towns.

In addition to major municipal and industrial projects, it is becoming common for individual landowners to construct private jetties and to dredge small boat channels through the fringing reef. Jetties not only damage reefs, they also can cause the area downstream to become stagnant. Marine life then succumbs to the sedimenta-

tion and raised temperatures that occur in such enclosed shallow water areas.

Perhaps the most serious aspect of the current expansion of urban regions is the strong tendency for development to occur in strip-like fashion along the coast. There is an expanding need for ports and docking facilities, and residences with access to the shore are sought after. Industries often prefer to locate major plants along the coastline where cooling water and private docking facilities are available and in order to facilitate waste disposal. Development along the coastline inevitably leads to a slow degradation of the littoral and sublittoral environment. The problem of coastal construction work is clear all over the coast from Ain Sukhna at the northern Gulf of Suez to the Ghardaqah-Safaga area. Construction materials are stored on the shore and some are lost with the tides. In addition, insufficient impact assessment studies supplied by landowners for their projects often allow many environmentally hazardous activities to take place in coastal areas.

Fishing and Other Forms of Exploitation

Uncontrolled fishing or certain types fishing may lead to deterioration or complete loss of fish resources. In Egypt, intense efforts have been made in the last ten years to modernize and expand the fisheries, and it seems likely that increasingly careful fisheries management will be needed to ensure that sustainable yields are not exceeded.

Spear fishing is most commonly done by visitors with no personal interest in "sustainable yields" and is therefore in competition with local fishermen. It also tends to be conducted on the more accessible and attractive reefs most valuable for recreation and tourism. Spear fishing rapidly leads to the elimination of favored food species such as grouper and snapper; Spear fishing is theoretically banned in Egypt, but it is hard to control fishing by divers from yachts that enter territorial waters without passing through local immigration controls.

There is also direct exploitation of other natural resources of the Red Sea. These include turtles, nesting birds, shellfish, sea cucumber, black coral and mangrove wood. On the whole, the level of exploitation has been low and sustainable. While the use of such resources in the past has had little or no environmental effect, this may no longer be the case. The coastal populations in some areas are now much greater, access to the coast is much easier, and people are becoming equipped with modern diving gear, guns and engine-powered boats. Few local inhabitants have been educated to have any concern for the long-term health of the environment, but most wish to acquire material possessions and are becoming more aware of the economic potential of Red Sea resources.

Visitor Impacts

While recreation and tourism present major reasons for protecting the coastal and marine environment, uncontrolled use by visitors can itself result in serious impacts. Extensive collection of corals, shells and other reef animals, spear fishing, damage to corals by swimmers and anchors, destruction of coastal vegetation by trampling and vehicles, and proliferation of waste and garbage, are the types of damage that may be caused by visitors and tourists.

In countries where diving tourism is important, such as Egypt, the main noticeable impacts have been due to anchor damage, coral collection, spear and hand line fishing at the most popular diving sites, and collection of corals, shells and other souvenirs by fishermen and merchants for sale to tourists.

The uncontrolled use of the reef around Ghardaqah area may be a problem in the near future. The number of diving sites (reefs) visited by boats in a single day may exceed the monthly capacity of the

reef. Controlling the number of divers is a priority in this area.

In Egypt especially, there may be a threat resulting from the demand for dried and inflated puffer fish as souvenirs. In particular many specimens of the puffer *Arothron hispidu*s are made into lampshades. This fish is a major predator of the Crown-of-Thorns Starfish and of the needle-spined sea urchin *Diadema setosum,* both of which can cause extensive damage to corals. There is evidence that reef damage near Ghardaqah by abundant urchins may be related to the elimination of their predators in this way.

Recent and Current Initiatives

Most of the recent and current initiatives in the coastal area of the Red Sea have the EEAA as a common feature.

THE GLOBAL ENVIRONMENT FACILITY PROJECT

The Egyptian Red Sea Coastal and Marine Resource Management Project (GEF) is a World Bank funded project, with three Egyptian partners, the Red Sea Governorate, TDA and EEAA. The project area covers the Egyptian coast of the Red Sea proper, extending from about 40 kilometers north of the city of Ghardaqah to the Egyptian Sudanese border at northern latitude 22°.

According to World Bank documentation, the project duration is 36 months; it has 6 main components and a preparatory phase. The components include:

- Coastal Zone Management.
- Environmental Assessment Capability.
- Marine Pollution Control.
- Reef Recreation Management.
- Marine Protected Areas Programme.
- CZM Monitoring and Evaluation.

GUIDELINE FOR ENVIRONMENTAL IMPACT ASSESSMENT

This guideline was issued by the EEAA in October 1996. Its main goal is to clarify various aspects of EIA in accordance with Law No. 4/1994. It also includes the different categories of projects and the EIA procedures EIA for each category. In addition, the guideline summarizes the sections of Law No. 4/1994 that regulate environmental impact assessment studies.

ENVIRONMENTAL GUIDELINES FOR DEVELOPMENT OF COASTAL AREAS

This booklet was issued by EEAA in March 1996. It summarizes the main guidelines concerning development of coastal zone areas, which fall into 13 categories. These are as follows:

- Fundamental principles.
- Identification of the setback line.
- Identification of coastal building front line (CBFL).
- Identification of reef protection line (RPL).
- Erosion and sedimentation.
- Establishment of marinas, embankments and jetties.
- Rules for mooring and anchoring in the Red Sea.
- Regulation of diving and water sports.
- Regulation of public beaches.
- Hotel ships.
- Aquaculture.
- Establishment of oil and gas installations.
- Establishment of infrastructure components.

In addition, the guideline identifies conditions for tourism development area planning and the components for environmental impact assessment of different projects on the shoreline.

THE ENVIRONMENTALLY SUSTAINABLE TOURISM PROJECT

The ECO-TOURISM project is funded by the United States Agency for International Development and is one of the activities being sponsored by the US/Egyptian Partnership for Economic Growth and Development (Gore-Mubarak Initiatives). The project is being carried out by Winrock International, Environmental Quality International and George Washington University. The first document issued by this project concerning the policy framework was in January 1997. The main objectives of this project are to assess the current status of protected area resource management, propose measures for remediation of environmental degradation, and increase the role of the private sector in handling environmental problems.

The second document issued by the project included the Mid-Project status update. This document indicated the achievements of the project during the first year, among them the installation of 250 mooring buoys from Ghardaqah to Safaga, which contribute to protection of the reefs in these areas.

DANISH-EGYPTIAN DEVELOPMENT COOPERATION IN THE ENVIRONMENT SECTOR

During the UN Conference on Environment and Development (UNCED) held in Rio in 1992, Egypt embarked on the formulation of a NEAP, supported by the World Bank in association with bilateral donors including DANIDA. The programme of cooperation signed by the two countries included a list of 27 potential cooperation projects to be studied and prepared for possible implementation. Among these projects was development of a National Coastal Zone Management Plan that was supported by DANIDA in both a Ghardaqah workshop and a Cairo Seminar. Under the umbrella of coastal zone management, there are several projects running in coordination with Egyptian organizations which could be summarized as follows:

- National CZM workshop and Seminar (1995) DANIDA (USD0.1 million) / Netherlands (USD0.1 million)/ Government of Egypt to support the inter-ministerial committee in preparing a national CZM plan.
- Technical Assistance to the Shore Protection Authority (1996-1997) DANIDA (USD1.0 million) / SPA (Ministry of Public Works and Water Resources), which included strengthening of SPA capacity in coastal engineering, planning and physical impact assessment.
- National Oil Spill Contingency Plan (1996-1998) DANIDA (USD1.6 million)/EEAA/Ministry of Marine Transport. This included updating and revision of the National Oil Spill Contingency Plan and the establishment of a command center for oil spill response.

Priority Actions

An action plan for the marine and coastal area of the Egyptian Red Sea should be formulated according to the needs of the region as perceived by the Governorates concerned (Red Sea, Suez and South Sinai) and must be coordinated with the activities of the GEF project, the TDA plan for the coastal areas, EEAA guidelines for coastal zone management and other relevant activities in the coastal area.

The nature of environmental problems will differ to some extent among the Governorates, as each have problems that could be selected as top priority for certain areas by the Governing Council. At the same time some problems are regional and can best be resolved through a cooperative program.

During the workshop held in Cairo, and following communication between the different Governorates a number of issues were identified as the main environmental

problems in the Egyptian Red Sea coastal area. These are:

- Shoreline erosion and flooding.
- Urbanization and irrational land use.
- Pollution.
- Deterioration of natural resources and habitat.

The action plan, originally designed for protection and enhancement of regional bodies of water and adjacent coastal areas, will need to address organizational issues on the national, regional (governorate) and local levels. The flowchart (Figure 2) shows the proposed organizational structure and links between the different levels. It should be noted that at the national level the need to establish a new organization could be avoided if the NCICZM, which already exists in the EEAA structure were slightly modified to assist in addressing governorate and local needs in implementation of the plan.

Including the three concerned Governorates will help in linking the planning and implementation processes. Each Governorate should determine the criteria by which its region is to be defined in order to ensure that the action plan is responsive to those particular characteristics. This will require cooperation among diverse sectors and interests, including coastal settlements, industry, agriculture, fisheries, human health, transportation, science, and indeed the full range of human activities in the region.

The action plan for protection of the marine and coastal area of the Egyptian Red Sea coast should be carried out in three main phases:

- Preparatory Phase: This will include data collection about the present situation, revision of all available materials and identification of gaps in information. This should be carried out at the national level with the help of local experts and international consultants as needed.
- Adaptation of the Action Plan: This phase would include organization of seminars and workshops on the local and regional levels in addition to an inter-Governorate meeting in order to adapt suggested actions to the needs of the different Governorates. The national committee should nominate an expert or consultation group to resolve differences between participating regional groups.
- Operational Phase: This will include implementation of the action plan at the local and regional level. During this phase the National Committee should supervise implementation and organize meetings between the different Governorates to ensure sharing of information and experiences.

There are two types of priority actions needed for protection of the coastal areas of the Egyptian Red Sea. The first includes regional problems that call for short-term actions at the local and regional level, with national supervision as needed. The second type includes problems of a national nature that require long term action on all levels and national implementation with possible international assistance. Table 3 summarizes some of the main priority actions. The flowchart in Figure 3 shows the proposed plan of action for Egyptian Red Sea coastal area.

Table 3: The Proposed Priority Actions Needed for the Red Sea Area

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Legislation	Review and update of existing regulations for protection of natural resources	National Local	Legislative framework	***
Legislation	Review and update of existing pollution control regulations	National Local	Legislative framework	***
Institutional strengthening	Training programmes for strengthening institutional capacities of agencies involved in management of Red Sea coastal areas	National Local	Capacity building	**
Institutional strengthening	Establishment of water pollution monitoring units for Red Sea linked to the national level	National Local	Management information Capacity building Technical development	**
Environmental Management	Development of National Coastal Zone Management Plan for Red Sea coast, including the Gulfs of Aqaba and Suez	National Local	Legal framework Management information Management programme	***
Environmental management	Strengthened enforcement capacity of Egyptian Environmental Affairs Agency	National Local	Capacity building	***
Habitat conservation	Effective enforcement of Law 4/94 for protected areas	National; Local	Capacity building Enforcement	***
Living marine resources	Review and update of current fishery legislation	National Local	Legal framework	***
Living marine resources	Establishment of a stock assessment database	Regional National	Management information Capacity building	**
Living marine resources	Development and adoption of improved fishing techniques	National Local	Capacity building Technical development	**
Living marine resources	Establishment of Marine Protected Areas at priority sites	Regional National Local	Preventive action Capacity building Technical development	***
Navigation risk	Development and implementation of sub–regional vessel traffic systems for the Gulf of Aqaba and Gulf of Suez	Sub–Regional National Local	Preventive action Capacity building Technical development	***
Navigation risk and pollution control	Establishment of a Regional Emergency Aid Center in Ghardaqah, with Egypt providing the land and infrastructure	Regional Sub–Regional National Local	Preventive action Capacity building Technical development	**
Navigation risk and pollution control	Provision of adequate reception facilities for oily wastes in Egyptian Red Sea ports consistent with MARPOL (1973–1978)	Sub–Regional National Local	Preventive action Capacity building Technical development	***
Petroleum development and transportation	Development of an Oil Spill Contingency Plan	National Local	Preventive action Capacity building Management information Technical development	**
Petroleum development and transportation	Preparation of guidelines for the use of dispersants for use in oil spills given the ecological vulnerability of the Red Sea	National Local	Technical development	**
Urban and industrial development	Development of an evaluation of point source pollution from urban and industrial sites	National Local	Environmental information Capacity building	**
Urban development	Development of a National Plan for Solid Waste Management in coastal cities in the Red Sea	National Local	Planning studies Capacity building Technical development	***
Urban development	Public awareness programme for recycling of wastes in coastal areas	National Local	Feasibility studies Capacity building Technical development	**
Urban development	Shoreline profiling programme and identification of “hot spots”	Local	Technical studies	**

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Urban development	Evaluation and implementation of flood control measures to protect coastal zone and marine environment	Local	Management information Capacity building Technical development	**
Urban development	Establishment of flood prediction and warning centers	Regional Local	Capacity building Technical development	**
Urban development	Support for the expanded use of flood water in agriculture	Local	Capacity building Technical development	**
Environmental information	Creation of an inventory of land resources of the coastal areas as an element of a national GIS database	National Local	Management information Capacity building Technical development	**

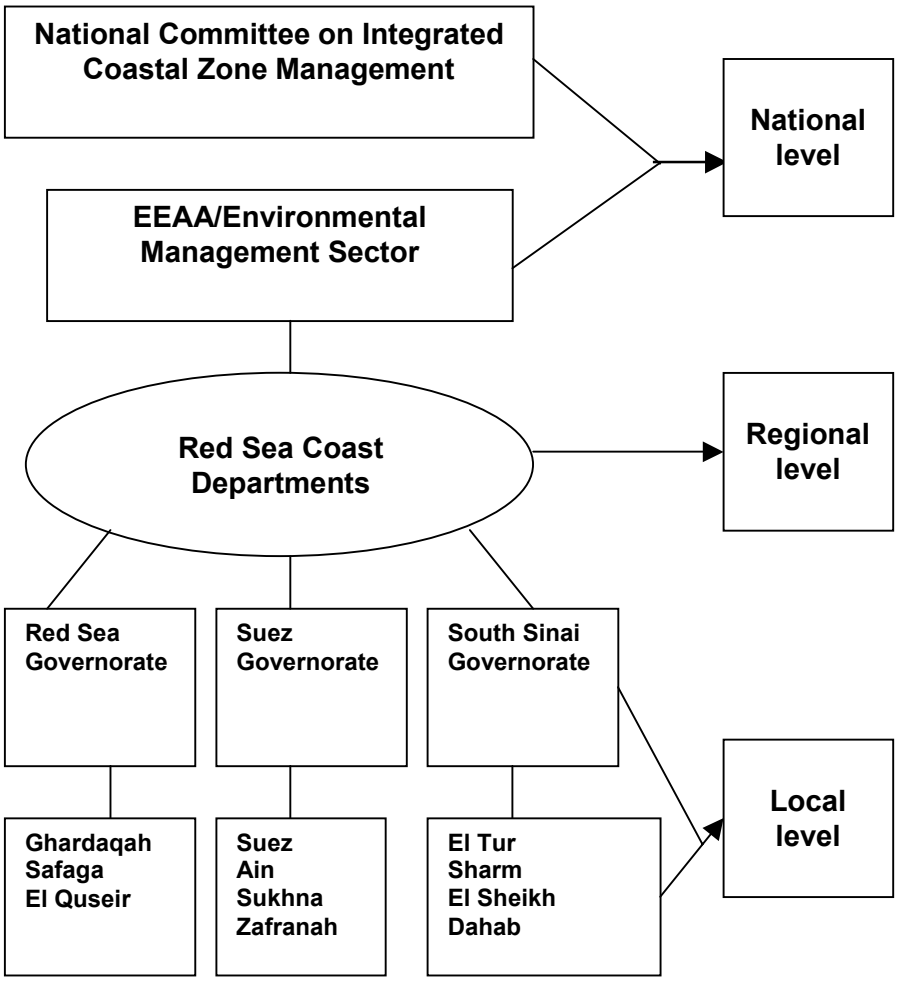

Figure 2. Flowchart showing the proposed organizational structure of the action plan institutional arrangement and the interrelations between the different levels

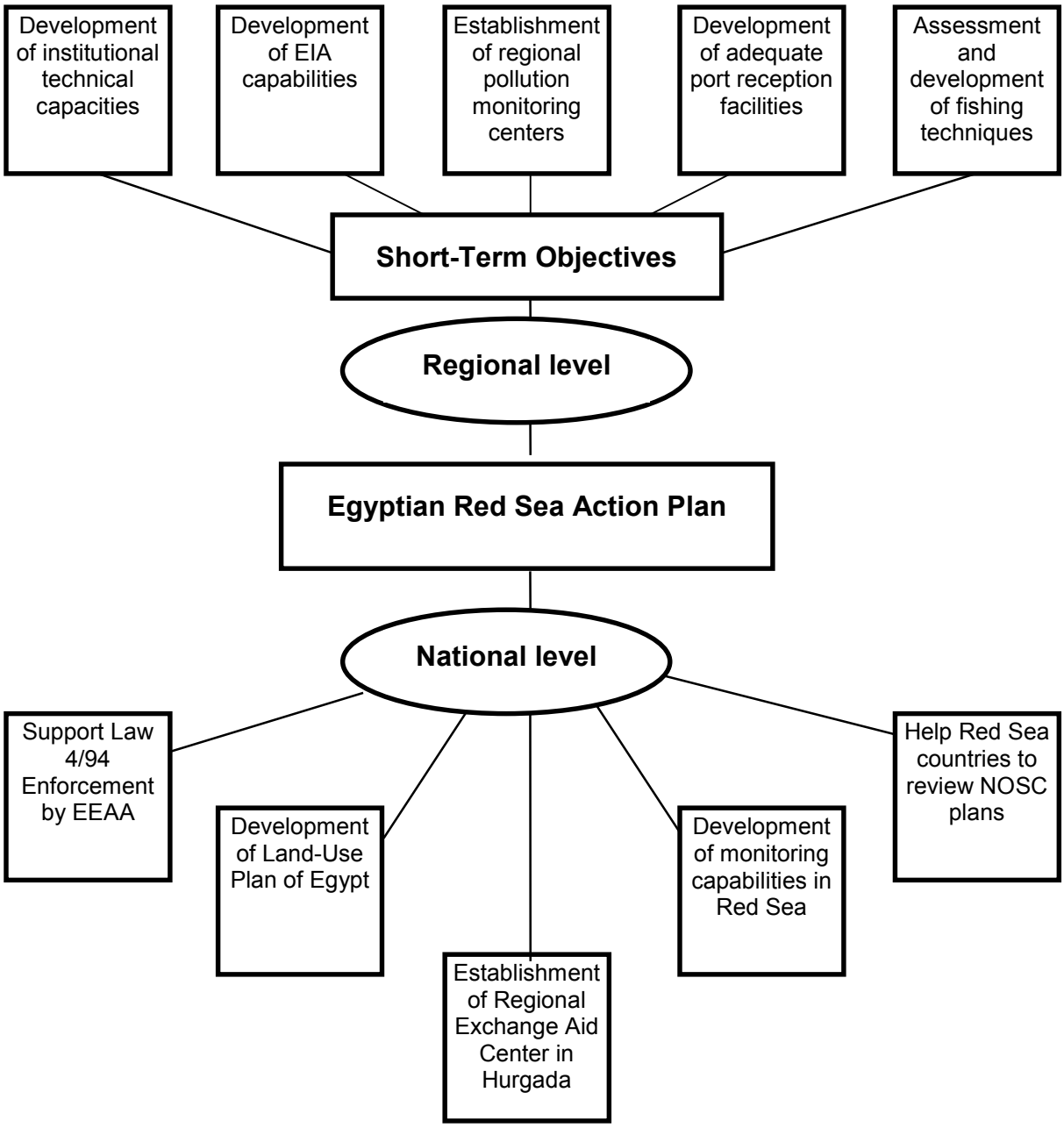

Figure 3. Flowchart Showing Proposed Plan of Action for Egyptian Red Sea Coastal Area

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Country Report

Hashemite Kingdom of Jordan

Introduction

The Red Sea and Gulf of Aden represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism. This narrow band of water shared by a number of coastal states is also an important shipping lane linking the world's major oceans. While large parts of the Region are still in a pristine state, environmental threats—notably from habitat destruction, over-exploitation and pollution—are increasing rapidly, requiring immediate action to protect the Region's coastal and marine environment. To this end, a Strategic Action Programme (SAP) has been prepared through a continuous, consultative and cooperative process among the coastal states, coordinated by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA).

The SAP is a programmatic approach to the development of country based regional environmental projects, providing and benefiting from linkages with ongoing regional seas initiatives and major international waters projects. This will assure a concerted approach to transboundary problems, and the realization of regional and global benefits. The SAP has been prepared by a Task Force including PERSGA member states, the Islamic Development Bank, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. Financial support has been provided by the countries of the Region, the Global Environment Facility (GEF) and selected donor organizations. The GEF has approved support for implementation of the SAP, which will be complemented by funding from a variety of international and domestic resources.

The present country report provides background information to the SAP process at the national level. It is based on information from publications and reports, listed at the end of this document, and a rapid assessment survey by the authors of this report.

Background

Jordan's Gulf of Aqaba coastline is 26.5 kilometers long. Within this small area are the country's only port, industrial facilities vital to the national economy, a growing tourism industry, and a delicate marine ecosystem which is increasingly threatened. See the Map at end of volume for current and planned land uses in the Aqaba region of Jordan. The coast can be divided into five zones, with different land uses. The town of Aqaba is at the northeastern

tip of the Gulf. This is the region's residential and commercial center and the current location of hotels and tourist accommodations. To the south of the town of Aqaba is the main port, which includes phosphate loading, grain and general cargo facilities, rice and cement-handling facilities, a container port and passenger ferry terminal. Immediately south of the ferry terminal is Jordan's Marine Science Station, which includes an enclosed stretch of beach front and coastal waters along 500 meters of shoreline, soon to be extended to 800 meters. Stretching along 6 kilometers of shoreline south of the Marine Science Station is the South Coast Tourism Zone, where major tourist and residential development is planned for the next twenty years. This stretch of coastline is included in the planned Red Sea Marine Park, which will extend from 50 meters inland of the high water mark to the 70 meter isobath depth. Finally, in the south along the Saudi Arabian border is the industrial port and South Coast Industrial Zone. This is a newer industrial area and the site of the Jordan Electricity Authority's power generating facilities. In future years, the South Coast Industrial Zone may become the preferred location for loading and unloading industrial cargo, thereby decreasing the volume of ship traffic at the main port. Approximately 30 percent of Jordan's coastline is currently occupied by port-related facilities.

Coastal and Marine Environment

The Gulf of Aqaba, one of two northern extensions of the Red Sea, is 180 kilometers long and 5-26 kilometers wide with an average water depth of 800 meters. The climate in the Gulf of Aqaba region is arid with average annual rainfall of 25-30 millimeters and mean daily air temperatures from 14°C (January) to 32°C (August). The Gulf of Aqaba is semi-enclosed and water circulation, which is caused mainly by evaporation rather than tidal action, is very slow. Based on preliminary observations in the Strait of Tiran, the residence time for shallow water in the Gulf of Aqaba is one to two years, and three years for deeper waters. Due to the long residence time, oil and other pollutants that enter the Gulf of Aqaba have a particularly detrimental effect since they are slow to disperse. The Gulf of Aqaba's distinctive conditions—low siltation, high temperature, and high dissolved oxygen content—result in a highly complex coral reef ecosystem. An estimated 50 percent of the shoreline is fringed with coral reefs. According to conservative accounts, 268 species of tropical and semi-tropical fish are found in the Gulf of Aqaba but the actual number could be as high as 1,000 species. Most species find their habitats in reef or sea grass areas. However, blacktip, hammerhead and whale sharks as well as pelagic fish species including skipjack tuna and bonito can be found in the Gulf of Aqaba's open waters.[1]

In addition to its important marine ecosystem, the Gulf of Aqaba is part of the Jordan Rift Valley, which serves as a flyway for millions of birds migrating from Europe and Asia to Africa and back. Over 200 bird species have been observed traveling this route. In the Gulf-fringing highlands, falcons and ospreys are among the predatory birds commonly sighted. A wide variety of gulls, terns, ducks, herons, egrets, sandpipers, plovers, wagtails, warblers, finches and swallows inhabit the Gulf of Aqaba's coastal areas.

Demography and Economics

The Gulf of Aqaba offers Jordan its only maritime access and is therefore of critical economic importance to the country. During the past two decades, the Jordanian Gulf of Aqaba coastline has been transformed by a variety of developments associated with economic growth. These include the construction of port and storage facilities, power generation stations, fertilizer production industries, hotels, restau-

1 For updated descriptions and impacts to the coral reefs and associated habitats for Jordan, refer to Wilkinson, 2000, pp 35-54.

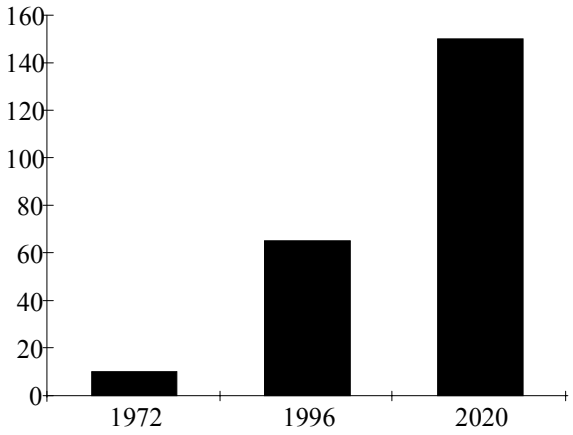

Figure 1: Aqaba Population (in thousands)
Source: Gulf of Aqaba Environmental Action Plan, 1996

rants, beachside concessions and roads. Aqaba's economic growth has been accompanied by a parallel growth in its population. As illustrated in Figure 1, since 1972, Aqaba has grown from a town of 10,000 to its current population of 65,000. The projected population in the year 2020 is 150,000.

Aqaba's major local economic sectors are the Ports Corporation and related transportation service, manufacturing, power generation and tourism. Specific information on the national economic importance of port activities, manufacturing and tourism is included in the section below.

CONCLUSION

The main challenge for environmental protection in the Gulf of Aqaba is in limiting negative impacts on coastal and marine ecosystems from industry, maritime activities, development and tourism. Jordan's Aqaba region has grown rapidly over the last several decades and will continue to grow based on increasing tourism, port and industrial activities. Effective environmental protection is essential to preserve the ecology of the Jordanian coast which is of intrinsic ecological value, as well as economically vital as a basis for the country's tourism industry. Major strides have been taken in recent years to develop regulatory and institutional mechanisms for promoting environmentally sustainable development in the Aqaba Region. This effort has involved key Aqaba industries as well as leading government institutions, and has been facilitated by the master planning efforts of the Aqaba Region Authority.

Coastal and Marine Resources

The three major economic sectors in Jordan's Aqaba region are manufacturing and power generation; port-related activities including maritime shipping and associated land transportation; and tourism. Economic information related to commercial fishing is also discussed because it has a direct impact on the marine environment. Figure 2, comparing employment distribution in the Aqaba Region and the entire Kingdom, illustrates the central role of transportation in the Aqaba labor market.

MANUFACTURING AND POWER GENERATION

Industrial production is the largest revenue generator in the Aqaba region, with annual revenues from fertilizer and mineral processing currently exceeding JD200 million (USD360 million). It is the second largest employer with approximately 1,700 workers. Aqaba's main manufacturing facility is the fertilizer factory of the Jordan Phosphate Mines Company (JPMC), located in the South Coast Industrial Zone, which produces 740,000 metric tons of diammonium phosphate (DAP) and 432,000 metric tons of phosphoric acid annually. The factory is made up of five separate but integrated processing plants including a sulfuric acid plant of two units, each producing 2,225 metric tons per day of 98.5 percent H_2SO_4 from 750 metric tons of powdered sulfur; a phosphoric acid plant; the DAP plant; a 20,000 ton per year aluminum fluoride plant that recovers fluoride; and a 44 MW steam-powered electricity generat-

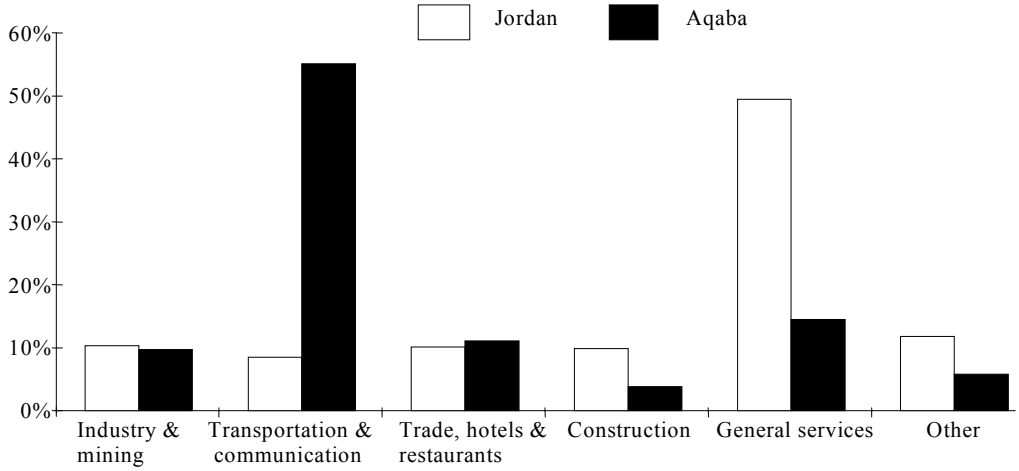

Figure 2: Employment Distribution for Aqaba Region and Kingdom of Jordan, 1991
Source: Towards 2020 Jordan Regional Planning Seminar, Aqaba Region Authority

ing plant that uses steam generated from the exothermic reaction in the manufacture of H_2SO_4. The power station is capable of producing all the electrical power needed by the company, though make up fuel oil is also burned. Figure 3, which compares export revenues of major industries, illustrates that fertilizer accounted for approximately 10 percent of Jordan's total export revenues between 1990 and 1995. Modernization of the JPMC factory in 1994 resulted in increased production, as illustrated in Figure 4. Further expansion of fertilizer production will result from an additional fertilizer plant, now being built by the Nippon Jordan Fertilizer Company. When operational, this plant will produce 300,000 metric tons per year of nitrogen-phosphorous-potassium (NPK) fertilizer, mainly for the Japanese market.

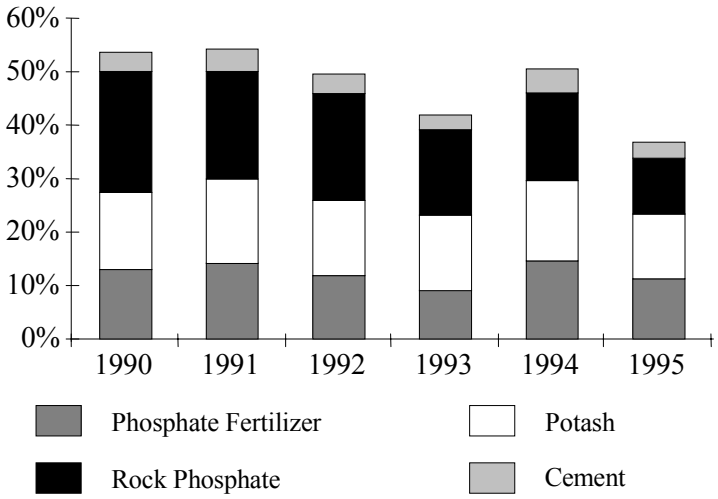

Figure 3: Export Revenue from Major Industries as a Percent of Total Domestic Export Revenues
Source: Central Bank of Jordan Monthly Statistical Bulletin Vol. 31 No. 12, December 1995

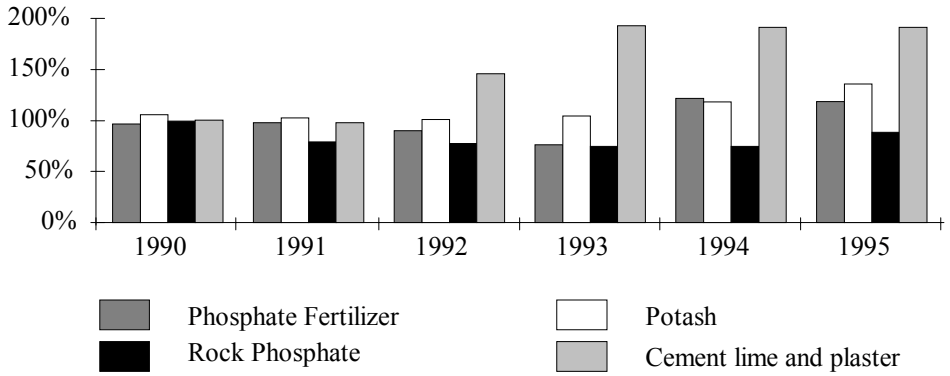

Figure 4: Industrial Production Levels Compared to 1988 Levels
Source: Central Bank of Jordan Monthly Statistical Bulletin Vol. 31 No. 12, December 1995

The Jordan Electricity Authority (JEA) currently operates two power stations. The main station (Aqaba Thermal Power Plant), with a capacity of 260 megawatts, is located in Jordan's South Coast Industrial Zone. The other station (Aqaba Central Power Station) consists of four diesel engines with a total capacity of 14 megawatts. JEA has already begun construction of a second station with three 130-megawatt units near the main station in Jordan's South Coast Industrial Zone. This expansion is only a partial response to the steady increase in energy consumption and projected demand in Aqaba, as illustrated in Figure 5, and the projected population increase and industrial expansion described above. To facilitate the exchange of regional surplus electricity, future projects will include regional networking to connect the Jordanian National Grid with the regional power grid in the Egyptian Sinai. In addition, a third stage may be added to the power station in the South Coast Industrial Zone. There is a possibility that natural gas may be substituted for fuel oil at the Aqaba power stations, depending on availability.

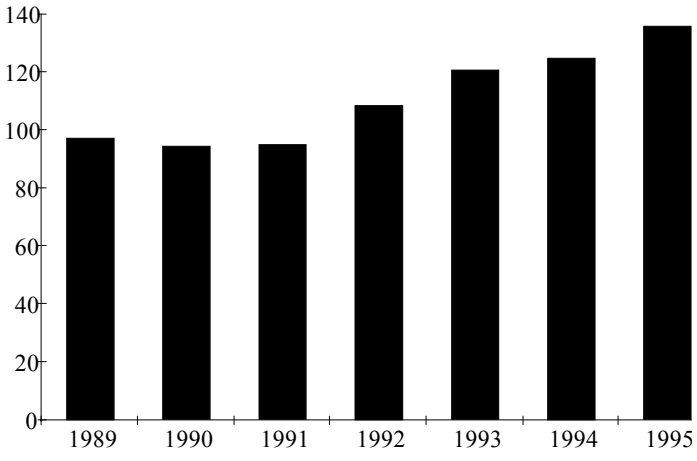

Figure 5: Electrical Energy Consumption in Aqaba (Gwh)
Source: Jordan Electricity Authority Annual Report, 1994 and 1995

PORT-RELATED ACTIVITIES

As Jordan's only outlet to the sea, Aqaba is of crucial importance to the national economy. The Port of Aqaba has emerged in the last two decades as a major regional shipping center, now ranking as the third largest Red Sea port after Suez, in Egypt, and Jeddah, in Saudi Arabia. Between 1989 and 1993, the Port of Aqaba received an annual average of 2,332 vessels handling 11.6 to 18.7 million metric tons of cargo each year. At its 1988 peak, twenty million metric tons passed through the port, and current capacity is 30 million metric tons annually. Plans are now being prepared to double the port's current capacity, to 60 million metric tons per year. The Ports

Corporation, which operates the port, is the largest single employer in Aqaba, with over 5,000 workers on the payroll and revenues totaling JD41 million (USD60 million) in 1993. Revenues generated by the Ports Corporation between 1989 and 1995 are shown in Figure 6.

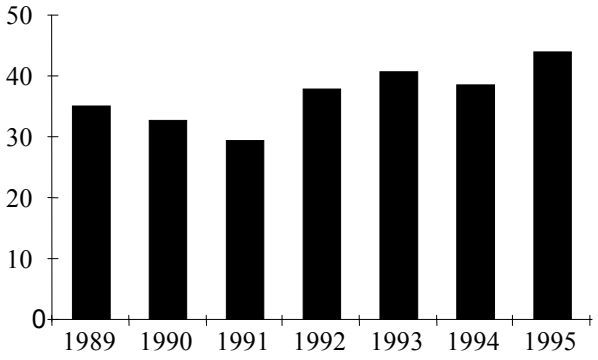

Figure 6: Ports Corporation Revenues (in millions of JD)
Sources: The Ports Corporation Year Book, 1995.
Ports Corporation Director, Engineer Mohammad Dalabeeh.

Exports through the Port of Aqaba from 1989-1993 ranged from 6.6 to 10 million metric tons per year. Of these exports, rock phosphate has been the leading commodity in terms of overall tonnage, ranging from 3.6 to 6.4 million metric tons in the 1989-1993 period (approximately 13 percent of world exports). During the same period, general cargo exports totaled 1.3 to 2.6 million metric tons; potash exports were in the 1.2 to 1.4 million ton range; cement exports ranged from 367,000 to 1.4 million metric tons; and phosphate fertilizer exports were 412,000 to 668,000 metric tons. During this period, revenue from the four major export industries constituted 45 to 55 percent of Jordan's total domestic export revenues as illustrated in Figure 3 above.

All of these industries, with the exception of phosphate, have increased their production levels since 1988. These changes are illustrated in Figure 4 above.

TOURISM

Tourism is an important sector in Jordan's economy. In recent years, both the number of tourist arrivals and the relative contribution of tourist revenues to Jordan's GNP have increased, as illustrated in Figures 7 and 8.

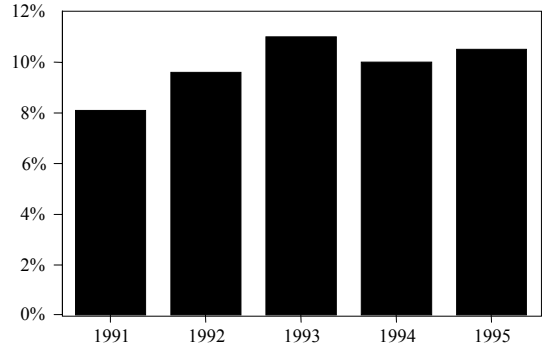

Figure 8: Tourist Receipts and Merchandise Revenues as a Percent of GNP
Sources: Ministry of Tourism and Antiquities, 1996
Central Bank of Jordan Annual Report, 1995

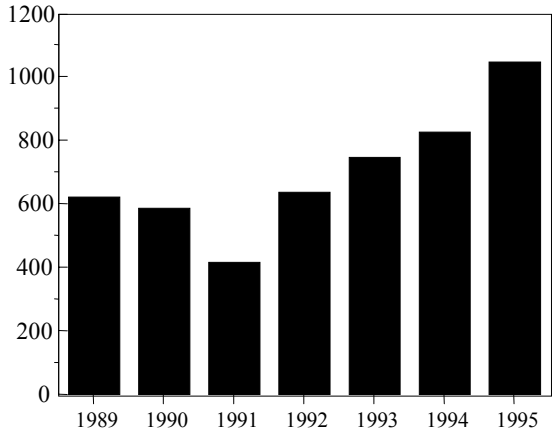

Figure 7: Tourist Arrivals in Jordan (in thousands)
Source: Central Bank of Jordan Annual Report, 1994

Tourism is a substantial component in Aqaba's growing economy. Currently, approximately 66 percent of tourists entering Jordan visit Aqaba. Tourism in the region generates estimated revenues of JD40 million (USD58 million) and employs an 800-person workforce. The city of Aqaba's 35 hotels, with some 3,300 beds, host an estimated 300,000 hotel

bed nights annually. Figure 9 describes the number and ranking of hotel rooms currently available and proposed for future development in the Aqaba region.

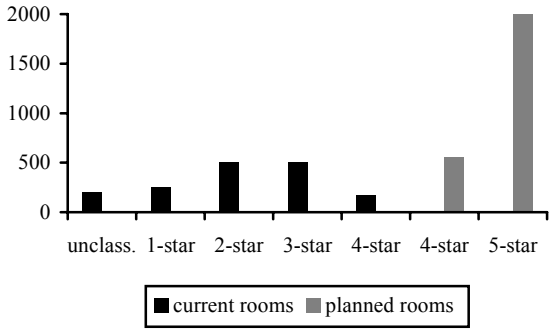

Figure 9: Current and Proposed Hotel Rooms in Aqaba

As this figure indicates, significant expansion of the Aqaba tourism sector, with a particular emphasis on luxury accommodations, is envisioned. A sample of proposed projects include: eight five-star and three four-star resort hotels, a 54 hectare "Disney type" amusement park, two 18-hole golf courses and accompanying resort, and 930 units of vacation homes. See the Map at end of volume for the location of these proposed developments.

FISHING

The fishing industry in Aqaba is small and artisanal, consisting of approximately eighty-five fishermen and forty boats in 1995. The total salable catch in 1995 was an estimated 15 metric tons, with a value of JD45,000. This represented a significant drop from the 1993 catch of 105 metric tons, and was well below the largest registered catch of 194 metric tons in 1966. As there are currently no holding facilities for temporary storage, fish are sold immediately at dockside, mainly to restaurants and hotels. The Aqaba Fishermen's Cooperative hopes that a holding facility and a programme for boat maintenance may be provided to fishermen in the coming years.

Legal and Institutional Framework

INTRODUCTION

In recent years Jordan has made great progress in improving the legal and regulatory framework for environmental protection. Changes have occurred at every level including national legislation, local initiatives specific to the Aqaba coast, and international agreements.

NATIONAL LAWS, STANDARDS AND GUIDELINES

Under the Law of the Aqaba Region Authority, No. 7 (1987), broad powers of governance are assigned to the Aqaba Region Authority (ARA). These powers include the authority to plan and execute projects in the industrial, tourism, agricultural and service sectors, and to supervise other public and private agencies undertaking projects in these sectors. The ARA Board of Directors includes representatives of key ministries (Municipal, Rural Affairs and Environment; Planning; Industry and Trade; Tourism) as well as the Ports Corporation, the Army, and the Department of Lands and Survey. The Board is empowered to appropriate lands, dispose of government property, and promulgate permits and licenses for activities carried out in the region. Regulations for the implementation of the ARA Law are prepared by the ARA President, submitted to the ARA Board of Directors and subsequently to the Council of Ministers for approval. The ARA has been the lead organization in Aqaba on efforts to improve and strengthen environmental controls. Environmental assessment procedures and coastal zone management guidelines, developed under ARA supervision as part of the preparatory phase of the World Bank/GEF-sponsored Gulf of Aqaba Environmental Action Plan, may provide important future guidance to development activities in the Aqaba region. Regulations for the Jordanian portion of the Red Sea Marine Peace Park are also being developed under ARA supervision.

In September 1995, the Law of Environmental Protection No. 12 (1995) was approved by the Jordanian parliament. A Royal Decree was issued to make the law effective as of the date of its publication in the Official Gazette. It was published and thus made effective on October 1, 1995. It establishes a national framework for environmental policy, including the formation of a Higher Council for Environmental Protection on which the Secretary General of the Aqaba Region Authority sits as a member. The Higher Council sets national environmental policy and review proposed environmental laws, specifications and standards prepared by a separate executive body, the General Corporation for Environmental Protection. The General Corporation is the primary body at the national level responsible for implementing pollution prevention regulations including inspection and monitoring. The Law also empowers the General Corporation to harmonize existing laws and settle current jurisdictional conflicts.

In controlling industrial wastewater discharges, Jordan Standard Specifications No. 202 (1982, updated in 1991) establishes maximum allowable limits for some thirty-seven pollutants discharged into streams, wadis or the sea, or used for natural recharge or irrigation. JSS 202 also includes normative standards for the protection of public and worker health, groundwater quality and aquatic life. The Water Authority of Jordan (WAJ) is responsible for monitoring industrial discharges semimonthly, to ensure compliance with JSS 202. To date however, monitoring has not taken place at this level of frequency, and enforcement actions based on JSS 202 are rare.

Publicly-owned wastewater treatment works operated by the WAJ are subject to Jordan Standard Specifications No. 893 (1994, updated in 1995). This standard sets maximum limits for a number of pollutants in sewage plant discharges. No standards or guidelines are currently in force for sewage sludge.

Several legal provisions address ship based pollution. Shipping Law No. 51 (1961) bans ships from dumping soil, stones, sand, scum, toxic and chemical waste, or any other material on land or water. Appropriate measures are required under this law for the prevention of spills during the loading and unloading of ships. The law sets fines for the violation of any of its provisions. Aqaba Port Quarantine Law No. 32 (1972) bans the discharge of ship based pollution, including bilge water. Daily fees to be paid by ships for garbage collection are established under Port Services Fees Law No. 49 (1976). This law was amended in 1987 by the Port Services Fees Law No. 20 and its amendments. The new Law of Environmental Protection makes ship captains personally liable for polluting substances released from their vessels. In addition to setting applicable fines and prison terms, the Law requires remediation at the responsible party's expense.

Some protection of fisheries and coral reefs is provided under Agriculture Law No. 20 (1973). This law provides for the issuance of fishing licenses pursuant to specified conditions, and additionally prohibits damage to or removal of corals. More explicit in banning harm to or removal of coral or shellfish from the Gulf of Aqaba is Article 25 of the Law of Environmental Protection, which specifies fines and prison terms for violators.

The Ministry of Energy and Mineral Resources has prepared comprehensive environmental guidelines for all energy sector operations in consultation with the World Bank and the concerned local institutions. These guidelines apply to the power subsectors, oil and gas operations, refineries and petroleum products, storage and distribution, oil and gas pipelines, and vehicle emissions.

Table 1 lists these national laws and regulations and the government agencies involved in their implementation.

Table 1: National Laws and Regulations Related to Coastal and Marine Environment and Resources

National Laws and Regulations	Year (in force)	Government Agency Concerned
Law of Environmental Protection No. 12	1995	Higher Council for Environmental Protection General Corporation for Environmental Protection
Jordan Specification Standard No. 893	1994	Water Authority of Jordan
Jordan Specification Standard No. 202	1982	Water Authority of Jordan
Law of the Aqaba Region Authority No. 7	1987	Aqaba Region Authority
Port Services Fees Law, No. 49	1976	Ports Corporation
Port Services Fees Law No 20	1987	Ports Corporation
Agricultural Law, No. 20	1973	Ministry of Agriculture
Aqaba Port Quarantine Law No. 32	1972	Ports Corporation
Shipping Law No. 51	1961	Ports Corporation

INTERNATIONAL AND REGIONAL TREATIES, CONVENTIONS AND AGREEMENTS

Jordan is party to eight principal international conventions relevant to the protection of the Gulf of Aqaba:

- The International Convention for the Prevention of Pollution of the Sea by Oil (London Convention) establishes controls on oil discharges from ships. Under this Convention, the Red Sea, including the Gulf of Aqaba, is considered a special zone where heightened protection applies.
- The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter regulates the disposal at sea of waste and other matter from ships, aircraft, platforms and other structures.
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) regulates the export and import between CITES parties of listed wild species of flora and fauna, including marine life. In addition, CITES parties can establish trade restrictions on species of flora and fauna within their jurisdiction that are determined to require protection.
- The International Convention for the Prevention of Pollution from Ships (MARPOL) was signed by Jordan in December 1994. Jordan's ratification of this Convention is expected soon. Annex I of this Convention (mandatory for all parties) establishes the Red Sea and Gulf of Aqaba as a special area where the discharge of oil and oily residues is prohibited. To foster compliance with this ban, parties are required to provide reception facilities for oil and oily residues from tankers and other ships using their ports. Under Annex II (also mandatory), bans on the discharge of certain categories of noxious liquid substances are established, along with the required provision of port reception facilities for such substances where needed. Annex V (optional) prohibits the dumping from ships of garbage other than food wastes.
- The Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment (Jeddah Convention) aims to protect the Red Sea, Gulf of Aden and Gulf of Aqaba environments. Article 6 of the Convention calls for appropriate measures against water and airborne pollution originating from land. Under the Protocol concerning Regional Cooperation in Com-

Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency, a marine pollution emergency response center is to be established, along with procedures for the exchange of scientific data and regional technical assistance.

- The Convention for the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention). In addressing the general secretariat of this Convention, Jordan's delegate declared Jordan an area forbidden to the importation or transshipment of foreign hazardous wastes.
- The United Nations Convention on Biological Diversity requires parties to take conservation and sustainable use of biological resources into account in making policy decisions. Measures required under the Convention include the establishment of a system of protected areas; identification and monitoring of biological diversity components and potentially adverse impacts on those components; and preparation of emergency response plans where human actions may pose a grave danger to biological diversity.
- The United Nations Framework Convention on Climate Change has the objective of stabilizing carbon dioxide and other greenhouse gas concentrations in the atmosphere at levels that would prevent dangerous interference with the climate system. Sea level rise, one of the widely anticipated results of global warming, could have a significant impact on Gulf of Aqaba marine and coastal ecosystems. Parties are required to prepare national greenhouse gas inventories and must take climate change into account, to the extent feasible, in their social, economic and environmental policies.

Three recent agreements between Jordan and the State of Israel, as part of the process of normalizing relations between the countries, are significant for environmental protection:

- The Peace Treaty between the State of Israel and Jordan (24 October 1994) establishes a firm basis for environmental consultation and cooperation between these two Gulf of Aqaba-bordering states in the areas of environmental planning, environmental legislation and enforcement, monitoring and emergency response. Among the geographical areas identified as prime targets for bilateral cooperation, the Treaty gives first priority to the Gulf of Aqaba marine environment and littoral zone. Areas specified for attention in this region are environmental impacts of industry, power generation, hazardous materials, solid waste, ports and tourism.
- Further elaborating on the objectives of the Israel-Jordan Peace Treaty is the Agreement between the Government of Jordan and the Government of the State of Israel on Cooperation in Environmental Protection and Nature Conservation, initialed by both in May 1995.
- In January 1996, the agreement on Special Arrangements for Aqaba and Eilat Between the Government of the State of Israel and the Government of Jordan was signed. Key environmental protection provisions in this agreement include establishment of a binational marine park called the Red Sea Marine Peace Park; joint environmental education efforts; and mutual assistance in emergency preparedness and response, including direct communication links and joint training programmes. These international agreements and treaties are summarized in Table 2.

Table 2: Treaties, Conventions and International Agreements Related to Coastal and Marine Environment and Resources

Treaties, Conventions and International Agreements	Year (in force)	Description
International Convention for the Prevention of Pollution of the Sea by Oil	1954	- Establishes standards for oil discharges - Designates Gulf of Aqaba as a special zone with heightened protection
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	1975	- Regulates disposal at sea of wastes from ships, aircraft, platforms and other structures
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	1979	- Regulates export and import of listed endangered species of fauna and flora - Additionally allows parties to give protection to selected species of flora and fauna within their jurisdiction
International Convention for the Prevention of Pollution from Ships (MARPOL)	1983	- Prohibits discharge of oil and noxious liquid substances from ships in the Gulf of Aqaba - Requires port reception facilities
Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment	1985	- Calls for establishment of a marine pollution emergency response center and procedures for regional data exchange and technical assistance - Calls for appropriate measures against land based water and air pollution
Convention for the Control of Transboundary Movements of Hazardous Wastes and their Disposal	1989	- Accompanies declaration that Jordan will not import or trans-ship foreign hazardous wastes
United Nations Convention on Biological Diversity	1993	- Calls for identification and monitoring of biodiversity components - Calls for establishment of protected areas and emergency response plans
The United Nations Framework Convention on Climate Change	1994	- Calls for stabilization of greenhouse gases, and requires parties to prepare greenhouse gas inventories
Peace Treaty Between the State of Israel and the Hashemite Kingdom of Jordan, and Arrangement between the Government of the Hashemite Kingdom of Jordan and the Government of the State of Israel on Cooperation in Environmental Protection and Nature Conservation	1994 1995	- Proposes cooperation in environmental planning, legislation, enforcement, monitoring, and emergency response with a focus on impacts from industry, power generation, hazardous materials, solid waste, ports and tourism
Special Arrangements for Aqaba and Eilat Between the Government of the State of Israel and the Government of the Hashemite Kingdom of Jordan	1996	- Establishes binational Marine Peace Park - Calls for joint environmental education efforts - Promotes mutual assistance in emergency response

KEY INSTITUTIONS

National and Local Institutions

The Law of the Aqaba Region Authority, No. 7 (1987), defines the area of the Aqaba region as approximately 8,300 square kilometers, comprising about 9.5 percent of the Kingdom. This area covers part of the Aqaba governorate and part of the Ma'an governorate (the Mudawwara area). General development responsibility for the Aqaba region is assigned to the ARA. The President of the ARA has ministerial authority to run the ARA and is appointed by the Cabinet of Ministers subject to approval by Royal Decree. Daily management of the ARA is the primary duty of the ARA Secretary General, who supervises the ARA's six main departments: Aqaba Town Planning; Tenders and Public Works; Finance; Administrative Services; Regional Planning; and Research and Studies. Of greatest relevance to this report is the establishment of the ARA Environment Unit in late 1994. The functions and authority of this unit will be substantially expanded in accordance with the recently approved Gulf of Aqaba Environmental Action Plan for Jordan, funded at USD3.5 million over three years by the GEF and

the Government of Jordan. Also relevant is the ARA's role in commissioning and drafting plans for new neighborhood development and urban renewal projects within the town of Aqaba as well as for industrial zones, road siting, and hotel and residential development outside the Municipality's boundaries.

The Ports Corporation is directly responsible for the construction, operation and maintenance of Aqaba port facilities. Given the economic importance of port activities and the physical scale of port operations, the Ports Corporation is a key partner in ARA efforts to address priority environmental protection concerns in the region. The Ports Corporation also bears responsibility for ensuring the health and safety of the largest work force in the Aqaba region. The Ports Corporation Director General is a member of the ARA Board of Directors. In addition to its responsibility for port facilities, the Ports Corporation has a Marine Department, which is responsible for the safety of ship operations in port areas. Within the Marine Department is a Marine Inspectorate, whose five inspectors periodically inspect ships for compliance with international maritime safety rules. These inspections primarily focus on the adequacy of navigational tools, communication equipment, fire-fighting appliances, life boats and other life-saving gear, and safety-related record-keeping. Observations pertaining to the environmental performance of ships are not part of the routine inspection report, but if ships are observed discharging oil or garbage into the marine environment, the Inspectorate works with the Royal Jordanian Navy to ensure that the violating ship remains in custody while formal charges are brought before a court of law.

The Royal Jordanian Navy (formerly the Royal Jordanian Coast Guard) is the most active presence in policing the environmental performance of marine vessels operating in Jordanian waters. The Navy conducts daily patrols of port areas to monitor merchant vessel activities and keeps a patrol boat on 24-hour watch in the ship anchorage area adjacent to the main port. Where a ship is found to be discharging oil or garbage, Navy personnel board the vessel, order the polluting activity to cease, and work with the port to obtain a court order barring the ship from leaving port pending an emergency court hearing on the alleged violation. The court hearing is typically held within 48 hours of initial detection of the polluting activity. Reportedly, fines ranging from JD1000 to 10,000 (USD1600 to 16,000) have been imposed. As a result of substantial compliance, no incidents led to prosecution during the 1993-1995 period. The Navy also engages in preventive measures including periodic meetings with shipping agents, at which the agents are urged to alert ship captains to Jordan's readiness to take tough enforcement actions against marine polluters.

The Aqaba Marine Science Station (MSS), administered jointly by the University of Jordan and Yarmouk University, with the objective of monitoring coral reef ecological trends and providing facilities for training and research. Since its founding, the MSS has conducted baseline research on coral life, marine water quality and the impacts of selected pollutants on the marine environment. The MSS is also responsible for maintaining the Marine Science Station Center, Jordan's only marine research center. This center, established in 1974, is located along a 500-meter stretch of coastline immediately south of the Aqaba ferry terminal, and provides protected habitat for fringing corals. The level of management at this location is high, and it currently has no global recognition.

The Royal Scientific Society contracts with the ARA, the Ports Corporation, and individual industries in the Aqaba region to monitor environmental quality and industrial discharges.

Three nongovernmental organizations play varying roles in addressing Gulf of

Aqaba environmental concerns in Jordan. The Royal Society for the Conservation of Nature (RSCN) is responsible for managing five terrestrial nature reserves. In Aqaba, the RSCN finances the salary of one of three inspectors who undertake daily patrols of merchant vessel operations in the Gulf of Aqaba. An independent environmental research and education organization, the Jordan Environment Society, has spearheaded the creation of a seven-member Aqaba Environment Committee, which is introducing environmental awareness programmes in the Aqaba public schools and serves as an independent "watchdog" of Aqaba development activities. The most recently established NGO addressing Gulf of Aqaba environmental concerns is the Jordan Royal Ecological Diving Society ("J Reds"). This group, found in August 1995, holds beach and underwater cleanup campaigns, organizes diver awareness and public education programmes, and has received a GEF Small Grant to establish three coral reef monitoring stations.

Regional Institutions

Several institutions are involved in promoting regional cooperation between Jordan and its neighbors. Active consultations on Gulf of Aqaba environmental protection are already well underway between Jordan, Egypt and Israel, largely as an outgrowth of the Middle East peace process. The Multilateral Working Group on Environment established Gulf of Aqaba environmental protection as its first target for regional cooperation. The Upper Gulf of Aqaba Oil Spill Contingency Project, with Jordan, Egypt and Israel as active partners, has emerged as a direct outgrowth of the Working Group's deliberations. The target of this joint effort is to create, in its first phase, an effective strategy for combating small to medium-sized spills (up to a combined total of 600 metric tons), with each of the parties having an Oil Spill Response Center.

In 1995, under the auspices of the Regional Economic Development Working Group (REDWG), the European Union sponsored the launching of the Taba-Eilat-Aqaba Macro Area ("TEAM" Area) Experts Group, whose agenda is to identify priority economic development projects involving Jordan, Egypt and Israel. A Free Trade Zone, a regional bypass road for commercial transit, and development of a regional airport are among the topics now under discussion for the northern Gulf of Aqaba area.

Another important consultative mechanism is the Eilat-Aqaba Coordination Committee, whose regular meetings bring together Israeli and Jordanian officials to discuss the economic and environmental implications of unilateral and bilateral development projects. This committee is an outgrowth of the "Agreement on Special Arrangements for Aqaba and Eilat" signed on January 18, 1996.

Under the auspices of the GEF-sponsored Gulf of Aqaba Environmental Action Plan, important strides are being made toward strengthening Jordan's legal and institutional framework for environmental protection and toward promoting regional cooperation in environmental protection. Through the GEF project, the Aqaba Region Authority is taking the lead in developing regulatory and institutional mechanisms to ensure effective environmental control of coastal industries, marine vessels, sewage, solid waste, and tourism development projects.

The Jordan Rift Valley Integrated Development Study is another planning initiative that interfaces with development projects in the Aqaba region as part of a broader survey of possible economic, social, environmental and infrastructure projects extending from the Tiberias Lake (Sea of Galilee) in the north, to the Gulf of Aqaba in the south. This included a feasibility study of the proposed Red Sea-to-Dead Sea canal, utilizing the 408-meter drop between the Gulf of Aqaba and the

Dead Sea to generate hydroelectricity for desalination projects.

CONCLUSION

Jordan has made progress over the last decade in creating and enhancing mechanisms for environmental protection in the Aqaba region. As this review illustrates, several new laws, standards and institutions have been established. The present challenge is to assure that they are enforced so as to have the maximum positive effect. On the national level, this challenge is clearly addressed in the 1995 Law of Environmental Protection, which explicitly calls for removing administrative overlap and ambiguity in enforcement authority. In addition, cooperation with neighboring countries in the Gulf of Aqaba in the areas of oil spill response and coral reef protection are critical to Jordan's ability to address these two environmental protection priorities.

Threats to the Environment

The physiographic features of the Gulf of Aqaba create a unique and diverse ecosystem, but one particularly susceptible to damage from pollution. The major pollutants and pollution threats in the region are marine oil spills and discharges, industrial pollutants, uncontained disposal of used motor oil, municipal and ship based sewage, and solid waste from marine and land based sources. Planned tourism development activities may intensify existing sewage and solid waste pollution concerns and may also heighten the risk of direct physical damage to coral reefs.

OIL POLLUTION FROM SHIPS

Ship traffic in the Gulf of Aqaba poses a major, sustained risk of damage to coral reefs and related marine life from oil pollution. Over 2,300 ships pass through the Port of Aqaba annually, yet the port has no reception facility for oil-contaminated bilge or ballast water. Tankers with a cargo capacity of 100,000 to 150,000 metric tons of crude oil arrive almost weekly in Eilat, discharging some discharging some 3.5 million metric tons of oil per year at the Eilat-Ashqelon Pipeline terminal. In the 1970s, nearly ten times the current volume of oil was transported from Iran to this terminal. Jordan's oil terminal, though presently unused, is likely to resume operations as a major shiploading facility for truck-transported Iraqi crude oil. In June 1996, a preliminary agreement was signed between the Government of Jordan and a United States holding company for the construction of an oil refinery near Tetin, 18 kilometers east of the Gulf of Aqaba, processing 250,000 barrels of oil per day primarily for the export market. This project, which may result in the marine transport of substantial quantities of oil products, will undergo a full environmental assessment before final approval is given.

Ship traffic in the Gulf of Aqaba poses a risk of oil pollution from the following sources:

- Small spills caused by the accidental or intentional release of oil-contaminated bilge or ballast water from freighters (0-2 metric tons).
- Minor spills caused by the release of oily ballast water from an oil tanker or the release of bunker oil during terminal operations (2-20 metric tons).
- Medium spills caused by the release of oil as a result of defective equipment or procedures at an oil terminal or pipeline facility (100 metric tons).
- Major spills caused by the rupture of a bunker oil tank in a bulk/cargo vessel collision (500 metric tons), shipwreck of a bulk/cargo vessel (1,500 metric tons), or a tanker collision causing the rupture of a single oil tank (7,500 metric tons).
- Disastrous spills caused by the wreckage of a fully loaded oil tanker (100,000-150,000 metric tons).

Small to minor oil spills have occurred frequently in the Gulf of Aqaba, causing

localized damage to coral and marring popular beach areas especially in the northern Gulf area, where shipping is most heavily concentrated. In 1990, some twenty-two small to minor spills were reported in Israeli waters alone. In Aqaba, forty-nine small to minor spills were reported in the period 1993-1996, in addition to one medium spill in 1995 in which about 54 metric tons of fuel oil spilled into the sea. The Ports Corporation reported sixteen spills in 1993, eleven spills in 1994, seventeen spills in 1995, and five spills in 1996.

POLLUTION FROM COASTAL INDUSTRIES

Jordan's South Coast Industrial Zone, immediately south of Jordan's planned South Coast Tourism Zone and adjacent to the Saudi Arabian border, contains the primary industries along the Gulf of Aqaba coastline. The principal industries located within this Zone are a large fertilizer manufacturing facility owned and operated by the JPMC; a storage area and loading terminal for potash from the Arab Potash Corporation; the "Solvochem" tank farm for chemicals, oils and solvents, and an associated port facility owned by the Aqaba Ports Corporation; and a 260 MW thermal power station operated by the JEA.

The five buildings of the JPMC fertilizer factory are designed to meet the pollution control standards of the United States Environmental Protection Agency. A primary environmental concern pertaining to this facility is the possibility of reef-damaging runoff during occasional flash floods from a "gypsum mountain" due east of the plant, where 2 million metric tons of fluorine-containing gypsum waste are deposited annually in an unlined, unconfined setting. With annual rainfall averaging only 25 - 30 millimeters, the risk associated with gypsum runoff is minimal. Another concern is the factory's discharge of chlorinated cooling water into the Gulf of Aqaba at a rate of 20,000 cubic meters per hour. At the discharge point located 145 meters from shore at a depth of 30 meters, the cooling water is approximately 3°C above ambient marine water temperature.

Ship loading and unloading operations pertaining to the JPMC facility present added environmental hazards. Raw sulfur used at the facility is unloaded from ships berthing at a nearby jetty, and fertilizer is loaded onto ships at the same jetty. Small quantities of sulfur and DAP are routinely spilled during these processes, and there is a risk of larger accidental spills. Ammonia releases during transport to the plant from a separate, nearby jetty pose a further risk to the environment and human health.

Other concerns pertaining to the JPMC facility include the possibility of explosion or health-endangering gas releases from a 30,000-ton on-site ammonia storage tank, in which cooled ammonia is maintained in a liquid state through refrigeration at -32 °C. As over 1,000 people are employed at the facility, immediate health hazards as well as broader ecological dangers require careful attention.

The Jordan Electricity Authority currently operates a 260-megawatt thermal power station in Jordan's South Coast Industrial Zone and is already underway with the construction of a second stage, which consists of three 130-megawatt units. A comprehensive environmental assessment was conducted prior to the construction of the power station. High-sulfur oil with a 3.2-3.5 percent sulfur content is transported from Iraq via tanker truck to be used at the current facility. No desulfurization equipment is currently used at the site, nor is such equipment planned for the new unit. Plans for retrofitting with such equipment have been considered for later phases of plant development. With 1,100-1,200 metric tons of oil burned per day, approximately 35 metric tons of sulfur are released from a 125-meter stack with twin flues into the atmosphere daily by the current plant, with double this amount expected to be emitted once the new facility begins operation. Winds carry sulfur dioxide and other flue gas emissions into unin-

habited inland desert areas southeast of the plant 90 to 95 percent of the time.

Heated cooling water discharges from the present and planned power stations may have an impact on nearby corals and marine life. At the present facility, some 38,000 cubic meters of cooling water per hour is discharged into the Gulf of Aqaba from an outlet 200 meters from shore and 20 meters below the surface. The temperature of this water is 3 °C above ambient water temperature at the discharge outlet. The water discharge temperature surveys by the Marine Science Station showed that, within 10 to 15 meters of the outlet, the temperature of this water is only 1°C above ambient water temperature. With an identical cooling system planned for the new plant, the volume of thermal discharges from the combined power stations will double in the coming years.

At the Arab Potash Company's storage facility in the South Coast Industrial Zone, 150,000 metric tons of potash are stored in two partially enclosed storage sheds. Closed conveyors, adjustable booms in the storage sheds, and dust collection equipment are generally effective in reducing on-site dust levels. Nevertheless, insufficient attention to proper operation of equipment suggests that elevated on-site dust levels may still pose a health hazard to the facility's 100 workers.

The Solvochem tank farm serves as a port reception and storage facility for imported chemicals including toluene, xylene, acetone and other ketones, vinyl acetate monomer and ethanol. Imported vegetable oils and beef tallow are also received from ships and stored on-site. The tank farm presently has seventeen tanks meeting American Petroleum Institute standards, and an additional fourteen tanks are currently under construction. Approximately 13,600 metric tons of chemicals and 6,000 metric tons of oils and beef tallow are received at the site annually.

Phosphate dust generated by ship loading at the Ports Corporation's phosphate berths is another environmental issue which has received considerable attention. In 1993 two choke feeders were installed on the phosphate berths to reduce dust emissions during ship loading operations. In April 1996, a third choke feeder entered operation. Following installation of the choke feeders, Ports Corporation officials estimate that dust emissions from the phosphate facility have been reduced by 90 to 95 percent. Significant additional phosphate dust emissions continue to occur during the unloading of phosphate from trucks and train cars into the six store houses at the phosphate port, as well as at transfer points on phosphate conveyors.

Potash and phosphate loading activities in the port of Eilat (Israel) are further contributors to mineral dust problems facing the Upper Gulf of Aqaba. An undetermined quantity of phosphate dust generated by port operations is emitted.

Hazardous and persistent solid wastes associated with land transportation pose additional environmental problems related to Aqaba region industries. In the absence of a clear hazardous waste management policy, used asbestos brake linings, exhausted automotive batteries and worn tires are discarded in a haphazard and, in some cases, health-endangering manner. During a recent site visit to the Iraqi-Jordanian Land Transportation Company repair yard, oil drums filled with asbestos brake linings sat uncovered and unsealed in outdoor areas immediately adjacent to the main repair shed. Tens of thousands of discarded tires were also observed both within the repair yard and around its periphery. The handling of used batteries, though not observed, is another matter of probable concern.

Truck traffic in the Aqaba region also generates air pollution and noise pollution. Although levels of exhaust gases have not been monitored, visual levels and preliminary modeling results indicate high pollution concentrations and noise levels in urban areas adjacent to truck routes. Diver-

sion of trucks from inhabited areas would reduce these impacts, but a recently constructed bypass road through the Aqaba mountain zone remains largely unused because its grade and slope length pose grave hazards to heavily loaded trucks. In 1994 alone, twenty drivers lost their lives in truck accidents on the bypass road.

The problem of waste oil disposal is particularly acute in the Aqaba region because of the high volume of bulk/cargo transportation via truck to and from the Aqaba Port and the industrial facilities in the South Coast Industrial Zone. An estimated 1,200 haulage vehicles enter or leave the Port of Aqaba each day, and several hundred additional trucks make deliveries to, or pickups from, the South Coast Industrial Zone, resulting in over 400,000 truck trips each year along local roads.

Inadequate provisions for waste oil collection and recovery pose a hazard to both the marine and terrestrial environments. Despite an official prohibition barring trucks from entering beach areas, truck drivers commonly drive heavy haulage vehicles to off-road areas within a few dozen meters of the water's edge. Waste oil has been discharged from trucks in sensitive tidal areas, posing a direct hazard to near-shore coral and related marine life. At a few points along the coastal truck route, prominent signage prohibiting trucks from entering unpaved beachfront areas can be seen, but this ban remains to be enforced.

The use of waste oil as a dust suppressant in unpaved truck repair yards is a further environmental hazard. At the repair yard of the Iraqi-Jordanian Land Transportation Company, some 85 heavy haulage vehicles are serviced each day. Waste oil from these trucks is transferred to an on-site underground storage tank which is believed to be concrete-lined. While most of the waste oil is pumped from the storage tank and transported to Jordan's oil refinery in Zarqa, some 5-10 cubic meters of waste oil is sprayed on the unpaved surface of the truck yard each month to reduce dust in the adjacent truck repair sheds. This practice has been employed throughout the 13-year duration of the facility's operation, and an undetermined quantity of waste oil now resides in the surface and sub-surface soil strata.

SEWAGE POLLUTION

Low nutrient levels are a major contributor to the diversity and abundance of coral in the Gulf of Aqaba's coastal waters. Sewage discharges into the Gulf of Aqaba have resulted in the proliferation of algae, depressing coral growth particularly in the Gulf's heavily settled northern reaches. The City of Aqaba has a sewage collection network that reaches approximately 65 percent of the city's population of 65,000 people. The remaining 35 percent of the population, primarily residing in the city's older, densely settled "Old Aqaba" and "Shalala" neighborhoods, are required by the local building code to have operable septic tanks. Many households lack such systems, however, with the result that untreated sewage percolates into sub-soils and possibly into shallow underlying groundwater.

Sewage entering Aqaba's sewage collection network is piped to the Municipal Sewage Treatment Works, approximately four kilometers north of the city in the Wadi Araba basin. The sewage is then treated by oxidation in a three-stage lined pond treatment system, capable of handling 9,000 cubic meters of sewage per day. Current daily loading is at 4,500 cubic meters per day, or about 50 percent of capacity. It is believed that half of the sewage placed in the ponds is lost to evaporation and seepage. Most of the losses are attributed to high evaporation rates in Aqaba. Sewage may also be infiltrating the brackish water aquifer from the holding ponds of the Municipality of Eilat, located some 6 kilometers north of the city of Eilat immediately adjacent to the Jordanian border. The sewage infiltration from both treatment plants and potential impacts on the aquifer require investigation. In Aqaba,

treated wastewater is available for landscape tree and agricultural irrigation in the vicinity of the treatment plant. Therefore, the cumulative water loss in the treatment process represents a lost opportunity for restricted irrigation and for reducing demand on scarce freshwater supplies.

Cargo vessels, tour boats, ferries and private yachts are additional sources of sewage discharge into the Gulf of Aqaba. An undetermined proportion of cargo vessels using the ports of Aqaba and Eilat have on-board sewage treatment systems, but none of the Gulf-bordering states employ measures to ensure the effective operation of these systems while ships are in port. Moreover, the three vessels operated by the Arab Bridge Maritime Company, servicing the Aqaba-Nuweiba ferry route, have no onboard sewage treatment systems. As a result, untreated sewage from the 1.2 million passengers who travel this route annually is dumped directly into the Gulf of Aqaba.

Physical Threats to Coral Reef Ecosystems

Development of the South Coast Tourism Zone

A precipitous rise in the numbers of divers and snorkelers visiting Jordan's reefs is expected in the coming years. The most dramatic plan for tourist development, described above, is in the South Coast Tourism Zone. As currently proposed, this development will include two 18-hole golf courses, a "Disneyland type" amusement park, eleven resort hotels with four to five stars and a residential resort villa complex. Directly inland of the Tourism Zone is a major new planned town ("Teeba"), projected to have a population of 100,000 by the year 2020—more than 150 percent of Aqaba's current population.

Most directly threatening to coral reefs will be the substantially increased numbers of aquatic tourists. Wastewater management and solid waste disposal are further issues directly affected by population growth in the South Coast area. Construction activity may cause chemical pollution from servicing of construction machinery, increased siltation during construction, and alteration of hydrologic conditions including runoff rates and flow patterns. Coastal zone management guidelines and other planning measures have been developed by the ARA to minimize the potentially adverse environmental impacts associated with such new development activities.

Aquatic Tourism

Aquatic tourism in Jordan has yet to approach the levels now experienced in neighboring Egypt and Israel. Rough estimates place the total number of divers in Jordan's Gulf of Aqaba waters during 1993 at a modest 3,000, up from 1,250 in 1989, compared to approximately 200,000 in both Israel and Egypt in 1995. Jordan's three dive centers have a maximum combined capability of hosting 160 divers at a time. Yet even at this relatively low level, Jordan's reefs show significant physical damage at a number of prime dive spots. Direct destruction of fragile reef structures is caused by tourists walking on exposed reefs, breaking off coral for souvenirs and collecting aquarium fish; divers resting on the sea bottom while adjusting their gear; snorkelers dragging their fins across shallow fringing reefs; underwater photographers steadying their cameras by bracing themselves on reef formations; and fishing and tourist boats dropping anchor or running aground on the reefs. Through implementation of Marine Park regulations proposed by the ARA, many of these potentially damaging activities should be controlled.

Fishing

Commercial fishing in Aqaba is done with shallow-water (5 to 15 meter) baited cage traps, hand-drawn gill and seine nets, and handlining with baited hooks and lures. As Jordanian fishing vessels are barred from operating outside Jordan's confined territorial waters, the local fishing fleet consists entirely of small outboard motor boats, ap-

proximately 5 meters in length. With fishing concentrated in or immediately adjacent to reef areas, damage to reefs from short-line anchors, snagged nets and lines, abandoned bait traps, and direct human contact is an ongoing concern. Marked reductions in the abundance and diversity of coral-dwelling fish, observed in recent years, are partially attributed to current fishing practices.

SOLID WASTE POLLUTION

Unlike the sporadic environmental impacts of oil pollution, solid waste generated by ship crews, ferry passengers, beach vacationers and local residents poses a constant, high-visibility environmental problem. Jordan's Gulf of Aqaba beaches and near-shore reef and seagrass areas are heavily impacted by discarded plastic and other refuse materials. The Port of Aqaba has solid waste receptacles in port areas and additionally provides a daily garbage collection service via barge to ships anchored offshore. Some 30 metric tons of garbage are collected by the Port of Aqaba each day, as compared to a daily average of 60 metric tons collected from Aqaba homes and businesses.

The efficient reception of marine vessel-generated waste in Jordan is not reflective of broader solid waste management practices in Jordan's Aqaba region. There is no properly maintained solid waste landfill. Instead, garbage from Aqaba households and businesses as well as the port is transported to an upland wadi due east of the planned South Coast Tourism Zone. At this site, piles of discarded waste line both sides of a winding one-kilometer road leading to the primary dumping area. Combustible garbage is burned in open fires, and non-combustibles remain exposed to the elements. No systematic recycling is currently practiced.

Threats to the environment are summarized in Table 3.

Table 3: Threats to the Coastal Environment and Marine Resources

Issue	Impacts	Immediate Causes	Root Causes	Scale	Severity
Oil Pollution from Ships					
Frequent small oil spills (less than 20 mt)	Damage to marine life, beach contamination	Discharge of ballast and bilge water	Lack of reception facilities and enforcement authority	Regional	Moderate
Oil spills of 2-20 mt	Damage to marine life, beach contamination	Bunker oil spill	Inadequate control and monitoring of procedures, equipment and personnel	Regional	Moderate
Oils spills of up to 100 mt	Damage to marine life, beach contamination	Discharges from pipelines or terminals	Inadequate control and monitoring of procedures, equipment and personnel	Regional	Severe
Potential oil spill of up to 150,000 mt	Destruction of marine habitats, devastation of beaches	Rupture of oil tanks in collision or wreckage	Insufficient tanker safety specifications, inadequate personnel and navigation procedures	Regional	Severe
Pollution from Coastal Industries					
Industrial chemical spills	Health risk and potential damage to marine life	Accidental spill during transport, storage or use of chemicals	Inadequate control and monitoring of hazardous substances	Local	Moderate
Air pollution - SO_2 emissions	Health risk and deterioration of aesthetics	Release of SO_2 from electrical facility and fertilizer plant	Inadequate air pollution control regulations, monitoring and enforcement	Local	Moderate

Issue	Impacts	Immediate Causes	Root Causes	Scale	Severity
Cooling water discharges	Alteration of marine environment	Release of cooling waters from electrical facility and fertilizer plant	Inadequate thermal pollution control standards, monitoring and enforcement	Local	Low
Phosphate dust emissions	Decreased coral growth around phosphate port	Release of phosphate dust during port operations	Inadequate pollution control standards, monitoring and enforcement	Local	Low
Gypsum disposal	Potential leaching of gypsum into the Gulf of Aqaba, or seepage into groundwater	Unconfined storage of gypsum at the fertilizer factory	Lack of proper hazardous waste disposal siting, regulation and enforcement	Local	Low
Waste oil disposal	Soil and possible groundwater impacts	Improper disposal of used motor oil and use of oil as a dust suppressant	Lack of proper oil disposal or recovery options and lack of effective regulations and enforcement	Regional	Severe
Sewage Pollution					
Municipal sewage	Raised water table and possible groundwater impacts	Treated sewage infiltration	Unlined maturation ponds and incomplete reuse of treated sewage	Regional	Unknown
Marine vessel sewage	Localized marine pollution	Direct discharge from ships	Inadequate on-board treatment	Regional	Moderate
Physical Threats to Coral Reef Ecosystem					
Development of South Coast Tourism Zone	Physical damage to reefs, alteration of coastline, eutrophication	Marinas, coastal construction, sewage infiltration, landscape irrigation	Inadequate environmental planning guidelines for coastal development	Local	Moderate
Aquatic tourism and fishing	Damage to corals, depletion of fisheries	Physical contact with reefs and overfishing	Lack of education about sensitivity of marine ecosystem, inadequate regulations and enforcement	Regional	Severe
Solid Waste Pollution	Aesthetic deterioration, physical damage to reefs and marine life	Beach litter, open dumping and garbage from ships	Inadequate solid waste collection, disposal, public awareness and enforcement	Regional	Moderate

Recent, Current and Planned Environmental Initiatives

Jordan, with assistance from a variety of international sources, is currently involved in an extensive process of planning and implementation of environmental legislation and projects aimed at protecting and enhancing the Gulf of Aqaba's marine and terrestrial environment. This process began in 1989 with the National Environmental Strategy Project, with assistance from the IUCN - World Conservation Union, which resulted in the 1991 publication of the *National Environmental Strategy for Jordan: A Resource Book of Information and Guidelines for Action*. This document gives an overview of environmental conditions in Jordan and recommendations for improvements. The Ministry of Planning and the Ministry of Municipal Rural Affairs and Environment, relying on background material provided by local consultants, and with support from the Government of Japan and the World Bank, then prepared the National Environmental Action Plan (NEAP) for Jordan. This involved a systematic planning process which prioritized actions based on envi-

ronmental criteria, and scheduled implementation of the highest priority items within three to five years. The NEAP is an ongoing dynamic process that responds to new environmental conditions and challenges.

In November 1991, the Jordanian Government requested that a proposal for a regional Gulf of Aqaba Environmental Action Plan be submitted to the GEF. A World Bank mission assisted the government in preparing the framework for an environmental action plan for the Jordanian portion of the Gulf of Aqaba. In October 1993, the Government of Jordan, with GEF and World Bank assistance, completed the Gulf of Aqaba Environmental Action Plan, Jordan (GAEAP). This document recommends twenty-three actions in six categories: legal and regulatory framework; institutional strengthening; infrastructure investments; marine park management; monitoring and applied research; and public awareness and environmental education. The primary objective of the GEF project is to enable Jordan to take the lead in establishing and implementing a regional collaborative framework for sustainable management and protection of the Gulf of Aqaba, and the conservation of its unique coral reefs. The GAEAP utilizes the comprehensive approach outlined in the GEF Council strategy for international waters to develop mechanisms for control of transboundary pollution, and addresses environmental issues that constitute regional and global priorities.

Development of the GAEAP advanced substantially under the GEF Project Preparation Advance (PPA), carried out during 1995-1996. Primary documents produced under the PPA include:

- Environmental assessment procedures for new developments in the Aqaba region.
- Coastal zone management guidelines for Jordan's planned South Coast Tourism Zone as well as other development areas.
- Environmental auditing procedures applicable to existing industries in the Aqaba region.
- Performance and discharge standards for industries located along or near the coast.
- Preliminary management guidelines for the Jordanian portion of the Red Sea Marine Peace Park.
- A report on marine vessel pollution prevention and port reception facility needs. Based on PPA documentation and analysis, the GEF Council approved full implementation of the GAEAP in June 1996.

During the three-year implementation phase of this USD3.5 million project, the GAEAP is providing staffing and training for the recently established Environment Unit of the ARA, including the hiring of a Unit Director, an industrial pollution prevention specialist, a coastal zone management/environmental assessment specialist, a GIS/computer programmer, a Marine Park Manager and Marine Park Staff, and support staff. In coordination with counterpart agencies in Aqaba and at the national level, the ARA will apply the Environmental Impact Assessment (EIA) and Coastal Zone Management (CZM) guidelines developed under the PPA; introduce an enhanced system for monitoring industry pollution prevention measures; and develop and implement a management plan for the Jordanian portion of the Red Sea Marine Peace Park. It will also work with the Ports Corporation to strengthen current efforts to monitor and enforce regulations barring marine vessel pollution of the Gulf of Aqaba, and to develop port reception facilities for oil-contaminated ship waste.

Important assistance in developing regulations for the Jordanian portion of the Red Sea Marine Park has been provided by the US Agency for International Development and the US National Oceanic and

Atmospheric Administration. This park, a specific outgrowth of the 1994 peace treaty with Israel, involves cooperation between the two parties in developing and implementing a marine park management strategy for the upper Gulf of Aqaba.

The Ministry of Energy and Mineral Resources has prepared comprehensive environmental guidelines for all energy sector operations in consultation with the World Bank and the concerned local institutions. These guidelines apply to the power sub-sectors, oil and gas operations, refineries and petroleum products, storage and distribution, oil and gas pipelines, and vehicle emissions.

Regionally, there are several additional significant developments. During 1994 and 1995, Jordan, Egypt and Israel took a first step toward developing a sub-regional approach to environmental protection through the preparation of an Upper Gulf of Aqaba Oil Spill Contingency Project funded by the European Union (EU) and the Government of Japan. This plan, currently under implementation, calls for coordinated emergency response centers in each of the three neighbors. In the spring of 1996, Jordan received a full complement of oil spill response equipment capable of handling spills of up to 300 metric tons. This equipment is housed at the Ports Corporation, which is responsible for coordinating Jordanian oil spill response efforts.

These recent developments are listed in Table 4.

Table 4: Recent, Current and Planned Environmental Initiatives

Programme/Project	Period	Budget (USD million)	Scale	Implementing Agency
Upper Gulf Oil Spill Contingency Project	1993–1996	7.0 (EU/Japan)	Regional	Aqaba Ports Corporation
Installation of three choke feeders at the phosphate port to reduce phosphate dust	1994, 1996	2.2 (Ports Corp.)	Local	Aqaba Ports Corporation
Development by the GEF PPA of environmental impact assessment, environmental auditing and coastal zone management procedures	1995	0.3 (GEF)	Local	ARA
Performance and discharge standards for industries on or near the coast	1995–1996		Local	ARA
Report on marine vessel pollution prevention and port reception facility needs	1995		Local	ARA Aqaba Ports Corporation
Proposal for creation of waste oil recycling demonstration project	1995		Local	ARA
Preliminary management guidelines for the Jordanian portion of the Marine Peace Park	1994–1995	0.1 (USAID)	Regional	ARA
Full implementation of Gulf of Aqaba Environmental Action Plan (GEF)	1996–1999	2.7 (GEF) 0.8 (Jordan)	Regional	ARA

Priority Actions

The priority actions presented here address the threats to the environment described above. Beyond the specific focus on identified environmental threats, two overarching objectives are relevant for each action:

- Strengthening the overall institutional capabilities of Jordanian Government agencies through the hiring and training of staff and the implementation of environmental protection laws and regulations.

- Improving regional cooperation to coordinate and enhance the efforts of individual parties bordering the Gulf.

Jordan has already taken significant action on improving its capacity for environmental protection. The establishment of the new national environmental law, the creation of the ARA Environment Unit, and the work of the GEF PPA are evidence of progress in this area. Regional cooperation is also critical to environmental protection because of the dramatic transboundary impacts on this small section of coast. As described above, the Middle East peace process and the opening up of relations between Jordan and Israel have created commitments for regional cooperation on a range of environmental issues.

INSTITUTIONAL GAPS

- Hire and train staff to implement Gulf of Aqaba environmental protection policies and regulations.

Under this action, staff have been hired to promote the full and effective implementation of industrial pollution prevention, coastal zone management, environmental assessment and marine park regulations. A full-time GEF Project Manager has been hired to supervise Project implementation over a three-year period, and an ARA Environment Unit Director has been hired to manage all ARA environmental responsibilities. Other key positions include a Marine Park Manager and Rangers, an Industrial Pollution Prevention Specialist, and a Coastal Zone Management/Environmental Impact Assessment Specialist.

- Acquire computer/GIS database capability.

Under this action, an assessment will be made to determine the information technology appropriate to support the work of the ARA Environment Unit. The information technology system chosen must be designed to promote planning, monitoring and enforcement actions. This equipment will be purchased, and a computer/GIS programmer hired to manage all computer and data functions, and conduct staff training in information technology applications for specific projects.

PHYSICAL THREATS TO CORAL REEF ECOSYSTEMS

- Implement GEF PPA coastal zone management and environmental impact assessment procedures.

The ARA will use the draft CZM and EIA procedures developed under the PPA to establish and implement guidelines for new construction. These guidelines will be coordinated with requirements that may be developed by the General Corporation on Environmental Protection. As a key step toward implementing the draft CZM guidelines, a statutory coastal zone management map will be proposed and adopted, establishing boundaries of coastal sub-zones (marine waters, beach, backshore, upland, etc.). EIA procedures, developed under PPA, will be supplemented in order to apply them to specific projects or categories of projects.

- Establish and implement a management plan and regulations for a Gulf of Aqaba Marine Park.

Under this task, a multi-use marine park (MP) will be officially established in Jordan. Authorizing legislation will be finalized and a management plan developed and implemented. This plan will include:

  - ◊ Regulations governing different user activities (e.g. motorized and non-motorized boating, diving, snorkeling, swimming, fishing, beach recreation).
  - ◊ Installation of boundary demarcations for different user zones within the MP, including mooring and marker buoys, terrestrial fencing, floating platforms, reef crossovers, and informational signs.
  - ◊ A detailed operating budget incorporating user fees and other means of financing ongoing MP operations.

◊ A public information and awareness programme, including printed information brochures for different user categories and audio-visual presentations for use at the MP visitor center, in Aqaba area hotels, and in public school and adult educational settings.

This plan will be implemented by a management team including a MP Manager, two MP Wardens and support staff. Park activities will be coordinated with regional counterparts.

- Hire and train staff to implement regulation of new development.

A carefully targeted training programme will be developed and implemented to strengthen Jordanian capacity to regulate and control new development based on environmental concerns. A coastal zone management specialist will be hired in order to assist in finalizing EIA and CZM requirements and the CZM statutory map; work with developers, engineers, architects and planners through all stages of project review to ensure compliance with CZM and EIA requirements; and train relevant ARA staff on the effective use of the new CZM and EIA procedures.

NAVIGATION RISK AND MARITIME TRANSPORT

- Improve navigational aids.

Navigational aids and radio communications in Jordanian waters should be improved, especially on major shipping channels.

- Develop and implement marine vessel pollution prevention and control standards and regulations.

Pollution prevention and control standards for marine vessels, consistent with the MARPOL Convention, will be developed under this action. Jordan, now a signatory to MARPOL 73/78, is expected to ratify the Convention and certain key annexes to the Convention in the near future. To meet its obligations as a MARPOL party, Jordan may be expected to develop regulations for marine vessel management of oily waste (bilge and ballast water and tank washings), noxious liquid substances, solid waste, and possibly sewage. A study will be conducted to examine the nature of Jordan's obligations under MARPOL, with specific attention to the introduction and implementation of ship record-keeping and reporting requirements, port inspection functions and port reception facility needs.

A specialist in marine vessel pollution prevention will be hired to help implement the new standards and regulations. The responsibilities of this position will include conducting regular inspections and sampling discharges, bilge and ballast water from marine vessels; compiling inspection information in a computer database; preparing reports on findings from inspections and coordinating strategies for reducing marine vessel pollution with regional partners.

- Develop a solid waste programme.

A mangement programme should be developed and implemented to control disposal of solid waste and litter from ships and ferry boats.

- Produce a feasibility study for bilge and ballast water reception facilities at the Port of Aqaba.

Under this action, a feasibility study for waste oil collection, recovery and reuse in the Upper Gulf of Aqaba region will be completed. Building upon consultations with the International Maritime Organization initiated under the PPA, various technological options for collection, storage, transport and recycling of waste oil from ships will be examined. Provisions for integrating waste oil from land transport vehicles into the collection and reuse system will be included. The feasibility of building a coordinated (Jordan-Egypt-Israel) waste oil recovery scheme will also be assessed. Fee based measures of cost recovery will be proposed, and sources of initial financing will be explored for a demon-

stration project in integrated waste oil recovery and reuse.

- Produce a prefeasibility study on mechanisms to reduce risk of catastrophic oil spills.

Through the Upper Gulf of Aqaba Oil Spill Contingency Project, significant steps have been taken to prepare for small to moderate oil spill response through the establishment of oil spill response centers in Nuweiba (Egypt), Eilat (Israel) and Aqaba. The Contingency Project, targeting spills of up to 600 metric tons of oil, leaves unaddressed the risk of a potentially catastrophic spill (up to 150,000 metric tons) resulting from a tanker collision or grounding in the Gulf of Aqaba. To address this hazard, a prefeasibility study of measures to enhance tanker safety will be conducted, to examine the economic feasibility and practical benefits of electronic navigational aids, pilotage requirements for tankers operating in the Gulf of Aqaba, and tanker design specifications (e.g. double-hull design). Harmonization of proposed measures among Gulf-bordering states will be explored as part of this analysis.

INDUSTRIAL DEVELOPMENT

- Create a demonstration project for marine waste oil recovery.

Building upon the feasibility study for bilge and ballast water reception facilities, the most appropriate options for recovery of marine waste oil for the Aqaba region will be put into practice as a demonstration project. This project could be effectively integrated with a parallel effort for waste oil from land transport vehicles.

- Adopt and implement regulations, standards, coastal zone management and environmental auditing procedures for coastal industries.

Based on the studies made during the preparatory phase of the GEF project, the ARA will adopt and implement guidelines for industrial pollution prevention. Through a permit based system for regulation of industries, the ARA will monitor air and water discharges, compile and analyze inspection data, review emergency preparedness plans, and assist industries in the preparation of environmental audits. Coastal zone management guidelines, to be implemented under the GEF project, will help guide future decisions about industrial siting.

- Hire and train staff to implement industrial pollution prevention regulations.

A carefully targeted training programme will be developed and implemented to strengthen Jordanian capacity to regulate industrial performance. Essential for the development of this programme is the hiring of two technical specialists under the supervision of the ARA Environment Unit Director: an industrial pollution prevention specialist and an environmental monitoring technician. The industrial pollution prevention specialist will implement the new permitting process, conduct facility inspections and review specific industry documents and practices relevant to control of industrial pollution. The environmental monitoring technician will be responsible for collection and analysis of both air and water samples. Special region-wide training efforts to reduce industrial pollution will also be carried out.

- Conduct waste oil contamination monitoring and initiate a demonstration project in waste oil recovery from land based sources.

Under this activity, inspection of surface and underground oil storage tanks will be undertaken and selective soil samples will be examined to determine possible waste oil contamination. Technical and economic aspects of waste oil collection, reuse and disposal will also be analyzed, and a demonstration project for reuse and disposal of waste oil will be created. This programme could be integrated with a parallel effort for marine waste oil recovery.

- Monitor marine water quality.

Under this action, a programme for monitoring the Gulf of Aqaba's waters has been designed by the ARA's Environment Unit in collaboration with the MSS, to be implemented jointly by the ARA and the MSS. A framework for the marine water quality monitoring programme is presented in Annex 9 of the October 1993 report, *Gulf of Aqaba Environmental Action Plan, Jordan*. Its objectives are to assess current marine water quality, and to establish measures for maintaining and improving water quality. The monitoring programme will include monthly baseline testing at selected locations both along the coast (including bathing areas) and in offshore Gulf of Aqaba waters, so as to assess the horizontal and vertical distribution and movement of nutrients, inorganic components, algae, oxygen, salinity, and other elements. The programme is funded by the United States Agency for International Development and the GEF, and will be coordinated with the monitoring activities of other littoral states.

- Further reduce phosphate dust emissions.

Under the GAEAP, the technical feasibility of different options for further reducing phosphate dust emissions in port areas will be examined. Improved operation of choke feeders can reduce dust emissions during shiploading; technological changes can be made in the equipment used to unload phosphate from trucks and train cars; and the design of conveyors and storage sheds can be enhanced. The preliminary cost estimate for a comprehensive dust collection system for the phosphate port at Aqaba is USD3.0 million.

- Undertake actions to manage transboundary marine pollution in the upper Gulf of Aqaba.

Actions should be undertaken to manage transboundary marine pollution in the upper Gulf of Aqaba.

URBAN DEVELOPMENT

- Develop a plan for municipal sewage water conservation and reuse.

Under this action, concepts for more effective utilization of treated sewage water will be analyzed and presented in order to achieve Jordan's "no-discharge" policy regarding sewage influx into the Gulf of Aqaba. Technical and economic feasibility of sewage water reuse will be examined with respect to both the existing treatment plant and the new facility planned for Jordan's South Coast Tourism Zone.

- Conduct groundwater quality monitoring programme.

Current monitoring of test wells in the vicinity of the Aqaba sewage treatment plant will be enhanced to clarify the extent and nature of possible sewage infiltration into the transboundary brackish water aquifer north of the city of Aqaba.

- Develop and implement a solid waste collection, recycling and disposal plan.

A solid waste collection, recycling and disposal plan, developed under this action, will examine the financial feasibility and environmental impacts of such options as separation of compostable organic waste and recycling of plastics, paper and metal waste. Mechanisms for safe handling, transport and disposal of medical waste will be presented in the study, and measures to ensure the segregation of hazardous wastes from the solid waste stream will be examined. Fee based systems for cost recovery and options for bidding out specific solid waste management functions to private contractors will also be explored. Full integration of port reception facilities for solid waste will be a feature of this plan.

APPLIED RESEARCH

- Strengthen applied research activities.

In particular, the current programme for development of a database for biological resources and environmental information should be strengthened. Programmes to

support operations and enforcement activities should be further strengthened and expanded.

The priority actions are summarized in Table 5.

Table 5: Priority Actions

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Environmental management	Recruitment and training of staff to implement Gulf of Aqaba environmental protection policies and regulations	National Local	Capacity building Management programme	***
Environmental management	Development of an improved computer and GIS database capability for environmental management of the Gulf of Aqaba	Local	Management information Capacity building	*
Habitat conservation	Implementation of GEF Project–supported Coastal Zone Management and Environmental Assessment procedures	National Local	Management programme Enforcement	***
Habitat conservation	Establishment and implementation of a management plan and regulations for a Gulf of Aqaba Marine Park, including fisheries management	Regional National Local	Legal framework Capacity building Management programme Enforcement	***
Habitat conservation	Recruitment and training of staff to implement regulations for new coastal development to reduce physical threats to coral reef ecosystems	Local	Capacity building Management programme Enforcement	**
Navigation risk	Improvement of navigational aids and radio communications in Jordanian waters, especially on major shipping channels	Sub–Regional National Local	Capacity building Technical development	**
Maritime transport	Development and implementation of pollution prevention control standards and regulations for ship–based sources	Local	Legal framework Capacity building Enforcement	***
Maritime transport	Development and implementation of a management programme to control disposal of solid waste and litter from ships and ferry boats	Regional National Local	Legal framework Enforcement Public awareness	***
Maritime transport	Preparation of a feasibility study for bilge and ballast water reception facilities at the Port of Aqaba and implementation of priority recommendations	Local	Feasibility study Technical development	***
Petroleum development and transport	Preparation of a pre–feasibility study on mechanisms to reduce the risk of catastrophic oil spills	Regional National Local	Management information Management programme	***
Industrial development	Design and implementation of a demonstration project for marine waste oil recovery	Regional Local	Demonstration activity Technical development	***

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Industrial development	Adoption and implementation of regulations, standards, coastal zone management and environmental auditing procedures for coastal industries	National Local	Strengthening standards Enforcement	***
Industrial development	Recruitment and training of staff for implementation of industrial pollution prevention regulations	National Local	Capacity building Strengthening standards Enforcement	***
Industrial development	Waste oil contamination monitoring and demonstration project in recovery of waste oil from land–based sources	Local	Management information Technical development	**
Industrial development	Programme to monitor marine water quality for pollution from industries	Local	Information gathering	**
Industrial development	Implementation of measures to further reduce phosphate dust emissions	Local	Technical development	*
Urban and industrial development	Cooperative actions to manage transboundary marine pollution in the upper Gulf of Aqaba	Sub–Regional National Local	Regional cooperation Management programme Technical development	**
Urban development	Development and implementation of a plan for municipal wastewater conservation and reuse	Local	Technical development	***
Urban development	Development and implementation of a groundwater quality management programme	Regional Local	Management information Management programme	**
Urban development	Development and implementation of a solid waste collection, recycling and disposal plan	Local	Technical development Regional cooperation	**
Applied research	Strengthening of current programme for development of database for biological resources and environmental information; further strengthening and expansion of programmes to support operations and enforcement activities	National Local	Capacity building Management information	*

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Country Report

Kingdom of Saudi Arabia

Introduction

The Red Sea and Gulf of Aden represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism. This narrow band of water shared by a number of coastal states is also an important shipping lane linking the world's major oceans. While large parts of the Region are still in a pristine state, environmental threats—notably from habitat destruction, over-exploitation and pollution—are increasing rapidly, requiring immediate action to protect the Region's coastal and marine environment. To this end, a Strategic Action Programme (SAP) has been prepared through a continuous, consultative and cooperative process among the coastal states, coordinated by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA).

The SAP is a programmatic approach to the development of country based regional environmental projects, providing and benefiting from linkages with ongoing regional seas initiatives and major international waters projects. This will assure a concerted approach to transboundary problems, and the realization of regional and global benefits. The SAP has been prepared by a Task Force including PERSGA member states, the Islamic Development Bank, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. Financial support has been provided by the countries of the Region, the Global Environment Facility (GEF) and selected donor organizations. The GEF has approved support for implementation of the SAP, which will be complemented by funding from a variety of international and domestic resources.

The present country report provides background information to the SAP process at the national level. It is based on information from publications and reports. References and summary data are provided at the end of the text.

Background

Saudi Arabia's Red Sea coastline extends over 13° latitude from al-Dourrah at the border with Jordan, north of Haql (approximately 29°30'N) south to the border with Yemen at Oreste Point (approximately 16°22'N). The coastline is approximately 1,840 kilometers in length, accounting for 79 percent of the eastern seaboard of the Red Sea (MEPA/IUCN,

1987). See Map of Saudi Arabia at end of volume.

As the climate is extremely arid, much of Saudi Arabia's biological productivity is confined to a narrow coastal strip and originates mostly from habitats such as coral reefs and the mangrove and seagrass communities found in shallow embayments (Table 1).

Table 1: Distribution of Physiographic Types in Saudi Arabia

Land Type	10^3Ha	Human Impact	%
Land, Arid	209,283	Land Area of Low Human Disturbance	83.2%
Land, Semi-Arid	4,920	Land Area of Medium Human Disturbance	6.7%
Land, Humid	766	Land Area of High Human Disturbance	0.08%
Land, Tropical	65,658		
Land, Sub-tropical	149,311		
Land, Temperate	none		

Source: WRI, 1995 (1989, prior to settlement of a number of border issues)

The continental shelf extends offshore for distances of less than 1 kilometer in the Gulf of Aqaba to over 100 kilometers in the Farasan Bank. The continental shelf area to the 200 meter depth contour is 77,859 square kilometers (WRI, 1995). Saudi Arabia claims a contiguous zone (in which it exercises economic control) of eighteen nautical miles and a territorial sea twelve nautical miles.

Average rainfall is generally less than 70 millimeters per year along the broad coastal Tihama (16 millimeters per year at al-Wajh, 63 millimeters per year at Jeddah and 63 millimeters per year at Jizan) although inland above the coastal escarpment it may exceed 200 millimeters per year.

In the past three decades, Saudi Arabia has undergone a rapid transformation from a state of underdevelopment with severe constraints to development and public welfare to a modern industrial country, complete with sophisticated infrastructure and modern health care (Table 2).

Much of Saudi Arabia's development has taken place in or has had an effect on the coastal lands and waters where 20.4 percent of the population of nearly 17 million were censused in 1992 (Ministry of Planning, 1994). Of these, 15.2 percent lived in the Red Sea coastal zone.

By 1987 about 8 percent of the Red Sea coast had been subject to extensive development (Chiffings, 1989). Much of this development involved landfilling and dredging, affecting substantial areas of the intertidal and nearshore sub-tidal habitats. Urban expansion and corniche development are continuing this trend towards deterioration of habitats and natural resources (NCWCD, 1990).

Table 2: Some Development Achievements between 1963 and 1994

Item	Period	Percent Change
Population	1974-1992	241
GDP (Producers' Prices)	1970-1992	323
Paved Roads	1979-1988	157
Port Capacity	1969-1992	3969
Hospital Beds	1973-1992	343
Agricultural Area	1976-1992	294
Fertilizer Production	1969-1991	9342
Refinery Production	1969-1991	269
Crude Oil Production	1963-1991	393
Cement Production	1967-1993	3058
Desalination	1970-1994	9928
Vehicles	1975-1990	888
Electricity	1974-1992	4055

Source: MOFNE Statistical Summary, 1974-1994

Saudi Arabia is experiencing major expansion of its population and economy that requires careful planning, particularly

with regard to its coastal and marine resource base. This is particularly true of the Red Sea coastal zone because of its greater length and pressures from urban and industrial development. In addition, much of the pressure from the 25,000 to 30,000 ships transiting through the Red Sea (Lintner and others, 1995) are associated with Saudi Arabia's oil production and petrochemical industries on both coasts.

Coastal and Marine Resources

HABITATS

Most of the information available on Saudi Arabia's coastal resources comes from an extensive survey of the literature as well as a field survey of the entire Saudi Arabian Red Sea and Gulf coasts by Saudi Arabia's Meteorology and Environmental Protection Administration (MEPA) in collaboration with the World Conservation Union (IUCN). The results are presented in a seven volume series (MEPA/IUCN, 1987). This effort provided a valuable baseline describing the predominant habitats and formed the basis for a national coastal zone planning effort. Currently, a process for cross-sectoral coastal planning has been submitted by MEPA for approval and promulgation.

In general, four physiographic zones were recognized within the Saudi Arabian Red Sea based upon species distribution. These were:

- Zone A - Gulf of Aqaba.
- Zone B - Northern Red Sea.
- Zone C - Central Red Sea, including the outer Farasan Bank.
- Zone D - Southern Red Sea.

The distribution of these zones (shown in Figure 1) may be determined by a variety of physical factors such as substrate type and availability, relative aridity of the associated land-mass and freshwater runoff, nutrient supply, water circulation and wave exposure. Climatic factors, in particular sea surface temperature, are probably of great significance and may influence or even limit the development of endemic forms.

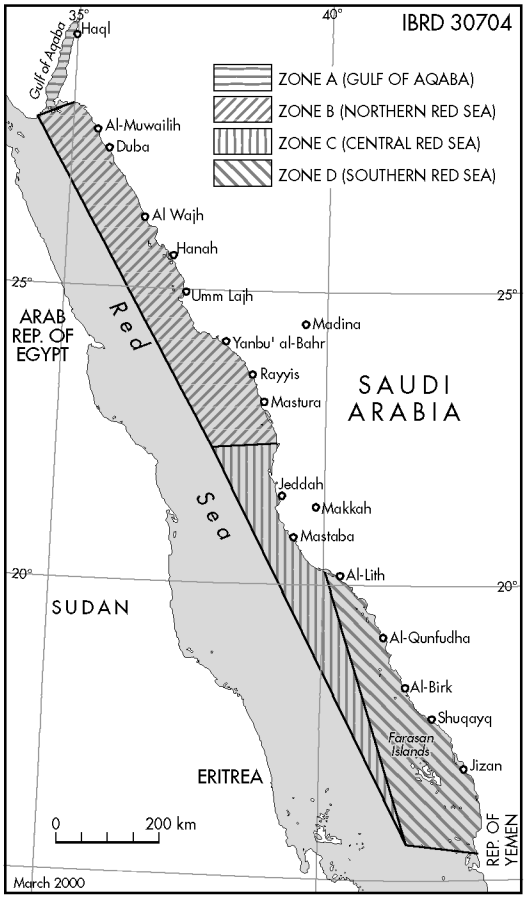

Figure 1. Biogeographical Regions in the Saudi Arabian Red Sea.

- Zone A (Gulf of Aqaba) is characterized by its geographical isolation and the relatively high number of species that are either restricted to or restricted from the area. The extreme north of the Gulf contains species found nowhere else in the Red Sea.
- Zone B (Northern Red Sea) is characterized by the seagrass *Thalassodendron ciliatum* which is found in this zone and Zone A but rarely elsewhere in the Red Sea. Temperature may be a determinant factor for many of the species distributions.
- Zone C (Central Red Sea, including the outer Farasan Bank) contains many

species absent from Zone B to the north and Zone D to the south. There is some evidence that coral abundance is important in explaining species distribution in this zone as well as temperature.

- Zone D (Southern Red Sea) has many species more suited to its waters which are laden with sediment from land based sources and undergo water mixing across the wide shallow coastal shelf. The highest sea temperatures are found in this zone and coral development is restricted. There is a lack of deep water habitat.

Distribution of coastal habitats along Saudi Arabia's Red Sea coast is generally determined by the interaction between seawater intrusion, terrestrial freshwater aquifers and tidal activities. A schematic diagramme showing the distribution of major habitats and their causal factors is shown in Figure 2.

Coral Reefs

The coral reefs of the Red Sea are among the most spectacular in the world. Most are situated along the coast and surrounding offshore islands and are in relatively good condition. However, reefs along some stretches, such as the coast surrounding Jeddah and the industrial city of Yanbu are becoming increasingly affected by development.

There are 194 species of corals recorded along the Saudi Arabian coast with the greatest diversity in the central portion. Five areas along the coast are noted for their extensive coral reefs: the Tiran Island area, Wajh Bank, the area north of Yanbu, the coastline between Obhur and Tuwwal north of Jeddah; and the outer Farasan Bank.

Coral reefs play an important role in the coastal ecosystem. They provide habitats for a wide variety of marine species and protect coastal lands from erosion and

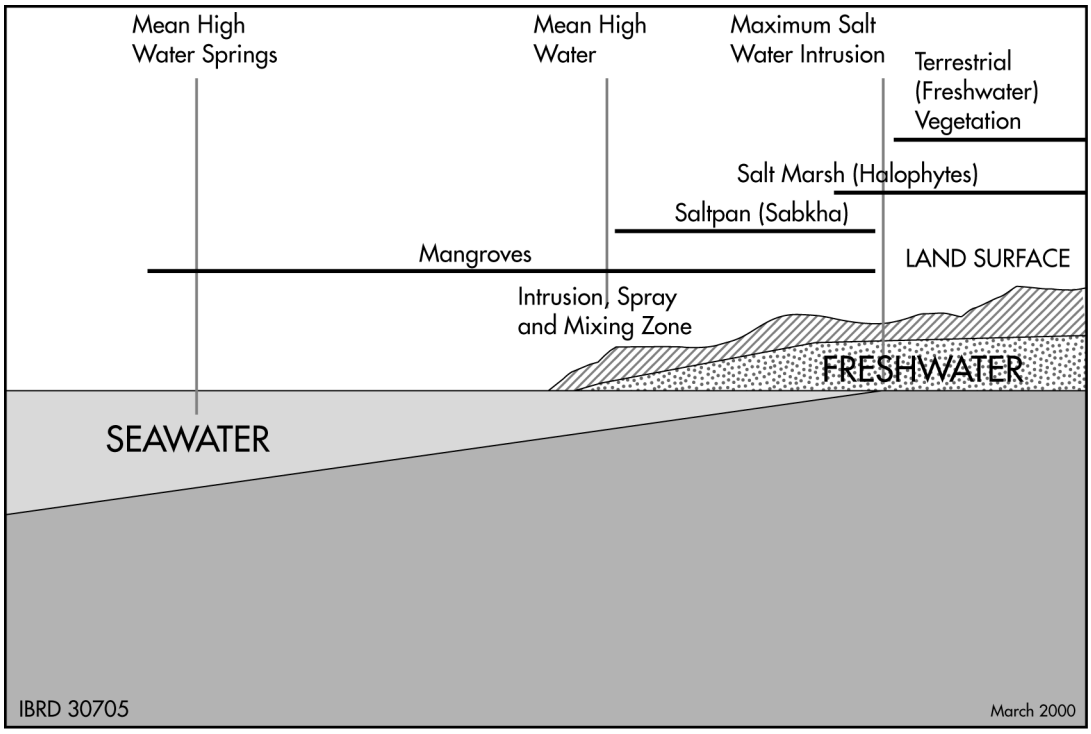

Figure 2. Schematic representation of habitat distribution along the Saudi Arabian Red Sea Coastline along with causal elements

storm damage. In the Red Sea, coral reef communities generally form extensive and productive reef flats which create protected habitat for many juvenile species as well as lagoons which also serve this purpose (Figure 3). Corals also create a protected environment for the development of coastal vegetation such as seagrasses and saltmarshes.[1]

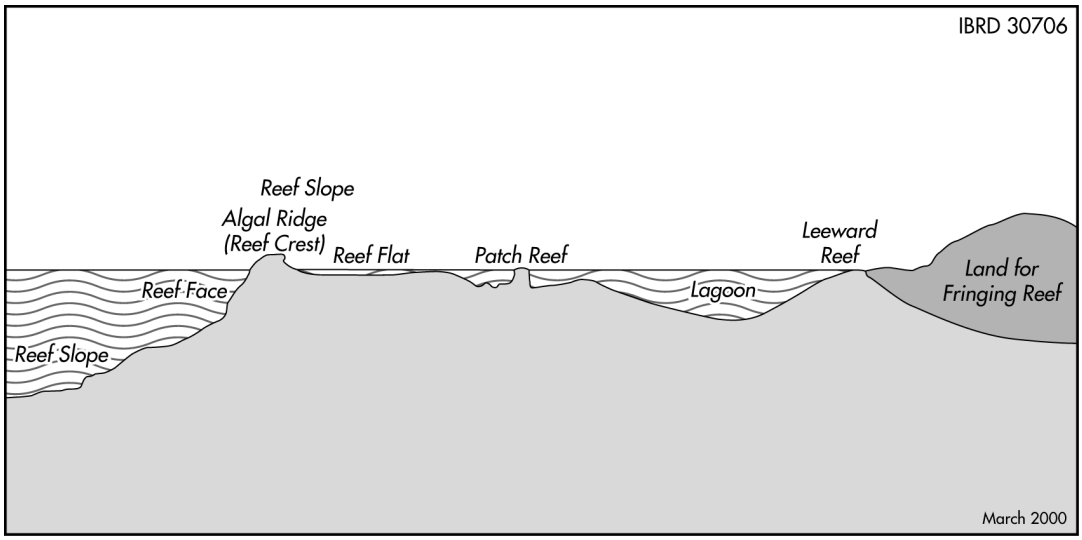

Figure 3. Cross sectional schematic diagram of Saudi Arabian coral reef structure

Mangroves

Mangroves generally grow in waterlogged and saline soil of the intertidal zone and are often associated with areas of runoff. Only two species have been recorded along the Saudi Arabian Red Sea coast, *Avicennia marina,* which is widespread, and *Rhizophora mucronata,* found at only six sites. They are found in such areas as broad coastal plains, protected shores, over shoals and spits, and in lagoons.

While mangroves are found scattered along much of the Red Sea coast, the major concentration is in the southern Red Sea where factors such as increased sediment create an environment more conducive to their development. This increased development in the south also coincides with areas of greatest agricultural potential. Agricultural development, properly planned and managed, could be beneficial to certain coastal habitats such as mangroves. Mangroves have a variety of values: they provide food in the form of detritus, shelter for numerous organisms (such as mollusks, crabs, shrimp, and fish), fodder for camels and goats, and fuel for human use. Mangroves are also important nesting sites for several species of birds.

Development of coastal recreation facilities and "Coastal Villages" in the Ras Hatiba area north of Jeddah and shrimp aquaculture along the southern Red Sea coast have contributed to the decline of Saudi Arabia's coastal mangroves.

Seagrasses

Seagrasses are fairly widespread along the Red Sea coast although they are more common in the southern Red Sea. They tend to be concentrated in shallow water areas such as lagoons, sharms (drowned wadi mouths), and marsas (shallow embayments) because of the soft-bottom sediments found in these areas. Of the eleven seagrass species in the entire Red Sea, ten have been recorded along the Saudi Arabian coast. As seagrasses are one of the most productive habitats in coastal

1 For updated descriptions and impacts to the coral reefs and associated habitats for Saudi Arabia, refer to Wilkinson, 2000, pp 35-54.

environments, their abundance along the Red Sea is indicative of a highly productive ecosystem.

Sabkhas

Sabkhas or saltpans are broad expanses of seasonally inundated mud flats, often encrusted with salt. These areas support significant microalgal growth when flooded, which may contribute to the overall productivity of the Red Sea. However, relative to other forms of coastal vegetation, these areas are less important ecologically.

Other Coastal Vegetation

Saltmarsh halophytes and freshwater-dependent vegetation such as date palms are also found along the Red Sea coast. In the far north, saltmarsh halophytes usually occur in a band 1-3 meters above the high water mark and are sparse and stunted due to the arid climate. The best developed and greatest variety of halophyte communities grow in the central region of the Red Sea. Some of the offshore islands also support dense stands of halophyte vegetation. In areas of plentiful freshwater supply, date palms develop.

Beaches and Coastal Dunes

Much of the Red Sea coastal area is dominated by a flat, low-lying desert or semi-desert plain. This is known as the Tihama and separates the mountains and the sea. On a typical shoreline, this plain ends abruptly and becomes a narrow, gently sloping beach, often backed by halophyte vegetation.

Bays, Sharms, and Marsas

The bays, sharms, and marsas of the Saudi Arabian Red Sea provide an important environment for mangroves, seagrasses, and saltmarshes. These ecosystems support a large variety of marine life including fish, shrimp, turtles, dugong, and birds. Maintenance of the complex relationships among species found in these environments is dependent on the conservation of various habitats. Although bays, sharms, and marsas are scattered all along the coast, they are more common in the central region.

Islands

Islands were not studied in detail during the MEPA/IUCN survey but the islands of the Saudi Arabian Red Sea are important sanctuaries for a variety of marine life, seabirds and turtles that feed or nest on and around islands. Many fish and invertebrates are supported by the reefs around these islands. Some of the Farasan Islands are inhabited and support fishing communities.

KEY MARINE AND COASTAL SPECIES

Birds

Saudi Arabia's Red Sea coast and its associated islands are globally important for birds as many of the Palearctic migratory pathways pass over the Arabian Shield. The tidal flats, in particular, are considered as important overwintering areas, hosting between one and two million wading birds of 125 species and serving as an important "refueling station" for many of the 113 species which have so far been recorded as passing through the area. In addition, many of the Red Sea Islands are important nesting sites for seabirds. The Red Sea supports internationally important concentrations of the brown booby *(Sula leucogaster),* pelican *(Pelecanus rufescens),* sooty gull *(Larus hemprichii),* white-eyed gull *(L. leucophthalmus)* and brown noddy (*Anous stolidus)* (NCWCD, 1990, Evans, 1994).

Marine Turtles

Five species of marine turtles have been recorded in Saudi waters of which the green turtle (*Chelonia mydas*) and the hawksbill turtle (*Eretmochelys imbricata*) are the most important (MEPA, 1989). The MEPA study estimated the Red Sea population of both species at around 3,500 individuals. All marine turtles except for the loggerhead turtle are on the IUCN list of endangered species.

The main threats to turtles in Saudi Arabia's Red Sea coastal zone come from the persistence of oil spills, loss of habitat and development activities that endanger nesting beaches. One example of such a threat can be found at Ras Baridi where uncontrolled particulate emissions from a large cement factory coat the beaches and create additional hazards for emerging turtle hatchlings. Fisheries exploitation of turtle populations in Saudi Arabian waters does not appear to be a problem because of cultural aversions to eating turtle meat.

Marine Mammals

Of the thirty species of whales and dolphins that might be expected to occur in Saudi waters, nineteen have been observed (Gasparetti and Shalhoub, ms.) The dugong (*Dugong dugong*) occurs in significant numbers (MEPA, 1989a). The MEPA study indicated that Saudi Arabia's two coasts constitute one of the two most important areas for dugong in the world. The species is long-lived, growing and reproducing slowly, making it particularly vulnerable to overexploitation. As herbivores, dugongs are also sensitive to damage to the shallow water seagrass beds upon which they depend for food.

The MEPA (1989a) study indicated that the population of dugongs in Saudi waters numbers around 2,000 and recommended that coastal areas important for dugong survival be set aside as protected areas. The more recent "Plan to Protect Areas in Saudi Arabia" (1990) prepared by the National Commission for Wildlife Conservation and Development (NCWCD) has included this recommendation in establishment of marine reserves.

FISHERY RESOURCES

Until the late 1970s, Saudi Arabia's fishery was exploited almost exclusively by artisanal fishermen from small boats and larger (up to 20 meters) sanbuks (Table 3). After 1980, an industrial fishery began and has grown until the largest company, Saudi Fisheries, currently lands around 1,500 metric tons of shrimp and a similar amount of finfish on both coasts (Saudi Fisheries, personal communication, 1995). Despite this, landings remain dominated by the artisanal sector.

Table 3: Fishing Boat Distribution along Saudi Arabian Red Sea Coast, 1995

Region	Industrial	Traditional	Pleasure	Total
Tabuk Region	7	888	34	**929**
Madina Region	2	749	478	**1,229**
Greater Makkah Region	18	2,382	1,485	**3,885**
Greater Jizan Region	89	1,239	131	**1,459**
Total	**116**	**5,258**	**2,128**	**7,502**

Source: MAW, 1996

Fishery Data

Fishery statistics from different sources have been analyzed. Despite broad agreement, differences between the various sources indicate the need for greater standardization. One significant problem in addressing specific questions stems from the fact that Saudi Arabia's fishery statistics are generally aggregated for both the Red Sea and Gulf fisheries. Specific studies (most notably Sanders and Morgan, 1989; MAW, 1987, 1996; Kedidi and others, 1984 and Peacock and Alam, 1980) do provide specific insights into the Red Sea which assist in development of general strategies for fishery management, but a reliable long-term series of catch and effort, required for specific management decisions, is not available at present.

Potential Yield

Fishing results (primarily from the FAO series which runs from 1950 to 1993) do not particularly suggest that effort is in excess of the sustainable yield of the combined Gulf and Red Sea potential, as the

landings continue to rise. This rise has occurred despite prior suggestions (Kedidi and others, 1984) that Saudi Arabia's Red Sea resources were fully exploited by the mid 1980s. As previously mentioned, specific statements about the Red Sea are limited to Sanders and Morgan (1989), which relied upon fragmentary Red Sea data, and the Ministry of Agriculture and Water (MAW) study, which undertook detailed samplings of Red Sea fishing ports for a one-year period in 1985-86. Detailed statistics for Red Sea resources in 1995 are found in MAW (1996).

indicate whether or not the northern Red Sea has provided increased landings.

What these studies indicate (Table 4) is that there is a general trend for increased productivity from the north (in the Gulf of Aqaba), south towards the border with Yemen. Over 74 percent of the annual Red Sea landings come from the southern section between al-Lith and the Yemen border (23 percent from al-Lith to Yanbu and only 3 percent from Yanbu to the Jordan border, MAW, 1989).

This is demonstrated by increased production both per kilometer of shoreline and

Table 4: Distribution of Red Sea Catch and Effort in 1983 (from Kedidi and others, 1984) and 1995 (from MAW, 1996)

Region	# Fishermen	Annual Landings (mt)	Catch/Unit Effort (mt/ fisherman/year)	Production mt/km of shoreline
Haql-Duba	29	80	2.758	.3
Duba-Wajh	39	90	2.307	.6
Wajh-Umm Lajh	86	250	2.903	1.4
Umm Laj-Yanbu	225	670	2.978	4.4
Yanbu-Rabigh	320	1,030	3.218	5.9
Rabigh-Jeddah	303	880	2.904	6.1
Jeddah	284	1,180	4.140	-.-[1]
Jeddah-Lith	174	460	2.644	4.1
Lith-Qunfudha	176	580	3.294	6.6
Qunfudha-Shuqayq	156	1,030	6.606	7.3
Shuqayq-Jizan	50	320	6.400	2.9
Jizan-Yemen Border	371	2,390	6.442	35.7
Farasan Islands	195	1,250	6.441	7.7
Total/Average 1983	**2,408**	**10,210**	**3.788**	**9.04**
Total/Average 1995	**10,640**	**22,887**	**2.151**	**12.4**

1 Jeddah landings included significant amounts of fish caught in sanbuks operating in the al-Lith and Qunfudah sectors, which were added to those sectors.

Productivity of the shelf adjacent to Tuwwal was estimated to be about 0.38 and 0.41 metric tons per square kilometers in 1982 and 1983 (Kedidi and others, 1984). Estimates of the grounds north of al-Lith to the Jordan border was 4,300 metric tons per year, which at that time was roughly equivalent to the current catch, indicating that the shelf was fully exploited. Peacock and Alam (1980) had suggested that the northern sector was overexploited. Since that time, Saudi Arabia's fishery landings have increased significantly although data are unavailable to

per fisherman. The increase is apparently based on productivity (or possibly area) of the fishable shelf as the least intensively stocked areas are the least heavily fished.

Species Composition of Landings

Red Sea landings are nearly evenly divided between benthic species associated with coral reefs and the "continental" shelf and pelagic species (shown in shading in Table 5) that generally migrate throughout their life history, most probably throughout the Red Sea and most likely between the Indian Ocean and the Red Sea. While man-

Table 5: Species Composition of Saudi Arabian Red Sea Landings, 1985 (MAW, 1986) and 1995 (MAW, 1996)

Species	% of total landings 1985	% of total landings 1995
Spanish Mackerel	*30.4*	*16.2*
Jacks	*12.0*	*10.7*
Cutlass Fish	*3.0*	*2.1*
Cobia	*0.1*	*0.1*
Indian Mackerel	*3.0*	*15.1*
Emperors	13.9	12.4
Groupers	13.0	10.6
Snappers	8.0	4.9
Barracudas	7.0	3.9
Miscellaneous	4.4	10.5
Sharks	2.0	1.8
Mullets	2.0	1.9
Parrotfishes	1.0	3.0
Wrasses	0.1	0.8
Sea Breams	0.03	1.2
Surgeon Fish	0.02	0.6
Rabbit Fish	0.02	4.0
Goat Fish	0.01	0.2

Note: Species in italics are pelagic species that may migrate across national boundaries.

agement of benthic species can largely be dealt with as a national issue (within certain limitations associated with transboundary recruitment), management of migratory species requires establishment of cooperative management regimes among the countries involved in exploitation of the shared resources. Thus, it would be expected that most of the Red Sea countries are similarly involved in exploitation of pelagic resources and should, therefore, be involved in joint management of the resource base.

In addition to the fact that tropical fisheries are inherently difficult to manage because of the diversity of species harvested, issues for Saudi Arabia in developing its fishery resources generally center on insufficiency of data upon which to initiate a substantive programme of fishery management. Despite this problem, the MAW has begun a programme of seasonal protection of breeding aggregations of groupers as well as a number of other regulatory actions. Management for targets of maximum or optimum sustainable yield, however, must await an improved database of catch and effort.

Management of migratory species will require more than unilateral national management actions as these species cross national boundaries and harvest in the waters of one country can affect harvest by others. Regional fishery management activities will need to be initiated in order for rational exploitation of these species to be undertaken. The work of such a regional entity should consist of identification of specific fishery resources that warrant development of detailed fishery management plans. These plans should be developed on the basis of best available scientific information and should be used as a guideline for national fishery management authorities for implementation.

NON-LIVING MARINE RESOURCES

Slightly more than 50 percent of Saudi Arabia's economic development currently originates in the oil sector Decreasing oil prices, coupled with efforts to diversify the economic base, brought the dependence on oil from a 1974 high of over 76 percent to 32.8 percent in 1985. Since that time, however, there has been a continuing trend upwards toward increased dependence on oil.

One aspect of this dependence on oil and petrochemical development is that Saudi Arabia's ports constitute a major center for maritime activities associated with the export of oil and oil products as shown in Table 6.

MARITIME TRANSPORT

The Saudi Arabian maritime fleet totals seventy-one ships of the types listed below with a total 865,343 GRT (1,240,874 DWT). The distribution of vessel classes in the Saudi-owned fleet is shown in Table 7.

Table 6: Crude Oil and Petroleum Products loaded in Saudi Arabian Ports (both coasts).

Product Loaded	Year	10^3 MT
Crude Petroleum	1988	122,703
Crude Petroleum	1989	126,549
Crude Petroleum	1990	175,840
Petroleum Products	1988	37,962
Petroleum Products	1989	38,430
Petroleum Products	1990	37,200

Source: WRI, 1995

Table 7: Saudi Arabia's Maritime Fleet By Vessel Type (both coasts)

Vessel Class	Number
Bulk	1
Cargo	11
Chemical Tanker	4
Liquefied Gas	1
Livestock Carrier	5
Oil tanker	23
Passenger	1
Refrigerated cargo	6
Short-sea passenger	7
Specialized tanker	1
Roll-on/roll-off cargo	11

A large percentage of the maritime traffic in the Red Sea is associated with transport of Saudi Arabian crude oil and petrochemical products, particularly between the northern Red Sea port of Yanbu which is the terminus of the Trans-Arabia Pipeline (Tapline), the Suez Canal and the Egyptian SUMED pipeline that transports oil across from the Gulf of Suez to the Mediterranean.

The result of all of this shipping pressure is that the Red Sea has much more pollution from marine transport and refinery inputs than the global average. The Red Sea is inherently dangerous to maritime traffic because of its narrow and congested deep water navigation routes bounded on either side by very restricted anchorages and coral reefs. Shipwrecks and collisions continue, despite advances in safety and navigational systems. Even at a major port such as Jeddah, 5-10 maritime accidents occur annually, some of which result in oil spills.

Legal and Institutional Framework

The key to any efforts to reconcile environmental concerns with economic and population expansion in Saudi Arabia lies in strengthening the institutional basis for coordination and implementation of necessary economic expansion in a sustainable manner.

MEPA is the central environmental agency in Saudi Arabia. It has not, however, been given the extensive enforcement and regulatory authority found in European or North American environmental agencies. Instead, Saudi Arabia has chosen to distinguish between the setting of environmental criteria such as standards, and actual operational management. Thus operational agencies such as the Ministry of Petroleum, Ministry of Agriculture and Ministry of Industry and Electricity retain actual regulatory control over activities carried out under their respective mandates, while MEPA sets environmental performance standards, monitors the activities of operational agencies and serves as a central coordinator for environmental management.

Among the innovative approaches employed by MEPA has been the memorandum of understanding with the Royal Commission for Jubail and Yanbu (RCJY) in which the commission has been delegated authority for managing environmental activities in the industrial cities. The arrangement has been so successful that in 1987 the RCJY was awarded the United Nations Sasakawa award for its environmental achievement. A recent analysis of environmental management in Saudi Arabia (MEPA, 1994) has suggested that this approach should be employed on a broader basis.

With regard to coastal zone management, MEPA has been consistently identified as Saudi Arabia's central environmental agency and the lead agency for coastal zone management. Despite this, institutionalization of authority for centralized coastal zone management has not

been fully achieved. Instead, each individual agency operates under its own specific mandate and numerous overlaps and potential conflicts abound (Table 8). Currently, the only recourse for resolving such conflicts and establishing national environmental policy is the Ministerial Committee for Environment. Day-to-day coordination mechanisms and central planning authority specific to the coastal

Table 8: Interagency Jurisdictional Issues within Saudi Arabia's Coastal Zone

Authority	Jurisdiction
MARINE ACTIVITIES	
Saudi Coast Guard	Jurisdiction between the border of the Territorial Sea (12 miles offshore) and 10 kilometers inland (Royal Decree No 33, dated 27/7/1377)
MEPA	Jurisdiction for prevention of Pollution in the Territorial Sea (Council of Ministers decision No 157, dated 20/11/1411 and Royal Decree No 7/505M, dated 28/3/1406)
Ministry of Agriculture (SWCC), Ministry of Petroleum (Saudi Aramco, oil companies), Ministry of Municipalities and Rural Affairs (Sewage Authority), Ministry of Industry and Electricity (SCECO and industrial cities) and RCJY	Control activities that emit pollutants into the Territorial Sea
MEPA	Jurisdiction for oil spill response (coordination mechanism established under Royal Decree 7/B/13307, dated 22/7/1411)
Ministry of Transport	Responsibility for Marine Navigation in the Territorial Sea
Sea Ports Authority	Responsibility for ports (Royal Decree No 7/505M, dated 28/3/1406)
Ministry of Agriculture	Jurisdiction for fishery activities (Royal Decree No 7/505M, dated 28/3/1406)
Ministry of Petroleum	Jurisdiction over oil production and marine mineral extraction activities in the Territorial Sea
Ministry of Defense	Jurisdiction of military activities within the Territorial Sea
SUBMERGED LANDS	
Sea Ports Authority	Responsibility for ports (Royal Decree No 7/505M, dated 28/3/1406)
MEPA	Jurisdiction for prevention of pollution including effluent from landfill ports (Royal Decree No 7/505M, dated 28/3/1406)
Ministry of Petroleum	Jurisdiction over oil production and marine mineral extraction activities in the Territorial Sea
Ministry of Agriculture and Water	Directed by Royal Decrees to enforce a moratorium on landfill ports (Royal Decree No M/9, dated 27/3/1408)
RESOURCE CONSERVATION	
Ministry of Agriculture	Responsible for fishery management (Royal Decree No 7/505M, dated 28/3/1406; Royal Decree No M/9, dated 27/3/1408)
NCWCD	Responsible for management of protected areas (Royal Decree No M/22, dated 12/9/1406)
Ministry of Agriculture	Responsible for management of national parks
COASTAL DEVELOPMENT	
Ministry of Municipal and Rural Affairs	Responsible for municipal development, flood water management and disposal of waste
Ministry of Industry and Electricity	Responsible for industrial development and electricity generation
Ministry of Agriculture	Responsible for agricultural development, development of groundwater resources and seawater desalination
MEPA	Responsible for setting standards for the environment (Royal Decree No 7/M/8903, dated 2/14/1401) and for carrying out a programme of environmental impact assessment; designated coastal zone management agency
Royal Commission for Jubail and Yanbu	Responsible for industrial development within the two industrial cities; also responsible (under a Memorandum of Understanding with MEPA) for environmental management in those cities

zone are lacking. A draft proposal for development of a national coastal zone management plan was submitted and approved for final promulgation by the Ministerial Committee for Environment in July 1997.

Saudi Arabia is signatory to regional and international agreements which place obligations upon it for prevention of pollution and protection of resources. Notable among these are:

- The protocol concerning Regional cooperation in combating pollution by oil and other harmful substances in cases of emergency (1978).
- The Regional Convention for the conservation of the Red Sea and Gulf of Aden against pollution from land based sources (1982).
- The Declaration of the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (1995).

Major actions to support sustainable development were undertaken in 1992 when a basic change in Saudi Arabia's system of government was made to incorporate National and Provincial Advisory Councils (Majlis Shoura) of experts whose purpose was to consider the issues facing Saudi Arabia's future development. Although it is too early to assess the impact of this change, it does appear that the councils are debating a number of cross-sectoral issues and suggesting useful solutions.

Future growth (based on a near doubling of the population during the next two decades) will either require considerable expansion of infrastructure or a major decrease in the rate of consumption of basic services if Saudi Arabia is to maintain quality of life for its inhabitants. Much of this expansion will require careful management to prevent environmental consequences of development activities in the coastal zone.

If such planning is to take place, attention must first be paid to the need for increased coordination between the many agencies whose mandates overlap and create potential conflicts within the coastal zone. It would also seem most appropriate that a centralized municipal planning entity, based upon the highly successful model of the Arriyadh Development Authority, be established in order to plan municipal expansion and mediate the potential conflicts between development and environment.

Threats to the Environment

Several significant issues will need to be addressed if Saudi Arabia is to continue to expand its economy and population while maintaining the highly desirable standard of living currently enjoyed by its people. A programme of sustainable development will inherently require investment on a level appropriate to address past, present and future impacts from such development.

Many of the environmental problems facing Saudi Arabia require an integrated approach for their solution. Such an approach has been difficult due to the sectoral organization of its government. Recent efforts in creating Advisory Councils and a national coastal zone management plan may begin to address this issue. Environmental monitoring and enforcement of existing environmental regulations also will need to be improved.

URBAN DEVELOPMENT

Expansion of Saudi Arabia's urban centers, particularly in Jeddah, clearly requires improved planning of future activities as well as considerable investment in rectification of prior problems. The entire process of urbanization has been accompanied by demographic dislocation, rapidly expanding demand for water, electricity and services and coastal landfilling. Saudi Arabia's government is strongly sectoral in its organization and requires an integrated and

and coordinated overlay if cross-sectoral problems are to be addressed.

Expansion of cities and other aspects of urban development constitute the single greatest pressure upon the coastal environment. Between the 1974 and 1992 censuses, Saudi Arabia's population grew from 7 million to nearly 17 million at an average annual rate of 3.24 percent. Urban population growth, however, was nearly 7 percent, compared to only 0.58 percent for rural areas (WRI, 1995).

In the 1992 census, there were three cities of over 750,000, including Riyadh with over 2.7 million and Jeddah, the largest, with 2 million. By 1995, the population of Jeddah was over 2.5 million (Olsen and others, 1996). Over 77 percent of the censused population lived in the six largest cities. Despite this trend towards urbanization, 22.4 percent of the population still live in villages and settlements of less than 2,400 inhabitants. Another 20.4 percent live in towns and villages larger than 2,400 people within the coastal zone (Ministry of Planning, 1994), for a total of 2.5 million along the Red Sea coast (WRI, 1995).

Table 9: Results of 1992 Census

Total Population	**16,929,294**
Population in villages of greater than 2,400	13,113,807
Inhabitants of villages less than 2,400 persons	3,815,487
Living in Coastal Zone (20.42%)	3,456,548
Arabian Gulf	888,252
Red Sea	2,568,296

Source: Ministry of Planning, 1992

There appears to be a growing recognition that the costs of catching up to and keeping pace with growth in Saudi Arabia's large cities may well warrant consideration of alternative planning strategies. One possible approach involves establishment of new "satellite" townships and new urban centers that encourage population movement away from the major cities.

While these alternative urban development strategies may suit economic activities, such expansion will intrude upon many undeveloped areas, particularly along the Red Sea coast. Significant emphasis will have to be placed upon urban planning and coastal zone management if the environmental deterioration that is currently occurring is to be avoided. Most urban environmental impact originates from three sources: landfilling, desalination and sewage.

LANDFILLING

Much of Saudi Arabia's coastal area is low-lying sabkha. Urban development has been accompanied by extensive filling of sabkhas and other coastal habitats in order to raise ground level for construction projects above the level of seawater intrusion. In the Red Sea coastal towns such as Jeddah, the bottom drops off over 20 meters immediately following the reef edge, creating a boundary for fill operations. In general, however, despite the existence of a Royal Decree prohibiting dredge or landfilling, private developers have continued to carry out extensive shoreline alteration projects, frequently without environmental analysis.

WATER USE

Much of Saudi Arabia's expansion has been made possible by extensive use of desalinated water. As a result there are issues of marine pollution from thermal emissions, brine and air quality problems. In addition, inefficient use of desalinated water through distribution leakage, waste and septic disposal has created secondary problems such as a rising groundwater table and consequent human health issues. This requires leak detection and repair, expansion of the central sewage network, and elimination of septic disposal. Activities to promote water conservation programmes for all user groups, including the public, should be given priority.

As of 1992 there were eighteen desalination plants operating along Saudi Ara-

bia's Red Sea coast, with a total combined capacity of 726,343 cubic meters per day (SWCC, 1992). The distribution of these is shown in Table 10.

Table 10: Seawater Desalination Plants on the Red Sea Coast of Saudi Arabia

Location	Capacity m^3/day	Start Up Date
Haql	3,785	1989
Duba	3,785	1989
Al-Wajh II	473	1979
Al-Wajh IIa	825	1986
Al-Wajh IIb	1,032	1989
Umm Lajh	3,785	1986
Yanbu (Madina)	95,000	1980
Rabigh	1,204	1982
Aziziah	3,870	1987
Jeddah II	37,850	1978
Jeddah III	75,700	1979
Jeddah IV	189,250	1982
Jeddah RO I	48,827	1989
Shuaibah (Makkah, Taif)	181,800	1989
Al-Birk	1,952	1984
Asir	75,700	1989
Farasan 1	430	1979
Farasan 1a	1,075	1989

The most recent start up is over seven years old. Rising populations require more water and Saudi Arabia is now faced with the question of either investing in increased capacity or undertaking demand-side management.

Such heavy dependence on desalination carries with it a number of environmental and security issues. In Jeddah, for example, the desalination plant produces a major portion of the NOx and SO_2 emissions and contributes heavily to the particulate and trace metal emissions load (Table 11).

Discharges into the marine environment from the Jeddah plants include chorine and anti-scalant chemicals as well as 1.73 billion cubic meters of brine at 51 ppm—over 1.3 times the ambient salinity of the Red Sea—at a temperature of 41°C—around 9°C over the average ambient Red Sea temperature. All of these loadings must certainly stress marine biota that are already living at the upper end of temperature tolerance for many marine species.

SEWAGE

Each of the coastal cities has developed sewage treatment capabilities. The figures shown in Table 12 only present an estimate of sewage release as many of the sewage treatment plants processing the waste stream are operating in excess of capacity, with the result that essentially untreated sewage is being emitted into the marine environment with impacts that range from eutrophication of coastal lagoons and malodorous inputs into the human environment, to contamination of

Table 11: Sources of Air Pollution in Jeddah

Pollutant	Refinery	Industrial City	Desalination	Vehicles*	Power	Total
CO	-	40	-	854000	-	854,040
VOC	3,700	-	-	-	-	3,700
HC	-	-	-	66,000	-	66,000
NOx	1,400	3,000	29,000	21,700	14,300	69,400
SO2	40,000	2,200	180,000	2,300	19,200	243,700
Particulates	530	58,000	6,800	-	1,010	66,340
Vanadium	-	-	50	-	9.1	59
Nickel	-	-	17	-	1.1	18
Lead	-	-	1.2	610	0.9	612

* Gasoline powered vehicles only
Source: MEPA.

Table 12: Estimated Red Sea Pollution Generated by Saudi Arabia's Municipal Sewage Treatment (metric tons per year)

Town	COD	BOD	P	N	NH^3
Jeddah	92,000	37,000	2,200	8,000	
Yanbu	99	39	2	8	
Western Region Unaccounted for	100,000	40,000	2,000	8,700	10,000
Northern Region, Unaccounted for *	66,000	26,000	1,300	5,700	
Southern Region, Unaccounted for *.	48,000	19,000	950	4,200	
Total	306,099	122,039	6,452	26,608	10,000

* This amount was estimated by per capita production rates from towns where no information was available during the study period. The unaccounted for values do not necessarily represent discharges to the Red Sea but do not include the inland cities of Taif, Makkah, Madina, Abha, Qassim, Khamis Mushayt.
Source: MEPA.

groundwater and human health problems resulting from contamination of the food chain.

GROUNDWATER

Rapid expansion in coastal cities has led to a number of environmental impacts on groundwater that must be addressed. These are caused by coastal city needs for water and electricity, disposal of sewage and other wastes, and industrial development. One unexpected aspect of urban pollution has been the rise in groundwater levels that has resulted from increased water use and insufficient sewage disposal.

In Jeddah, groundwater inputs have made the groundwater table rise at a rate of 0.5 meters per year in much of the town, causing pooling at the surface in some areas. High groundwater levels can create habitat for insect-borne disease; damage to roads, infrastructure and buildings; and lead to waterborne disease by allowing contaminated water to enter the potable water system. The sources of this rise are shown in Table 13.

Table 13: Sources of Groundwater in Jeddah

Source of Groundwater	Groundwater Input (m^3/year)		Amount
Horticulture	10,690,000	(8%)	
Sewage	89,878,000	(67%)	
Leakage from distribution system	32,840,000	(25%)	
Area of Jeddah (km^2)			1,200
Groundwater (m^3/m^2/year)			0.11
Sediment porosity			0.2
Groundwater rise (m/year)			0.56

Source: Olsen, and others, 1996

High dependency on desalinated water also leads to air pollution and creates a significant economic drain in terms of investment and operation to keep up with the heavy domestic and industrial demand for water (Olsen and others, 1996).

In addition to basic investment and operational costs associated with water use, there are other costs associated with human health and damage to infrastructure caused by the rising groundwater table. It has been estimated that the actual cost of water when these are included is an order of magnitude greater than the production cost and three orders of magnitude greater than the subsidized cost to the customer.

NAVIGATION AND MARITIME RISKS

The Red Sea is inherently dangerous for maritime activities. It is narrow, with congested and confined shipping lanes in a

central trench that is 2,000 meters in depth and bordered with coral reefs. In addition prevailing winds carry most of the marine pollution onto Saudi Arabia's coastline. Thus, any activity which would increase maritime safety would have a positive impact upon Saudi Arabia's coastal lands.

INDUSTRIAL DEVELOPMENT

Industrial development along Saudi Arabia's Red Sea coast has been accompanied by inputs of a number of marine pollutants in addition to those from sewage. A summary of the marine and air pollution inputs from the Red Sea coastal areas is shown in Table 14.

Table 14. Marine and Air Pollution Emissions from Red Sea Coastal Provinces

14a. Water Pollution Emissions from Red Sea Coastal Provinces (mt/yr)

Pollutant	Sewage	Industrial Cities	De-salination	Re-fineries	Petro-chemical	Total
COD	293,200	2,570			270	296,040
BOD	144,580	1,114		1,543		147,237
P	51,580	9				51,589
TSS				1,623		1,623
SS		1,071			63	1,134
N	29,480					29,480
NH_3	10,000					
N_{tot}		88				88
Barium	285					285
Copper	345					345
Cadmium	10					10
Chromium	54					54
Chlorine			630	146	100.2	876
Iron	825					825
Lead	195					195
Manganese	195					195
Nickel	2,909					2,909
Oil				1,164	369	1,533
Phenol				49		49
Phosphorus	3,298	95			2.2	3,396
Phosphate			3.20			3
Sulfides				452		452
Zinc	13,043					13,043
Heat Load (gram cal./yr)			18,250,000			18,250,000
Brine			1.73E+09			1.73E+09

14b. Air Emissions from Red Sea Coastal Provinces (mt/year)

Pollutant	Source							
	Vehicles[1]	De-salination	Power Generation	Re-fineries	Industrial Cities	Cement	Petro-chemical	Total
SO_2	2,300	384,000	137,000	132,840	2,200	14,700	3,530	676,570
No_x	21,700	57,800	61,000	7,900	3,000	21,500	2,860	175,760
HC	66,000							66,000
CO	854,000				40			854,040
Particulates		18,000	6,000	710	58,000	232,510		315,220
VOC			3,000	44,800			18,090	65,890
Pb	610		6					616
Vanadium		173	173					346
Nickel		57	57					114

1 Includes Jeddah only.

In addition to these industrial inputs, nearly the entire Saudi Arabian coast suffers some degree of oil pollution (Awad, 1995). Awad's survey indicated that the Red Sea receives 6,836 metric tons or 14.61 kilograms per square kilometer per year of oil from shipping, nearly 1.5 times the global average of 3.2 million metric tons per year or 9.17 kilograms per square kilometer per year. Global refinery input is 0.56 kilograms per square kilometer per year, whereas the Red Sea receives 6.64 kilograms per square kilometer per year, nearly 11 times as much. This stems largely from the fact that the prevailing winds over most of the year are from the north-northwest and blow whatever pollution originates from the numerous annual transits of the Red Sea onto the Saudi coastline.

Maritime activities are not the only source of oil pollution as is shown in Table 15 which indicates the sources of refinery inputs into the Red Sea from Saudi Arabia.

Table 15: Sources of Oil Pollution Originating from Red Sea Refineries

Source	Mt/yr
Jeddah Refinery	273
Yanbu Refinery	1,120
Yanbu Oil Terminal	345
Rabigh	900

Source: Awad, 1995.

COASTAL DEVELOPMENT

Saudi Arabia's coastline has been developed without sufficient analysis of environwmental impacts. Corniche roads have been built by landfilling to the reef edge; private villas and coastal cities have been developed with extensive dredging and landfill; and municipal sewage outfalls have been built in proximity to recreational beaches. There is an immediate need for a structured programme of environmental assessment and integrated planning for development projects that have an impact on coastal resources.

FISHERY DEVELOPMENT

Expanded development of Saudi Arabia's fishery management database will be required to sustainably manage fishery resources. Additional attention will need to be paid to management of migratory species that traverse international borders and require regional management. Destruction of important coastal habitat (landfill of mangroves, filling in of back reef lagoons, etc.) will need to be reduced since this translates directly into decreased recruitment to the exploited populations.

A summary of threats is provided in Table 16.

Recent, Current and Planned Environmental Initiatives

Although traditional Saudi society contained several cultural devices for conservation of rangelands and other resources, the consolidation of the country led to a decrease in political/tribal modalities for implementation. In 1977, the small island of Umm al-Qamari was given de facto protected area status. Asir National Park was established by the MAW in 1981 (NCWCD, 1990).

Following these initial efforts, the MEPA survey in the early 1980s identified forty-six areas warranting consideration as part of a system of coastal protected areas (MEPA, 1987). Saudi Arabia's Environmental Protection Coordinating Committee (EPCCOM) designated them as "Environmentally Sensitive Areas" (Table 17).

In 1987, the NCWCD was formed with the express mission of handling Saudi Arabia's wildlife and conservation management issues. It began a process of *de facto* designation of terrestrial and coastal protected areas according to the classification system in Table 18. While these categories tended to coincide with IUCN, some modification was undertaken for greater applicability to the Saudi Arabian situation. The equivalent IUCN categories are also shown in the table. By 1989, this

programme had placed 51,405 square kilometers of land (2.4 percent of total), under protected status. In 1990, the NCWCD published its "Plan to Protect Areas in Saudi Arabia" that contained a system of protected areas that could place 12.8 percent of Saudi Arabia's land mass under conservation management.

Priority Actions

Priority actions are listed in Table 19.

- Enforcement of legislation related to management of coastal and marine areas.
- Final approval and effective implementation of the coastal zone management plan.
- Implementation of management programme for the Farasan Islands Marine Protected Area.
- Development and implementation of management programme for Marine Protected Areas at Wajh Bank, sites in Straits of Tiran and other areas on the Red Sea.
- Rehabilitation of mangroves from damages caused by landfilling and camel grazing.
- Stock assessment and management programme for finfish and shrimp with an evaluation of catch and effort.
- Measures to control intensive collection of fish and invertebrates on reef flats and spearfishing.
- Development and implementation of a conservation and management programme for breeding birds and nesting turtles on offshore islands.
- Update of current fisheries management programme.
- Enforcement and public awareness activities for coral reef conservation, including control of overfishing, trampling of corals, anchor damage, littering and souvenir collection.
- Review of current navigation charts, conduct hydrographic re–surveys and prepare updated charts for key areas along shipping routes and in vicinity of key ports.
- Improvement of navigational aids and radio communication in Saudi waters, especially on major shipping channels.
- Implementation of current Oil Spill Contingency Plan, including development of local response plans.
- Review of port reception facilities and upgrade of measures as appropriate.
- Improved management of air pollution, brine disposal and thermal discharges from desalination plants at urban areas and industrial ports.
- Improved control of emissions from cement plants in coastal areas, especially Ras Baridi.
- Effective control of dredging and filling for urban and industrial development, port construction and maintenance dredging of navigation channels.
- Upgrading of wastewater collection and treatment in coastal areas, especially Jeddah.
- Development and implementation of a special programme for the management and reduction of elevated groundwater tables in the Jeddah urban area.
- Strengthening of environmental planning and management of urban development in the Jeddah Region.
- Strengthening of the current programme for development of a database for biological resources and environmental information, and further strengthening and expansion of monitoring programmes to support operations and enforcement activities.
- Expand activities of Saudi Public Awareness Programme implemented by public and private sector parties.

Table 16. Threats to the Coastal and Marine Environment and Resources

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Habitat Destruction					
Coastal development and land reclamation	Dredging and filling, destruction of coral reefs, loss of productive lagoons	Urban, industrial and port development, expansion of coastal population	Inadequate environmental planning, Lack of ICZM, Limited use of EA	Localized, above all in vicinity of large settlements	Severe
Mangrove destruction	Deterioration of mangrove habitat; decreased fish and shrimp catches; lower water quality	Construction of shrimp ponds, Grazing by camels	Lack of regulations and management, lack of awareness	Localized	Moderate, locally severe
Damage to coral reefs	Loss of coral habitat and decline in reef associated fauna, coral breakage	Anchor damage, ship grounding, damage by fishing nets, trampling of reefs, collecting of marine souvenirs	Inadequate navigation systems, lack of moorings, destructive fishing, lack of awareness and enforcement	Localized	Moderate
Living Marine Resources					
Potential overfishing of pelagic and demersal fish stocks	Decline in landings, decrease in average size	Increased fishing efforts, landing beyond Maximum Sustainable Yield	Lack of stock assessment and reliable statistics	Throughout area	Moderate
Potential overfishing shrimps	Decline in landings	Increased fishing efforts in limited areas, illegal shrimp fisheries	Lack of stock assessment, Lack of enforcement	Southern Red Sea coast	Moderate to severe
Collection of turtle and bird eggs	Decrease in nesting populations	Subsidiary food supply	Lack of public awareness, lack of enforcement	Localized	Low to moderate
Navigation and Maritime Risks					
Navigation risks	Risks of ship collisions and grounding	Limited navigational devices and inadequately separated traffic	Navigational hazards, heavy maritime traffic	Throughout the area, near major ports	Moderate
Marine vessel sewage	Localized marine and beach pollution	Discharge from ships	Inadequate onboard treatment, lack of port reception facilities	Throughout the area	Moderate
Ship discharge of solid waste	Solid waste on shoreline, in mangrove areas and coral reefs	Discharge of solid waste from ships	Inadequate surveillance and enforcement, lack of port reception facilities	Throughout the area	Low to moderate
Spillage of hazardous chemical cargoes	Damage to marine life, contamination of industrial intakes and recreational beaches, human health risk	Ship accidents at port entrances or collision at sea	Navigational hazards, inadequate navigational aids, heavy traffic	Throughout the area, specially near ports	Moderate to severe
Petroleum Development and Transport					
Small oil spills (< 20 mt)	Beach contamination, damage to coastal and marine biota	Tanker cleaning, discharge of ballast and bilge water, discharge of waste oil, bunker oil spill	Lack of reception facilities at ports; inadequate control, lack of enforcement	Localized, near ports and terminals	Moderate
Medium oil spills (20-100 mt)	Beach contamination, damage to coastal and marine biota	Discharges from terminals, small accidents at sea	Inadequate controls and monitoring of equipment and personnel, Inadequate training	Localized, near ports and terminals	Moderate to severe

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Risk of large oil spills and disasters (> 100 mt)	Destruction of coastal and marine habitats and biota, devastation of beaches	Rupture of oil tanks in collision or wreckage	Insufficient tanker safety specifications, inadequate navigation aids	Localized, throughout the region	Severe
Industrial Activities					
Surface and groundwater use	Excessive surface and groundwater for industrial use	Excessive pumping, inadequate concern for conservation	Inadequate regulation of water exploitation	Localized in industrial areas	Moderate
Industrial pollution	Decline in water quality	Chronic release of pollutants	Inadequate regulations and enforcement	Localized	Moderate
Pollution from desalination plants	Decline in water quality, habitat deterioration	Release of thermal brine contaminated with chemicals (chlorine)	Dependence on desalinated water, inadequate plant maintenance	Localized	Moderate to severe
Waste oil disposal	Soil and groundwater pollution	Improper disposal of used motor oil	Lack of proper oil disposal and recovery, lack of regulations and enforcement	Localized	Presently low
Urban Development					
Surface and groundwater	Excessive surface and groundwater use, saltwater intrusion	Excessive pumping of groundwater	Inadequate water conservation, inadequate maintenance of distribution systems	Localized	Moderate
Discharge of insufficiently treated sewage	Groundwater impacts, eutrophication, public health threats	Insufficient sewage treatment, lack of maintenance of existing plants and discharge pipes	Inadequate pollution control regulations, monitoring and enforcement	Localized, urban areas	Moderate to severe
Water discharge	Rise in groundwater levels	Discharge and leakage of water from distribution and irrigation network	Inadequate planning and irrigation systems, lack of maintenance	Localized, urban areas	Severe
Discharge of insufficiently treated sewage	Groundwater impacts, eutrophication, public health threat	Insufficient sewage treatment, lack of plant and pipe maintenance	Inadequate regulations, monitoring and enforcement	Localized, urban areas	Moderate
Urban growth	Spreading of urban development, inadequate services	Rapid expansion of cities	Lack of planning and coordination	Local	Moderate to severe
Recreational villages	Major constructions along coastline	Growing need for recreational sites	Inadequate coordination and EA, lack of control and enforcement	Localized	Moderate to severe
Other Concerns					
Sedimentation from agriculture and grazing	Destruction of vegetation cover, mobilization of dunes and sand sheets, smothering of coral reefs	Grazing by livestock	Inadequate management of coastal grazing	Localized	Low to moderate
Use of pesticides and fertilizers in the coastal zone	Contamination of soils and water, presence of pesticides in marine organisms	Large-scale use of pesticides and fertilizers for agricultural purposes	Inadequate planning and surveillance, lack of control and awareness	Localized	Low

Table 17. Marine Protected Areas (in italics already established; others proposed)

Protected Area	Size km^2	Major Habitats and Regional Significance	Impacts and Conflicts	Priority
Strait of Tiran	Undefined	Islands and extensive coral reefs with diverse reef associated fauna in transition area, turtle nesting, dugong	Small part of area used by tourists from Egypt	Regional
Ras Suwayhil	267	Pristine and diverse coral reefs and reef associated fauna, high cliffs, and scenic features, seabirds, dugong	Unknown	Regional
Sharm Zubayr coast	80	Coastline and sharm with fossil reef cliff, narrow reef flats and fringing reef, northernmost mangroves	Construction of causeway	National
Ghubbat Bal'aksh	33	Sharm and coastline with reefs, particularly high coral diversity, seagrass beds, osprey, low hills inland	Unregulated recreation	National
Sharm Dumagyh, Sharm Antar	70	Scenic lagoons with fringing reefs, seagrass beds, mangroves, green and hawksbill turtles, osprey	Fishing and recreation	National
Wajh Bank, Sharm Habban and Sharm Munaybirah	2840	Extensive shallow water area with mainland coast and offshore islands, most extensive coral reef system of Red Sea, diverse reef associated fauna, seagrass beds, mangroves, turtles, bird nesting sites, key area for dugongs	Collection of turtle and bird eggs, fishing	Global
Qalib Island chain	included in Wajh Bank	Series of low lying, sandy islands, seagrass beds, coral reefs, lagoons, nesting site for turtles and seabirds	Collection of turtle and bird eggs	National
al-Hasani Island, Libana Island	Undefined	High aspect islands with shallow and deep fringing reefs, important nesting site for turtles and sea birds	Egg collection	National
Ras Abu Madd, Sharm Hasi	Combined with previous area	Scenic sharms and high quality fringing reefs, fossil reef terraces, osprey	Fishing activities	National
Ras Baridi, Sharm al-Khawr Island	30	Sand beaches, small islands, coral reefs, seagrass beds, important nesting beach for green and hawksbill turtles, bird nesting area, dugong	Pollution from industrial source	Regional
Sharm Yanbu	50	Deep, sheltered, bi-lobed lagoon, mangroves and seagrass beds, fringing reefs, osprey, dugong	Recreation activities	National
Yanbu Royal Commission protection area	*5*	*Mangroves and good quality fringing reef, osprey*	*Unknown*	*Local*
Shi'b al-Qirin Reef	15	High quality inshore and offshore reef complexes, osprey	Unknown	National
Marsa al-Usalla, Marsa Tawil	30	Shallow lagoons, dense stands of halophytes, mangrove, seagrass beds, algal beds, osprey, migratory birds	Livestock grazing on inland halophytes	National
Mastura beach	30	Low lying shoreline with stands of reed (*Phragmites*) and palms, rare freshwater dependant vegetation site	Recreation pressure	National
Marsa as-Sarraj	200	Largest land-locked lagoon on Saudi Arabian Red Sea coast, mangroves, halophytes, seagrass beds, high quality reef, osprey, important coastal wetland	Agricultural development, fishing	National
Marsa Umm Misk	67	Shallow bay with extensive seagrass beds, small stands of mangrove, osprey, dugong	Unknown	National
Haramil Island	included in previous area	Small elongated island, halophytes, dugong, osprey, nesting bridled terns and brown noddies	Island used by fishermen	National

Protected Area	Size km^2	Major Habitats and Regional Significance	Impacts and Conflicts	Priority
Ras Hatiba	450	Large shallow lagoon, sand and coral-line spits, small mangrove stands, off-shore reefs, high diversity, prime site for education and extension	Recreation pres-sure, unregulated development	Local
Jeddah salt marsh	100	Marshland and coral reef, key site for birds: large concentration of waders, osprey, spoonbill, flamingos	Oil pollution and other waste dis-posal, possibly development	National
al-Shuayba, Mastaba	100	Large lagoon with extensive man-groves, fossil reef terrace and good quality offshore reefs, bird breeding area, osprey	Cutting of man-grove, unregulated rec-reational devel-opment	Local
Qishran	Undefined	Complex of reefs, coral spits, seagrass beds and extensive mangroves, impor-tant seabird site, osprey, dugong	Development for recreation, possi-ble corniche	National
Inner Farasan Bank	Undefined	Low lyind, seasonally inundated mainland coastline, fringing mangroves, islands, birds nesting and dugong area	Unknown	National
Outer Farasan Bank	Undefined	Major reef and island system with di-verse habitats, mangrove, seagrass, coral reefs, bird and turtle nesting area, representative of central Red Sea	Unknown at pre-sent	National
Umm al-Qamari	*2*	*Two small islands off the Red Sea coast, with thousands of birds such as collared doves, herons, pelicans, gulls and sooty falcon*	*None*	*National*
Marka Island	Undefined	Low, sandy island with dense halophyte vegetation, good quality reefs, bird breeding site	Used by fisher-men, possible egg collection	National
Ras Tarfa	230	Coastal and terrestrial reserve, large spit with mangroves and seagrass beds, key site for marine and terrestrial habitats, important bird area	Possibly hunting	National
Farasan Is-lands	*3310*	*Terrestrial and coastal reserve, archi-pelago of coral islands, coral reefs, seagrass beds, marine mammals, nest-ing seabirds, two species of man-groves, endemic gazelle*	*Fishing, growing development, recreational pres-sure*	*Global*
Khawr Amiq, Khawr Raqa	Undefined	Lagoons, osprey	Unknown	Local
Khawr Nahoud	33	Lagoon with fringing corals, seagrass beds, mangroves, dugong, important bird site, osprey	Presently un-known	National
Khawr Itwad	70	Lagoon, abundant seagrass, extensive mangrove stands, fringing corals	Unknown	Local
Shi'b Abu al-Liqa, Shi'b al-Kabir	140	Small lagoonal areas with abundant mangroves, coral reefs	Unknown	Local/ national
Khawr Wahlan	27	Representative saltmarsh with halo-phytes, significant coastal wetland area	Grazing	National
Duwayyimah	160	Productive shallow lagoon, seagrass, mangroves, osprey, dugong	Unknown	National

Table 18: NCWCD Conservation Categories and Their IUCN Equivalents.

NCWCD Category	IUCN Equivalent(s)
Special Natural Reserves	I. Strict Nature Reserve/Scientific Park II. National Park IV. Nature Conservation Reserve or Managed Reserve/Wildlife Sanctuary
Natural Reserves	I. National Park IV. Nature Conservation Reserve or Managed Reserve/Wildlife Sanctuary
Biological Reserves	I. Strict Nature Reserve/Scientific Park IV. Managed Reserve
Resource Use Reserves	V. Protected Landscape or Seascape VI. Resource Reserve VIII. Multiple Use Management Area/Managed Resource Area IX. Biosphere Reserve
Controlled Hunting Reserves	VIII. Managed Resource Area

1. Special Natural Reserves are intended as prime sites of high biological excellence which emphasize conservation of biological diversity. All exploitive activities within the area of Special Natural Reserves would be strictly regulated.
2. Natural Reserves are areas of lesser natural excellence which have undergone some alteration and which may be managed either by the NCWCD or other agencies.
3. Biological Reserves are proposed to carry out conservation priorities that include protection of important rangeland seed stocks, demonstration of the benefits of range lands management, protection of critical water catchment areas, and protection of local biological communities or coastal resources.
4. Resource Use Reserves are visualized as relatively large areas in which the emphasis is on sound resource management rather than pure conservation goals.
5. **Controlled Hunting Reserves** are suggested for areas in which wildlife is managed with the aim of providing improved and sustainable hunting at some time in the future when game population have recovered (as a result of management activities).

Table 19: Priority Actions

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Legislation	Enforcement of legislation related to management of coastal and marine areas	National	Capacity building Technical development	***
Environmental management	Final approval and effective implementation of the coastal zone management plan	National	Legal framework Capacity building	***
Environmental management	Implementation of management programme for the Farasan Islands Marine Protected Area	National Local	Legal framework Management information Management programme	***
Environmental management	Development and implementation of management programme for Marine Protected Areas at Wejh Bank, sites in Straits of Tiran and other areas on the Red Sea	National Local	Legal framework Management information Management programme	***
Habitat conservation	Rehabilitation of mangroves from damages caused by landfilling and camel grazing	National Local	Management programme Public awareness	**
Living marine resources	Stock assessment and management programme for finfish and shrimp with an evaluation of catch and effort	National	Management information Management programme	***
Living marine resources	Measures to control intensive collection of fish and invertebrates on reef flats and spearfishing	National Local	Enforcement Public awareness	**
Living marine resources	Development and implementation of a conservation and management programme for breeding birds and nesting turtles on offshore islands	National Local	Legal framework Management information Management programme	**

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Living marine resources	Update of current fisheries management programme	National	Management information Management programme Production programme	*
Tourism management	Enforcement and public awareness activities for coral reef conservation, including control of overfishing, trampling of corals, anchor damage, littering and souvenir collection	National Local	Legal framework Management programme Public awareness	**
Navigation risk	Review current navigation charts, conduct hydrographic re–surveys and prepare updated charts for key areas along shipping routes and in vicinity of key ports	Regional National Local	Capacity building Technical development Management information	**
Navigation risk	Improvement of navigational aids and radio communication in Saudi waters, especially on major shipping channels	National Local	Capacity building Technical development	**
Petroleum development and transport	Implementation of current Oil Spill Contingency Plan, including development of local response plans	National Local	Capacity building Technical development	**
Maritime transport	Review of port reception facilities and upgrade of measures as appropriate	Local	Technical review Technical development	**
Industrial development	Improved management of air pollution, brine disposal and thermal discharges from desalination plants at urban areas and industrial ports	National Local	Technical development	**
Industrial development	Improved control of emissions from cement plants in coastal areas, especially Ras Baridi	National Local	Technical development	*
Urban development	Effective control of dredging and filling for urban and industrial development, port construction and maintenance dredging of navigation channels	Local	Enforcement Environmental planning Monitoring Public awareness	***
Urban development	Upgrading of wastewater collection and treatment in coastal areas, especially Jeddah	Local	Feasibility studies Capacity building Technical development	***
Urban development	Development and implementation of a special programme for the management and reduction of elevated groundwater tables in the Jeddah urban area	Local	Management programme Technical development	***
Urban development	Strengthening of environmental planning and management of urban development in the Jeddah Region	Local	Environmental planning	**
Applied research	Strengthening of current programme for development of database for biological resources and environmental information, and further strengthening and expansion of monitoring programmes to support operations and enforcement activities	National	Capacity building Management information	*
Environmental Education	Expand activities of Saudi Public Awareness Programme implemented by public and private sector parties	National Local	Public awareness Environmental education	***

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Country Report

Northern Coast of Somalia

Introduction

The Red Sea and Gulf of Aden represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism. This narrow band of water shared by a number of coastal states is also an important shipping lane linking the world's major oceans. While large parts of the Region are still in a pristine state, environmental threats—notably from habitat destruction, over-exploitation and pollution—are increasing rapidly, requiring immediate action to protect the Region's coastal and marine environment. To this end, a Strategic Action Programme (SAP) has been prepared through a continuous, consultative and cooperative process among the coastal states, coordinated by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA).

The SAP is a programmatic approach to the development of country based regional environmental projects, providing and benefiting from linkages with ongoing regional seas initiatives and major international waters projects. This will assure a concerted approach to transboundary problems, and the realization of regional and global benefits. The SAP has been prepared by a Task Force including PERSGA member states, the Islamic Development Bank, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. Financial support has been provided by the countries of the Region, the Global Environment Facility (GEF) and selected donor organizations. The GEF has approved support for implementation of the SAP, which will be complemented by funding from a variety of international and domestic resources.

The present country report provides background information to the SAP process at the national level. It is based on information from publications and reports, listed at the end of this document, and a rapid assessment survey by the authors of this report.

Background

Somalia has 3,300 kilometers of coastline, of which 1,300 kilometers face the Gulf of Aden from Ras Caseyr to the border with Djibouti. The western part of this coast between Saylac and Berbera is shallow with exposed, high energy sandy beaches. The central portion between Berbera and Bosaso consists of mainly shallow, sandy shorelines, broken rarely by protruding rocky outcrops and cliffs which may extend into the shallow water. In the eastern

part between Bosaso and Ras Caseyr high mountains reach the sea. This area is characterized by rocky shores with steep cliffs, often interspersed with short segments of narrow sandy beaches. East of Xabo the coast again becomes shallow. There are no perennial rivers along the northern coast of Somalia. Freshwater reaches the coast only during irregular flash floods following torrential rains. The surface runoff from land has no significant influence on the marine environment. The lower reaches of larger wadi systems may form khoris (creeks), natural harbors that offer safe anchorage for smaller fishing vessels. The continental shelf rarely exceeds 15 kilometers in width, except for the extreme northwestern section near the border with Djibouti, where it is much wider. It covers a total area of 8,400 square kilometers. There are only two groups of islands along the Gulf of Aden shore of Somalia: The Saad ad-Din group near Saylac consists of six small, low-lying, exposed islands with sandy beaches, while Jasiired Maydh in the central part near Ras Xatib is a steep-faced rock a little over 1.5 kilometers in length with an average height of 100 meters.

The climate is arid with an average annual rainfall of less than 300 millimeters. Seasonal variation is mainly influenced by the monsoon winds, which also determine the coastal currents. From May to August, the southwest monsoon drives a strong current from the level of Socotra to the east. It influences the water masses in the Gulf of Aden, where the main current direction is eastward during this period. However, along the northeastern coast there is a counter current that flows westward, fed by northeasterly flowing waters passing between Socotra Island and the mainland into the Gulf of Aden. From October to March, during the northeast monsoon, waters flow from the Arabian Sea into the Gulf of Aden. The main current direction along the Somali coast is westward, but in the northeast there is a counter current that flows east. During the southwest monsoon there are upwellings of cold water in the northeast that are rich in nutrients, but generally low in oxygen. These upwellings generate phyto- and zooplankton blooms. They break down during the northeast monsoon when the water in the area is warmer, less nutrient rich and saturated with oxygen (Swallow, 1991).

Very little information is available about the habitats and biota along the Gulf of Aden coast of Somalia. The information given here is based on a rapid assessment survey which the authors conducted in April and May 1996. Most nearshore subtidal areas are shallow with sandy substrate, occasionally interspersed with fields of cobbles or boulders and with rocky outcrops. Even steep rocky cliffs usually continue as shallow sand areas under the water's surface. There are very few seagrass beds; they are found mainly in the extreme northwestern part near Saad ad-Din Island. Further east, sand movement prevents seagrass settlement. Most hard substrates support macrophytic algae and vast areas are covered by these macroalgal beds. Coral growth is limited, partly by a lack of suitable substrates and partly by hydrographic conditions. Occasional coral growth was observed in the eastern and western parts of the coast. Extensive coral reefs, possibly the largest ones in the entire Gulf of Aden, occur in the vicinity of Saad ad-Din Island. Smaller coral reef areas were found west of Xabo and between Buruc and Bosaso (see Map of northern coast of Somalia at end of volume).[1] Twelve larger mangrove areas have been identified. Most of them consist of the black mangrove (*Avicennia marina*) only, but on Saad ad-Din Island *Rhizophora* was found as well.

Along the Gulf of Aden coast three areas have been proposed for protection (Table 1). The Daloh Forest Reserve, to the north of Erigavo, has a coastal section which consists of sandy plains with sparse

1 For updated descriptions and impacts to the coral reefs and associated habitats for Somalia, refer to Wilkinson, 2000, pp 35-54.

Table 1: Coastal and Marine Protected Areas along the Gulf of Aden Coast of Somalia

Protected Area	Size (km^2)	Year	Major Habitats and Significant Species	Management	Global Recognition
Daloh Forest Reserve	2510	proposed	Terrestrial protected area with coastal section; *Prosopis* forest, Somali wild ass, several species of gazelles, leopard, sandy coastal plain	None	None
Maydh Island	> 1	proposed	Rocky island, possibly up to 100,000 breeding seabirds per season	None	None
Aibat, Saad ad-Din and Saba Wanak		suggested	Coastal area and coral islands, probably most extensive mangrove areas (*Avicennia* and *Rhizophora*) and coral reefs of entire Gulf of Aden, rich reef associated fauna, important breeding area for large numbers of seabirds	None	None

grass cover. In the core area, there is one of the last reasonably intact rocky evergreen forests of the country. Among other wildlife it would protect gazelles, Somali wild ass and leopard. Maydh Island lies adjacent to Daloh Forest Reserve. From June to September, it is estimated that the island is occupied by up to 100,000 breeding seabirds. Outside the breeding season guano is traditionally collected from the island. Aibat, Saad ad-Din and Saba Wanak are two islands and an adjacent stretch of coastline near Saylac. This area has the largest mangrove stands and coral reefs along the Gulf of Aden coast of Somalia. It is an important breeding area for a large number seabirds (Simonetta and Simonetta, 1983, Kelleher and others, 1995, Fishpool pers. comm.).

In 1988 Somalia had about nine million inhabitants. The largest town along the Gulf of Aden coast is Berbera. Its population varies seasonally between an estimated 50,000 and 150,000 inhabitants. The second largest (perhaps now the largest) town is Bosaso which over the last five years grew from little more than 5,000 to over 100,000 inhabitants today (some estimates are as high as 120-170,000). Other larger settlements along the coast are Saylac, Laas Qoray, Qandala, Xabo and Caluula with 1,000 to 3,000 inhabitants each (Table 2). The population of coastal towns and villages is significantly higher during the winter than during the summer. Throughout Somalia animal husbandry and agriculture are the main economic factors. Despite rich living marine resources that could make a significant contribution to economic development, fisheries currently account for only 2 percent of the GDP (FAO, 1995). Other marine based activities are even less important.

Somalia, one of the poorest countries in Africa, is currently suffering from civil strife which broke out in 1988 and resulted in collapse of the central government and a breakdown of the national economy. The conflict led to destruction of dwellings, water points, crops, and industrial installations; looting of livestock; and the planting of millions of land mines. A major

Table 2: Number of Fishermen and Boats along the Gulf of Aden Coast of Somalia

Location	Population	No. of fishermen		No. of Sail Boats and Motor Boats (MB)			Facilities			
		Full-time	Part-time	Sail boat	MB active	MB idle	Cold storage	Engine /hull repair	Jetty	Dry storage
Bereda	800-1000	30-40	45	20	10	5	-	+	-	+
Calula	1,000-1,200	20-25	35	25	5	-	-	-	-	+
Xabo	1,000-1,500	80-120	60	10	5	-	+	+	+	+
Gesaley	800-1,000	28	80	24	2	-	-	-	-	-
Qandala	2,000-3,000	138	150	26	21	5	+	+	+	+
Buruc	300-400	38	60	16	3	-	-	-	-	-
Mareero/ Ba'd	200-300	15	-0	3	3	-	-	-	-	-
Bosaso	120,000 -170,000	140-200	200	27	38	11	+	+	+	+
Qaw	200-300	20	0	5	2	1	-	-	-	-
Elayo	500-700	24	0	12	20	15	-	-	-	-
Laas Qoray	2,000-3,000	80-100	0	20	20	12	+	+	+	+
Maydh	600-1,000	90-120	60	15	30	23	-	-	-	+
Heis	200-300	10	0	10	11	6	-	-	-	-
Karin	300-500	15	0	0	0	0	-	-	-	-
Berbera	50,000 -150,000	200	80	15	50	15	+	+	+	+
Bullohar/ Geeri	100-150	0	15	0	0	0	-	-	-	-
Lughaye	400-700	25	0	0	2	1	-	-	-	+
Saylac	1,000-1200	40	0	3	6	4	-	-	-	+
Lawyo-addo	300-400	0	0	0	0	0	-	-	-	-
Totals	**181,700 -336,650**	**993-1158**	**785**	**231**	**226**	**92**				

proportion of the rural population was displaced. Taking into account the number of refugees who left the country and the number of dead through conflict and starvation, the remaining population is estimated at 6.3 million (FAO, 1995). In January 1991, inter-clan conflict in the northwest resulted in the displacement of an estimated 100,000 people, many of whom were skilled. In May 1991, former British Somaliland declared itself independent and a government was installed, but the "Republic of Somaliland," which controls the western part of the coastline, is not recognized internationally. The Somali people, in collaboration with the international community, are facing the challenging task of rehabilitation and reconstruction. FAO, in collaboration with other international agencies and NGOs, is currently operating relief and rehabilitation programmes (FAO, 1995).

Coastal and Marine Resources

Both fisheries and maritime transport play a minor role in the economy of northern Somalia, although in the present situation of relative security in the western and eastern regions, both sectors are growing. Other coastal activities, such as salt mining and the collection of guano, are only of local importance. There is no oil or gas exploitation, nor tourism in the area.

Berbera and Bosaso are the two main ports along the Gulf of Aden coast, linking northern Somalia mainly to the countries of the Arabian Peninsula. Berbera has an airport and Bosaso an airfield, which provide the focal point for relief project implementation and back-up support. There are daily commercial flight connections to Djibouti and regular flights to Dubai. Additionally, UN flights link Bosaso and Berbera to other towns inside Somalia,

Nairobi and Djibouti. The road system in the coastal areas is underdeveloped. A paved road in reasonable condition links Berbera to Hargeisa, the capital of Somaliland. A track along the coast from Bosaso via Berbera to Djibouti can only be passed by 4-WD vehicles. In most of the area east of Bosaso, topography makes the construction of a coastal road difficult and many settlements in this section are only accessible by boat or by a track from far inland.

LIVING COASTAL AND MARINE RESOURCES

Fish and shellfish resources in the Gulf of Aden are characterized by high diversity and a limited number of commercially exploitable species. In the 1970s and 1980s, several attempts were made to estimate the stocks of Somalia's living marine resources. Among others, the following research vessels visited the area: F. Nansen (1974, 1986), Isla de Lanzarote (1978-79), Colombus (1979-80), and Georgy Ushakov (1987). Vastly different estimates are given by different sources and reported statistics often do not distinguish between the Indian Ocean and the Gulf of Aden coasts. In these cases it is assumed that the value for the northern coast is roughly one third of the total. In general, statistical data are scarce and not very reliable. For the period since 1988 no statistics are available at all.

While populations of demersal fish stocks and crustaceans are stable throughout the year, the hydrographic regime results in seasonal fluctuations of small and large pelagics. The most abundant species is the Indian oil sardine (*Sardinella longiceps*). The highest concentrations are found in the Cape Guardafui area, with stocks decreasing gradually westwards. Round herring (*Etrumeus teres*), anchovies (Engraulididae) and scads (*Alepes* spp., *Atule mate*) are important resources that are seasonally fished in the Gulf of Aden. For the entire Somali coast, the Maximum Sustainable Yield (MSY) of small pelagics has been estimated at 70,000 to 100,000 metric tons. Predominant large pelagic fish species include tunas (*Thunnus* spp., *Euthynnus affinis*, *Katsuwonus pelamis*), Spanish mackerel (*Scomberomorus commerson*) and jacks (*Caranx* spp.). In commercial terms, the yellowfin tuna (*Thunnus albacares*) and the Spanish mackerel are the most important species exploited by artisanal fisheries and ocean-going longliners. Most migratory species, whose stocks are shared with other countries, belong to this group. Yellowfin tuna, skipjack tuna (*Katsuwonus pelamis*), Spanish mackerel, kawakawa (*Euthynnus affinis*), and dolphinfishes (*Coryphaena* spp.) belong to this group. The MSY for large pelagics has been estimated at 2,000 to 4,000 metric tons.

Fishing for sharks and rays is a traditional activity for the majority of the fishing communities along the Gulf of Aden coast. The meat is salted and sun-dried, which is a rather simple method of preservation. There are relatively stable markets for shark meat in East Africa and the product is mostly exported to Mombasa and Zanzibar. Throughout the summer, intensive shark fishing takes place at the following sites: Xabo, Butiyalo and Hantara (eastern section=Bari Region), Elayo, Laas Qoray and Maydh (central section=Sanag Region), Lughaye and Geeri (western section=Awdal and Sahil Regions). Major sharks and rays targeted by these fisheries are: hammerhead sharks (Sphyrnidae), largetooth sawfish (*Pristis pectinata*), whitetip shark (*Triaenodon obesus*), tiger shark (*Galeocerdo cuvier*), and guitarfishes (Rhinobatidae). Over the past seven years, sharks and rays accounted for 35-40 percent of the landings in northern Somalia. This is mainly due to the fact that shark products can be preserved easily, while there are no processing and storage facilities for bony fishes. Between 1989 and 1993, at the height of Somali civil strife, which cut off the traditional trading routes, the export of shark products was interrupted. Fishermen continued to fish sharks, however, but only used the fins, which fetch high prices, and

fetch high prices, and discarded the body. Shark fins for the East Asian market were mainly exported to Dubai. In 1994, the export of shark meat to Mombasa resumed and over the last three years an estimated 150-200 metric tons of shark meat were marketed. Additionally, 8-10 metric tons of dried shark fins were exported to Dubai.

Demersal fish stocks on the southern banks of the Gulf of Aden are underexploited. Landings by local fishermen, who operate with canoes and motorboats, are minor compared to the expected MSY. During the last few years some larger trawlers, converted to processing docks, obtained catches from local fishermen. However, they accept only groupers and snappers of 1 kilogram and above. Additionally, demersal stocks are exploited by foreign trawlers, who illegally intrude into Somali waters, usually at night. The predominant families of demersal fishes landed are groupers (Serranidae), snappers (Lutjanidae), emperors (Lethrinidae), rabbitfish (Siganidae), croakers (Sciaenidae), and mullets (Mugilidae). During its 1975-76 survey, the R/V F. Nansen estimated the MSY of large pelagics for the entire coast of Somalia at 40,000 metric tons per year. Large foreign trawlers that operated under license along the northeast coast between 1978 and 1982 reported daily catches between four and seven metric tons.

Commercially important invertebrate resources are spiny lobsters (*Panulirus* spp.) and deep sea lobsters (*Puerulus sewelli*). The latter occurs over coarse sand and hard mud at depths below 180 meters along the northeast coast. The extent of this resource is unknown, however from present levels of exploitation the MSY has been estimated at about 500 metric tons for spiny lobsters and 1,500 to 1,800 metric tons for deep sea lobsters. From 1982 to 1985, total annual catches of crustaceans ranged between 436 and 559 metric tons. Other invertebrates that are occasionally exploited in unknown quantities are shrimps, prawns and cuttlefish.

Spawning and nursery areas along the Somali coast have not yet been identified. The two largest creeks along the coast are Khor Xabo and Khor Butiyalo. They are both fringed by mangroves and are expected to be important nursery areas for fish and shrimp. Khor Butiyalo is known as an important spawning area for penaeid shrimps.

Artisanal fisheries have a long tradition in Somalia. Important landing sites along the coast are Caluula, Xabo, Qandala, Laas Qoray, Berbera, Lughaye, and Saylac. Though still underdeveloped, artisanal fisheries are essential for the livelihood of a large portion of the coastal population. However, Somalis tend to regard fishing as an inferior occupation fit for those who have lost their livestock or who have no land to farm. As a consequence the number of fishermen is very low compared to the whole population. About 2,000 men work full-time or part-time in this sector. They use Glass Reinforced Plastic (GRP) boats of 6.4 to 8.5 meters length (most of which are aging by now), usually powered with inboard engines of eight to twenty-two horsepower. These motorboats have begun to replace the traditional, locally-made wooden crafts (canoes and beden, a type of small sail boat), although canoes are still widely in use in the eastern section. Use of fiberglass boats with outboard engines is growing. The most widely used fishing gear on these boats is large mesh size (300 millimeters and larger) nylon shark nets. Other gear commonly used by artisanal fishermen includes handlines, long-lines (mainly for sharks), gillnets, and lobster traps. In Xabo and Qandala, beach seines are used to catch sardines for bait. Between 1982 and 1985 total annual catch rates in this sector ranged between 4,070 and 7,720 metric tons, with the peak in 1984.

Trawlable areas along Somalia's Gulf of Aden coast are limited. For this reason industrial fisheries are not well developed. However, large trawlers that came to the area in recent years reported high catches

of demersal fish, crustaceans and cuttlefish. Statistical data are lacking and during the past eight years no national or licensed foreign fishing vessels has legally operated in the area. Between 1982 and 1985 there was a rapid increase in total annual catches of this sector from 3,900 to 11,940 metric tons. About 70 percent of the landings from Somali waters were by foreign-owned vessels (FAO, 1988).

During the 1980s several initiatives were taken to develop the fisheries sector. The two main projects were: the Northwest Coastal Fishery Development Project (NWCFD), and the Northeast Coast Fishing Enterprise (NECFISH). They were managed separately under the supervision of the Ministry of Fisheries and discontinued following the collapse of government. The aim of the NWCFD was the development of artisanal fisheries on the northwest coast by providing basic infrastructure for the collection, processing and distribution of fish. It also provided training and workshop facilities to fishermen. A 400 metric ton freezer store with a freezing capacity of four metric tons per day was the focal point of the project.

NECFISH promoted fisheries development in the Bosaso-Qandala-Caluula region. It developed an industrial fishery of small and large pelagics off the northeast coast and supported artisanal fisheries by providing infrastructure for collecting and processing high quality fish products for the export market and by providing assistance and training to local fishermen. The industrial component aimed at an annual catch of 50,000 metric tons of pelagic fish. However, between 1990 and 1996 total fish catches dropped to a low of possibly only 1,500 metric tons along the entire coastline of Somalia (excluding sharks). All onshore facilities operated by these and other projects (Table 2) have been idle for many years now. Where the installations have not been looted, they are aging and deteriorating. In 1996, apart from small containerized chill rooms, only mobile vehicle cold storage was available in the north. Huris, motorized fishing boats, and sail boats are mostly laid up due to the lack of fishing gear, spare parts and maintenance. The fishing communities, however, are still present and in some places the number of people has increased because of immigration from other parts of the country.

Although at the national scale fisheries contribute insignificantly to the GDP, they are an important economic factor for coastal communities, both in terms of employment and income. However, with the lack of government institutions, it is not possible to determine the financial capacity of the sector. For the same reason there are no government loans available. Some private entrepreneurs extend limited loans to individual fishermen, in the form of materials and food, but these loans are coupled with high interest rates and materials are overpriced. Some international organizations and NGOs are extending limited assistance to the fisheries sector, mostly by providing fishing gear and training. Some isolated basic infrastructure was established, such as storage and processing facilities for selected marine products. Attempts to rehabilitate existing facilities such as canneries have thus far been unsuccessful. Problems affecting the fisheries sector may be summarized as follows:

- With the collapse of the central government, the traditional production and trade pattern broke down. The relationship between fishermen, boat owners and traders has lapsed. Fishermen are largely unable to market their catches.
- Local business is unable to generate sufficient foreign currency to import fishing gear, boats and engines in order to replace the present aging materials.
- The former storage and processing facilities, which bought most of the products in the past, are no longer operational. Installations were often looted and the condition of the remain-

ing buildings and equipment is deteriorating rapidly.

Green turtles (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) are found at several sites along the Gulf of Aden coast of Somalia. Their numbers and nesting beaches are unknown. Maydh Island and the Saad ad-Din group are important areas for nesting seabirds. Population numbers are largely unknown; there are several species of terns (*Sterna* spp.), sooty gulls (*Larus hemprichii*), brown noddy (*Anous stolidus*) and numerous other species.

Pastoral nomads form the majority of the Somali population, followed by farmers. Animal husbandry is an important economic activity in the coastal zone, providing many employment opportunities. There are considerable fluctuations in the coastal population as many nomads and their flocks move to the coastal areas after rainfall and then return back to the mountainous hinterland during the hot and dry summer months.

NON-LIVING RESOURCES

During the 1980s, offshore oil explorations were conducted. These surveys showed that the continental shelf of Somalia may have oil and gas reserves. Several oil companies applied for concessions and Elf-Somalia and Agip were granted concessions for the eastern and central parts of the Gulf of Aden coast. No reserves of economic importance have so far been found and at present there is neither oil nor gas exploitation.

There is currently no seawater desalination to produce freshwater. Table salt is produced in Tokhoshi, a small village west of Saylac, where the major economic activity is salt mining. The salt is sold to other parts of Somalia and exported to Ethiopia.

MARITIME TRANSPORT

Traditionally, maritime transport has played an important role in Somalia. Almost all exports and imports are made via the sea. However, dhow based trading along the coast is in decline, leading to increased isolation of coastal fishing communities that depend on the dhows for their supplies. Berbera is the main port on the Gulf of Aden coast. It is fully operational, even for commercial traffic, and mainly serves the inland towns of Hargeisa and Burao. Berbera port has four deep-water berths with a total quay length of 650 meters. The livestock export of the northwest is handled through this port. Saylac and Maydh are small ports with limited berthing and handling capacities. Bosaso is the main port in the northeast. It is fully operational and used for the export of livestock, fisheries products and incense. Commercial traffic at Somali ports has increased dramatically during the last few years.

MARINE AND COASTAL TOURISM

Unlike other East African countries, tourism never played an important role in Somalia. The Ministry of Tourism had been aiming at developing a viable tourism industry. The 1984 Tourism Development Act provided for the acquisition of land, including beach properties. It also had provisions for the protection and preservation of ecology and environment and for planning of Marine Protected Areas (MPAs). The five-year development plan for 1982-1986 placed an emphasis on the development of tourism infrastructure (Sheppard and Wells, 1988). These plans have not materialized, but there is considerable potential for the development of tourism in Somalia, including coastal and marine activities, once the situation is stable.

Legal and Institutional Framework

Somalia has signed the Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (1993), and ratified

the following Conventions and Protocols relevant to the marine environment:

- Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (1988).
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (1985).
- Convention on the Conservation of Migratory Species of Wild Animals (1986).
- Protocol Concerning Cooperation in Combating Marine Pollution in Cases of Emergency in the Eastern African Region (1988).
- Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region (1988).
- Protocol Concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1988).
- Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (1988).
- United Nations Convention on the Law of the Sea (1989).

National environmental legislation is poorly developed and inadequate for meaningful environmental assessment, resource allocation, and management and protection of habitats and resources. Existing national laws and regulations are summarized in Table 3.

Table 3: National Laws and Regulations related to Coastal and Marine Environments and Resources

Law, Ordinance, Regulation	Year (in force)	Government Agency
Sanitary Code	1936	Ministry of Health
Maritime Code	1959	Ministry of Marine Transport and Ports
Water Development Agency Law No. 28	1971	Ministry of Minerals and Water Resources
Law on Somali Territorial Sea and Ports, No. 37	1972	Ministry of Marine Transport and Ports
Water Law No. 77	1972	Ministry of Minerals and Water Resources
Port Regulations, decree No. 67	1978	Somali Ports Authority
Sewage and Drainage Law No. 3	1983	Water Development Agency
Joint Venture Guidelines	1983	Ministry of Fisheries and Marine Resources
Tourism Development Act	1984	Ministry of Tourism
Fisheries Law No. 13	1985	Ministry of Fisheries and Marine Resources

Somalia has not yet formulated a national policy for the exploitation of marine resources. Sainlos (1987) gives an overview of marine environmental legislation before the collapse of government. In the present situation these laws and regulations are not enforced and the national institutions are of no relevance. The status as of 1988 is summarized below:

- A National Marine Affairs Committee was established to oversee the overall development of the sector. This Committee was chaired by the Ministry of Marine Transport and Ports and members included the following ministries: Minerals and Water Resources, Fisheries and Marine Resources, Foreign Affairs, Education and Defense.
- The Ministry of Marine Transport and Ports had a mandate for development

of maritime transport and the improvement of port facilities. It was also responsible for environmental control of coastal areas, including ports, prevention of marine pollution and navigation safety. The implementation of the Maritime Code, other laws and regulations related to the marine environment, and regional and international conventions were under the responsibilities of this Ministry. Legislation to control pollution, however, was restricted to ships in ports. The Somali Ports Authority and the Somali Shipping Agency operated under this Ministry.

- The Ministry of Fisheries and Marine Resources was established in 1977 with the objective of developing and managing Somalia's untapped fisheries resources. It was supported by staff from the Soviet Union and later by FAO. Basic marine fisheries legislation is contained in the Maritime Code of 1959. In 1983, the Ministry of Fisheries and Marine Resources issued a joint venture guideline and in 1985 the National Fisheries Law. It is composed of six departments: production, planning, research, marketing, personnel and administration. The Ministry is the Focal Point for PERSGA.
- The National Range Agency within the Ministry of Livestock, Forestry and Range was responsible for National Parks, but at the time the government collapsed, there were no MPAs and no legislation concerning their establishment or management (Elder, 1987).
- The Ministry of Tourism was in charge of establishing MPAs. Legislation, following the Kenyan model, has been prepared for a network of protected areas.
- The Ministry of Minerals and Water Resources was created in 1969. Its two main responsibilities were the development of mineral resources including mining and geological survey, and the development of water resources within the country.
- Other Ministries involved in the management and development of coastal and marine resources were Education, Interior and Defense.

Since the outbreak of civil strife, hardly any fisheries development work has been carried out. In the absence of government, Regional and District Councils and Councils of Elders took up the role of principal coordinating organizations for the inflow of aid to their respective jurisdictions. International agencies and NGOs have worked in coordination with the Councils of Elders in the development of a sustainable institutional base. Institutional coordination takes place through the District and Regional Councils to ensure a reasonable level of public accountability. In the case of research, extension or credit accountability has to be established (FAO, 1995).

One of the institutions of the “Republic of Somaliland” is the Ministry of Fisheries and Coastal Development. Created in 1993, this Ministry is in charge of encouraging public and private investment for the exploitation of marine resources; increasing fisheries production within the MSY; protecting the coastline and sea from environmental degradation; initiating and developing research and training facilities for the fisheries sector; and developing employment opportunities in the marine sector.

Threats to the Environment

The Gulf of Aden coast of Somalia is still in a largely pristine state. In the present situation there is hardly any development and most threats to the marine environment come from poaching and alleged dumping of hazardous waste by foreign vessels. Additionally, certain living marine resources show signs of overexploitation. Anthropogenic pressure is otherwise low and restricted to the immediate vicinity of

the larger settlements. Threats to the environment are summarized in Table 4.

HABITAT DEGRADATION AND DESTRUCTION

Physical damage to coral reefs, which may result in a loss of coral habitat and decline of reef associated fauna, is currently low. Reef fisheries so far have a minor impact on the reef habitat, but in the northwest corals are collected occasionally and shipped to Djibouti for sale to tourists. The extent of this activity is unknown. The establishment of collecting stations for reef fishes is currently being considered by a private entrepreneur. If not managed properly, this may have negative effects on the reef habitat.

Most mangrove habitats are still in reasonably healthy condition, despite grazing by camels and collecting of branches and trunks as firewood and building material. According to a survey by the authors, utilization of this resource largely occurs at sustainable levels. Only one mangrove area immediately west of Bosaso showed signs of severe degradation. However, a survey of all mangrove areas along the Gulf of Aden coast of Somalia is necessary to determine their present status.

LIVING MARINE RESOURCES

Because of limited availability of boats, engines and fishing gear, and consequent low fishing efforts and smaller fishing areas, most resources targeted by artisanal fisheries are still under-exploited. However, the rate of collection of spiny lobsters is increasing rapidly and pressure on this high-priced resource may soon result in local overfishing. Without stock assessment, however, it is not possible to determine the MSY.

It is difficult to estimate the effects of the present level of shark fisheries on the local populations. Shark stocks are unknown and since the collapse of government no fisheries statistics have been collected. The fact that sharks are often caught in remote areas and that export does not always follow established channels poses an additional problem. Fishermen throughout the area report a sharp decline in shark catches, which is likely to indicate overfishing of this resource.

In the absence of law enforcement and legal protection, the level of poaching by foreign vessels is high. A large variety of boats from small dhows to large stern trawlers illegally fish in Somali waters. Pakistani, Taiwanese and Italian vessels have so far been captured by militias. In addition to uncontrolled exploitation of living marine resources, the sea bottom is being damaged by heavy trawls. The level of illegal fisheries along the Gulf of Aden coast, which usually occurs at night, is lower than along the Indian Ocean coast. At present it seems impossible to determine the extent of the damage from these activities (FAO, 1995).

Considering the lack of any control, the danger of exploitation of living marine resources by private entrepreneurs without any environmental concern must be rated high.

Local fishermen, who are in need of subsidiary food sources, continue to collect turtle eggs and utilize turtles for meat, oil and shells. Turtles are hunted directly or caught as a by-product in fishing activities. The overall pressure on turtle populations in the Somali section of the Gulf of Aden is unknown, but it may be high and therefore it is reasonable to assume that this resource is being overexploited.

NAVIGATION, MARITIME RISKS AND SHIP BASED POLLUTION

The world's major transport route for hydrocarbons passes through the Gulf of Aden and the frequency of tanker movements poses a constant threat of oil spills of any magnitude in the event of an accident. The risk of a major oil spill may be low, but the consequences could be very serious. There is neither a Contingency Plan to deal with oil pollution emergencies nor a spill response capacity in Somalia.

Ross (1987) proposed a draft Contingency Plan for Somalia. Technology and capability for cleaning up spills is lacking within the country and the Marine Emergency Mutual Aid Center in Djibouti, which should cover the Gulf of Aden coast of Somalia, is awaiting re-activation. According to UNEP (1987), some 590 million tons of oil travel annually along the coasts of Somalia. With the absence of surveillance capability in the area, tankers routinely discharge oily ballast and annual discharges from these operations were estimated at 33,000 metric tons (UNEP, 1982). Tar balls are regularly found on certain sections of the Somali coastline, above all on the high-energy beaches in the western sector. Marine vessel sewage and discharge of solid waste pose additional threats. In the absence of waste reception facilities at the ports, ships dispose their waste offshore. Heavy maritime traffic and limited navigational devices result in constant risks of ship collisions and grounding.

In general, pollution of the marine environment is limited and does not pose a serious threat. However, there are repeated anecdotal reports of illegal dumping of hazardous wastes along the coast of Somalia. These reports occasionally appear in the international press (e.g., Anon., 1996). Although the extent is unknown, there cannot be any doubt that illegal dumping of toxic wastes poses a major threat to the coastal and marine environments of Somalia. Illegal disposal of hazardous substances obviously constitutes a major concern.

Industrial Activities and Urban Development

There is no heavy industry along the Gulf of Aden coast of Somalia. The only refinery, located in Berbera, is currently not operational. However, the urban population is growing rapidly and urban development in Bosaso and Berbera is largely uncontrolled. Adjacent to major population centers, domestic sewage is a locally important source of marine pollution. Wastewater is mostly collected in septic trenches. Untreated sewage may contaminate groundwater. A comparatively small amount of wastewater reaches the sea directly and is probably not a major source of marine pollution. In the absence of any monitoring, it is not possible to estimate the amount of toxic leachates and pathogenic organisms entering coastal waters. Allocation of limited freshwater resources with inadequate concern for water conservation and inadequate maintenance of distribution systems affects surface and groundwater reserves.

In rural and urban areas, management of solid waste is either inadequate or lacking. Near human habitations, especially in Bosaso, Berbera and Saylac, solid waste is dumped onto the shore and into the sea, causing damage to coastal and marine life and deteriorating aesthetics. During periods of heavy rain, leaching of substances from dumps near the shore poses a potential hazard. The inadequate and unsanitary disposal of human feces, possibly infected, in rural and urban areas is probably a major source of contamination of ground and surface water supplies. Improper waste disposal is a serious health problem. It attracts domestic animals, rodents and flies which spread disease. In most areas basic sanitation is virtually absent. The level of fecal coliforms in drinking water and in the sea remains unknown. Skilled personnel, monitoring and analysis laboratories and equipment are lacking. A general lack of awareness aggravates this problem.

Other Concerns

In some areas, above all near the urban centers, there is beach mining for limestone, sand and gravel in the coastal zone. This activity destroys coastal vegetation and results in increased erosion and siltation.

Agricultural practices place additional pressure on the coastal environment. Overgrazing by livestock results in increased siltation in coastal waters due to

erosion of coastal soils and sand dunes. The destabilization of coastal sand dunes is the single most important hazard. The accelerating rate at which active dunes appear is of major concern. All over Somalia, some 465,000 hectares of formerly stable dunes have been reactivated in coastal areas (UNEP, 1987).

Table 4: Threats to the Coastal and Marine Environment and Resources

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Habitat Destruction					
Mangrove destruction	Deterioration of mangrove habitat, decreased fish and shrimp catches, reduced water quality	Grazing by camels, wood collection,	Lack of regulations and management, lack of awareness, lack of alternative fuel	Localized	Low to Moderate
Living Marine Resources					
Potential overfishing of sharks	Decline in shark catches	Increased fishing efforts	Lack of regulations	Throughout the area	Severe
Illegal fishing by foreign vessels	Decline in catches, destruction of subtidal habitats by trawling	Lack of surveillance and regulations	Lack of government	Throughout the area	Severe
Illegal shark fisheries for foreign shark fin market, by foreign vessels	Decline in shark catches, bycatch of turtles, dolphins and finfish	Increased fishing effort, high profits	Lack of surveillance and regulations	Throughout the area	Severe
Potential overfishing of lobster	Decrease in average size	Increased fishing efforts in limited areas	Lack of stock assessment hampers resource management, lack of regulations	Localized	Moderate
Collection of turtle eggs by artisanal fishermen	Decrease in nesting populations	Need for subsidiary food supply	Lack of public awareness, lack of alternative food sources, lack of regulations	Localized	Possibly severe
Navigation and Maritime Risks					
Navigation risks	Extensive and routine risks of ship collisions and grounding	Limited navigational devices	Heavy maritime traffic	Throughout the area, particular in port areas	Low to moderate
Marine vessel sewage	Localized marine and beach pollution	Discharge from ships	Inadequate onboard treatment, lack of port reception facilities	Throughout the area	Moderate
Ship discharge of solid waste	Solid waste on shoreline	Discharge of solid waste from ships	Inadequate disposal facilities, lack of regulations and enforcement, lack of port reception facilities	Throughout the area	Low
Petroleum Development and Transport					
Potential small oil spills (< 20 mt)	Beach contamination, damage to coastal and marine biota	Tanker cleaning, discharge of ballast and bilge water, discharge of waste oil, bunker oil spill	Lack of reception facilities at ports, inadequate control, lack of enforcement	Localized, near ports	Low
Potential medium oil spills (20-100 mt)	Beach contamination, damage to coastal and marine biota	Small accidents at sea	Lack of control and monitoring, lack of regulations and enforcement	Localized, throughout the area	Low to moderate

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Potential large oil spills and disasters (> 100 mt)	Destruction of coastal and marine habitats and biota, devastation of beaches	Rupture of oil tanks in collision or wreckage	Insufficient tanker safety specifications, poor navigation aids	Localized, throughout the Region	Moderate to severe
Urban Development					
Surface and groundwater	Excessive exploitation of surface and groundwater for municipal use	Excessive pumping of groundwater,	Allocation of water resources with inadequate concern for water conservation, inadequate maintenance of distribution systems	Localized	Low to moderate
Discharge of untreated or insufficiently treated sewage	Groundwater impacts, threat to public health	Lack of sewage treatment plants	Lack of pollution control regulations, monitoring and enforcement	Localized, urban areas	Low to moderate
Disposal of solid waste in coastal areas, disposal of human feces	Damage to coastal and marine life, deterioration of aesthetics, threat to human health	Improper disposal	Lack of adequate waste disposal regulations and enforcement, lack of a waste management system, inadequate public awareness, lack of sanitary facilities	Localized	Low to moderate
Other Concerns					
Siltation from grazing	Destruction of vegetation cover, resulting in mobilization of dunes and sand sheets	Grazing by livestock, fuelwood collection	Lack of regulations and management of coastal grazing	Mainly in western part of coast	Severe
Illegal disposal of hazardous waste by foreign vessels	Damage to living coastal and marine resources, threat to human health	Lack of surveillance and enforcement	Lack of government	Throughout the area	Severe

Recent, Current and Planned Environmental Initiatives

In the present situation there are no environmental initiatives, but even before the collapse of government, such initiatives were hampered by lack of knowledge about resources and habitats, and a lack of legislation, training and monitoring capacities.

Priority Actions

Although since 1988 the situation in Somalia has changed drastically, recommendations for improved management of coastal and marine resources made by UNEP (1987) remain valid. There is a clear need for strengthening the skills of the human resource base to improve assessment, planning and management of coastal and marine environments. Human resource development must be an integral component of all activities listed below. Priority actions for the Gulf of Aden coast of Somalia are summarized in Table 5:

- Measures to control the illegal dumping of hazardous waste by foreign vessels along the coast of Somalia should urgently be introduced.
- It is suggested to establish a joint "Coastal and Marine Environment Committee" with representatives of the Regional and Local Councils, NGOs and international agencies. This Committee should coordinate environmental initiatives and assess the ability of major marine resource systems to support sustainable development.

- There is an urgent need to establish objectives and policies and to promote appropriate legislation for the management of coastal and marine habitats and resources. A Coastal Zone Management Plan should be prepared and implemented as soon as this becomes feasible.
- A feasibility study for the establishment of Marine Protected Areas should be conducted. Conservation management should be introduced as soon as feasible. The Saad ad-Din area and Maydh Island should be given highest priority.
- The extent and status of mangrove areas and present use of mangrove products needs to be assessed. A management programme for sustainable use of mangrove resources should be developed and implemented for the benefit of traditional resource users. This programme should include alternative sources of fuel.
- Measures against illegal fishing activities by foreign vessels are urgently needed.
- A fisheries management plan should be prepared for sustained fisheries development. Any management programme for sharks and rays, bony fishes, and crustaceans must be based on a comprehensive assessment and critical evaluation of pelagic and demersal stocks.
- A poverty alleviation programme should be developed for fishing communities. This would include provision of basic fishing gear and reasonable access to markets. This programme should be coordinated with present activities by FAO and NGOs in the area.
- Current navigation charts should be reviewed, hydrographic re-surveys conducted and updated charts prepared for key areas along shipping routes and in vicinity of key ports.
- Navigational aids and radio communcations in northern Somali waters should be improved, especially on major shipping channels.
- An Oil Spill Response Contingency Plan needs to be developed and implemented within the framework of the Marine Emergency Mutual Aid Center in Djibouti. This activity must include response capacity building.
- In the medium term, a feasibility study on the development of port reception facilities and waste management systems should be prepared for Berbera port.
- Near major population centers, levels of pollutants and their effects on living marine resources and human health need to be monitored. Wastewater collection and treatment facilities in Berbera and Bosaso should be developed.
- There is an urgent need for baseline surveys of marine ecosystems upon which to base the effects of oil, toxic chemicals, pathogens and other forms of pollution. A database containing information on biological resources and the environment should be developed. A monitoring programme should be set up to support management and enforcement activities. Institutions for applied research and monitoring need to be established.
- The development of sub-regional maritime regulations is proposed. Existing legislation should be revised for application in the Gulf of Aden management area.

Table 5: Priority Actions

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Special issue	Introduction of control measures against illegal dumping of hazardous waste by foreign vessels	Gulf of Aden Coast	Enforcement	***
Environmental management	Establishment of a joint Coastal and Marine Environment Commission	Gulf of Aden Coast	Capacity building Technical assistance Technical development	**
Environmental management	Preparation and implementation of a Coastal Zone Management Plan	Gulf of Aden Coast	Legal framework Capacity building Planning framework	**
Environmental management	Feasibility study for establishment of Marine Protected Areas	Gulf of Aden Coast	Legal framework Management information Management programme	*
Environmental management	Development and implementation of conservation and management plans for Maydh Island and Saad ad-Din Island	Gulf of Aden Coast	Capacity building Management information Management programme	**
Habitat conservation	Development of a mangrove conservation programme and identification of alternative sources of fuel	Gulf of Aden Coast	Management programme	*
Living marine resources	Introduction of measures against illegal fishing activities by foreign vessels	Gulf of Aden Coast Local	Enforcement	***
Living marine resources	Stock assessment for shark fishery	Gulf of Aden Coast	Management information Management programme	***
Living marine resources	Stock assessment for finfish and lobster fisheries	Gulf of Aden Coast	Management information Management programme	***
Living marine resources	Development of a management programme for fisheries, including marketing	Gulf of Aden Coast	Technical study Management information Management programme Production programme	***
Community development	Development and implementation of poverty alleviation programmes in fishing communities, including provision of basic fishing gear	Gulf of Aden Coast	Feasibility studies Technical assistance Technical development	***
Navigation risk	Review of current navigation charts, conduct of hydrographic re–surveys and preparation of updated charts for key areas along shipping routes and in vicinity of key ports	Gulf of Aden Coast Local	Capacity building Technical development Management information	*
Navigation risk	Improvement of navigational aids and radio communications in northern Somali waters, especially on major shipping channels	Gulf of Aden Coast Local	Capacity building Technical development	*
Petroleum development and transport	Development and implementation of Oil Spill Contingency Plan, in the framework of the Marine Emergency Mutual Aide Center (MEMAC) in Djibouti	Gulf of Aden Coast Local	Capacity building Technical development	**
Industrial development	Preparation of feasibility study and development of port reception facilities for Berbera port, in the medium term	Local	Feasibility study Capacity building Technical development	*
Urban development	Development of wastewater collection and treatment facilities in Berbera and Bosaso, in the medium term	Local	Feasibility study Capacity building Technical development	*

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Applied research	Establishment of database for biological resources and environmental information; preparation of a programme for environmental monitoring	Gulf of Aden Coast	Capacity building Management information	**
Applied research	Development of a proposed sub–regional maritime law and proposed revision of legislation for application in the Gulf of Aden Coast management area	Gulf of Aden Coast	Legal framework Capacity building	*

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Country Report

Republic of the Sudan

Introduction

The Red Sea and Gulf of Aden represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism. This narrow band of water shared by a number of coastal states is also an important shipping lane linking the world's major oceans. While large parts of the Region are still in a pristine state, environmental threats—notably from habitat destruction, over-exploitation and pollution—are increasing rapidly, requiring immediate action to protect the Region's coastal and marine environment. To this end, a Strategic Action Programme (SAP) has been prepared through a continuous, consultative and cooperative process among the coastal states, coordinated by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA).

The SAP is a programmatic approach to the development of country based regional environmental projects, providing and benefiting from linkages with ongoing regional seas initiatives and major international waters projects. This will assure a concerted approach to transboundary problems, and the realization of regional and global benefits. The SAP has been prepared by a Task Force including PERSGA member states, the Islamic Development Bank, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. Financial support has been provided by the countries of the Region, the Global Environment Facility (GEF) and selected donor organizations. The GEF has approved support for implementation of the SAP, which will be complemented by funding from a variety of international and domestic resources.

The present country report provides background information to the SAP process at the national level. It is based on information from publications and reports, listed at the end of this report, and a rapid assessment survey by the authors of this report.

Background

The Sudanese Red Sea coast is about 750 kilometers long, including bays and inlets. With an average annual rainfall of 111 millimeters (varying from 36 millimeters at Halaib to 164 millimeters at Suakin) the wide, shallow coastal plain is very dry. It lies within the desert and semi-desert subzone. Numerous freshwater streams drain the Red Sea hills, but there is no perennial water flow in the lower reaches of the

coastal plain. Only after the torrential rains that occur mainly in November and December, is there occasional freshwater influx into the Red Sea. The largest stream, Khor Baraka, reaches the sea via the vast Tokar Delta.

The widest and deepest parts of the Red Sea lie off Port Sudan. In most of the Sudanese Red Sea, the water is extremely transparent, sometimes as deep as 70 meters. Surface temperatures range between 26.2 and 30.5°C, and salinity is rather high (39-41 ppt). From May to October, surface currents flow in a southerly direction; for the rest of the year they flow northwards. The maximum tidal range is about 55 cm (Schröder, 1981, 1983; Sheppard and Wells, 1988; Krupp and others, 1994).

Typical features of the Sudanese Red Sea are coastal lagoons and sheltered bays (marsas) that form natural harbors and fish landing places. Several of these lagoons are fringed by mangroves (Khalil, 1994, Khalil and Krupp, 1994, Salih and others, 1994, Wilkie, 1995). The black mangrove, *Avicennia marina*, is the only species occurring in the area. Well developed mangrove stands were reported at thirteen sites (see Map of Sudan at end of volume). Seagrass beds are frequently found in the shallow waters of marsas and in lagoons between the coast and the fringing reef. The Sudanese coast is characterized by the most diverse reefs of the Red Sea. Most of the coast is bordered by fringing reefs 1-3 kilometers wide separated by deep channels from a barrier reef 1-14 kilometers wide. The outer barrier drops steeply to several hundred meters depth. One of the most unique reef structures of the Red Sea is Sanganeb Atoll (Krupp, 1990). Its steep slopes rise from a sea floor more than 800 meters deep. Coral reefs of the Sudanese Red Sea are described in more detail by Betz and Otte (1980), Schröder and others (1980), Vine and Vine (1980), Schröder (1981, 1983), Schröder and Nasr (1983), Mergner and Schuhmacher (1985), Sheppard and Wells (1988), Musa (1991), Abdellatif (1993), El Hag (1994), and Krupp and others (1994).[1]

The Red Sea State of Sudan borders the entire coastline and has a total area of 221,000 square kilometers. According to the 1993 census, its population is about 685,000 people, with an average household size of 5.0 persons, below the national average. The difference in household size between rural and urban areas is minor. Some 54 percent of the population live in urban areas. Port Sudan is the largest coastal city with a population of about 390,000. The Red Sea State is home to a complex ethnic blend of people. The indigenous Beja group is largest of the tribes in the State. It is divided into several subgroups, the Amarar, Besharin, Hadandawa, Beni Amer and Halaga. The Hadandawa is by far the largest group. It occupies the area south and east of Sinkat and Haiya up to Tokar. They are primarily nomadic and pastoral. The Besharin and the Amarar are also nomadic and occupy the northern part of the State. Other important tribes are of Arab stock, the largest of which is the Rashidiya. They are also nomads. Following the 1980s drought, the settled rural population moved to the urban centers or reverted to temporary nomadism.

The State is well endowed with natural resources, but its inhabitants are comparatively poor, especially those living in rural and marginal urban areas. At present, the natural wealth of the Red Sea is largely underexploited. There is no offshore oil exploitation and the contribution of fisheries and tourism to the GNP is negligible. In 1993-94 all fisheries, forestry and agricultural services contributed less than 3 percent to the GNP. The backbone of the local economy is maritime transport, with the national shipping company, Sudan Line, of major economic importance. It is expected that the resources of the Red Sea

1 For updated descriptions and impacts to the coral reefs and associated habitats for Sudan, refer to Wilkinson, 2000, pp 35-54.

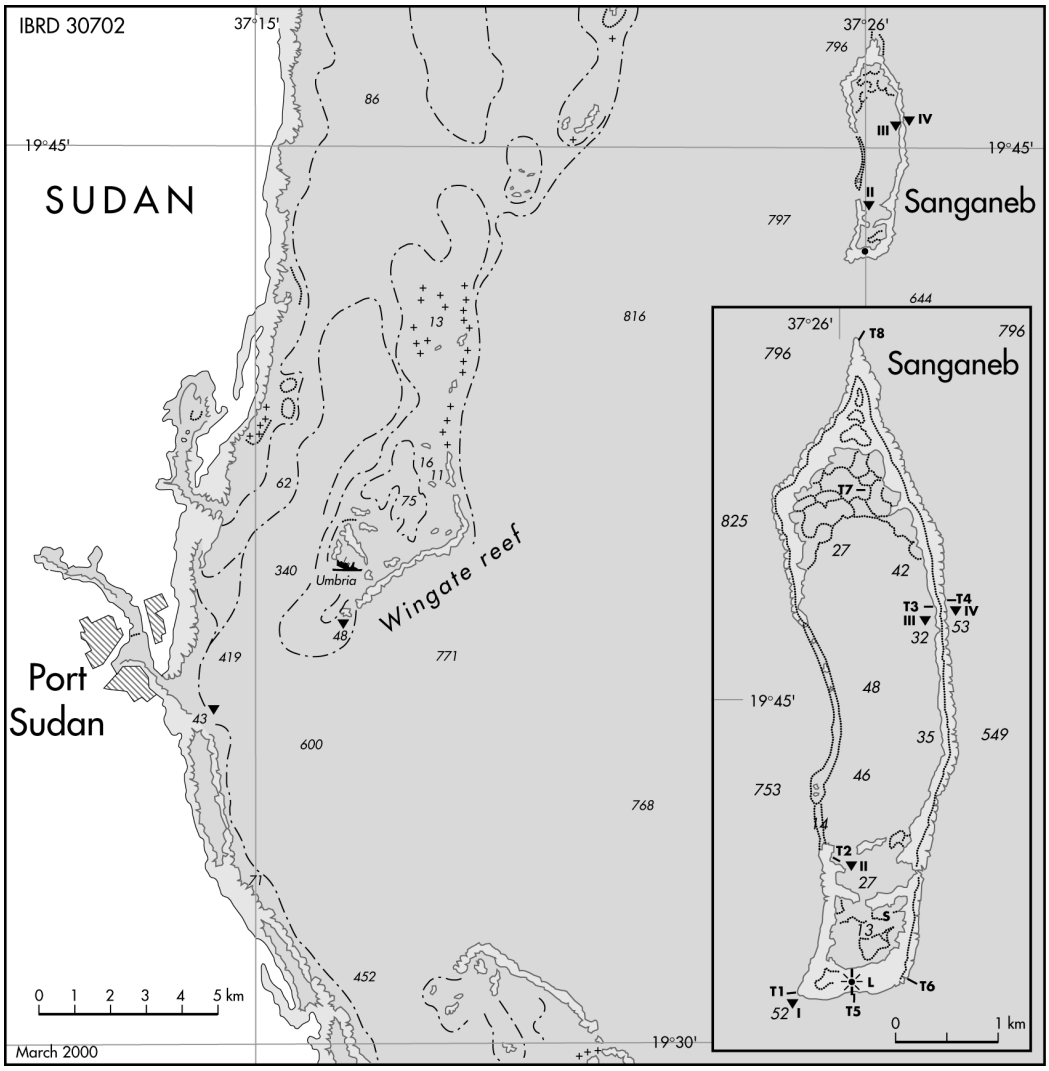

Figure 1. Map showing reefs in the vicinity of Port Sudan (from Mergner and Schuhmacher, 1985, modified).

will rapidly gain importance in development planning.

Coastal and Marine Resources

The major economic sectors along the Sudanese Red Sea coast are maritime transport and port-related activities. At present, fisheries and tourism play a minor role at the national level, although subsistence fisheries are locally important. Both tourism and fisheries have enormous growth potential. Shrimp farms are being planned and a considerable expansion of industrial production in the coastal zone is expected once the planned Free Zone project is implemented (FZD, 1994).

The main source of employment statistics is the 1993 population census. In the Red Sea State, the total population age ten and over was given as 434,000. Of this group, 49.7 percent were defined as economically active. Out of the total economically active population, 79 percent were employed. The majority of the 21 percent who were unemployed were seeking work for the first time. Of those employed, 70.3 percent were living in urban and the rest in rural areas, 33.2 percent worked in agriculture and fisheries, 21.6 percent in community and social services, 16.4 percent in transport and storage and 13.9 percent in wholesale and retail services. The manufacturing sector em-

ployed only 7 percent of the labor force. Females made up 8.7 percent of those employed. For both sexes, 54.2 percent of the labor force (excluding those seeking work for the first time) consisted of employees, 4.2 percent of employers, 31.5 percent were self-employed and 8.0 percent were working unpaid for family members or others. The percentage of employees has increased (34.5 percent in 1983), while that of employers has declined (8.5 percent in 1983). Self-employed workers have also declined (46.4 percent in 1983). In urban areas the majority of the labor force were employees, while in rural areas the majority (60 percent) were self-employed.

It is estimated that during the intercensal period (1983-1993) the growth rate of the labor force was 5 percent per year while employment increased by 3 percent per year. During the same period unemployment grew by 20 percent per year, partly because of a decline in imports and exports since 1989 and partly because of the increasing number of new entrants into the labor market. Out of the unemployed, 14.4 percent had worked before.

Employment opportunities in the State are largely limited to the urban centers, above all Port Sudan and Tokar. Although agriculture and fisheries provide some employment opportunities for the rural population, these sectors are of minor importance as compared to urban employers. The fisheries sector, while potentially important, does not employ a large number of people. The reasons are: limited marketing opportunities, inadequate transport facilities, lack of cold storage, and inadequate policies relating to fish resource utilization. At present, fisheries rank very low in the resource utilization priorities of the Red Sea State.

Port Sudan provides considerable employment opportunities for casual laborers, although there has been some decline in port-related activities over the past few years. This, however, is considered a temporary phenomenon which is expected to change with improvement in the country's economic conditions. The recent creation of the Red Sea State provides new employment opportunities in government departments. Port Sudan also provides the most employment in both the formal and informal sectors. The private sector, including banks and industries, is an important employer. There are fourteen larger industrial plants in the State, all of which are located at Port Sudan.

At the time of the study in 1996, salaries and wages were generally low while inflation could run as high as 200 percent per month. Wage policies are set by the government. The minimum basic monthly wage for an unskilled laborer was SDD10,000. This could reach SDD50,000 for a government official. The private sector might offer higher salaries than the government, with a minimum basic monthly salary of SDD30,000 for an unskilled laborer and up to SDD200,000 for a senior employee. The average cost of living for a household of five persons was estimated to range between SDD50,000 and 300,000 per month.

Major trade routes link the Red Sea State to the rest of the country and the outside world. Port Sudan and Suakin are the two main ports. Port Sudan also has an international airport. A highway and a railway link Port Sudan to Khartoum and other parts of the country.

LIVING COASTAL AND MARINE RESOURCES

About sixty-five species of bony fishes are currently considered to be of economic importance, in addition to sharks, rays, shrimps, lobsters, crabs, mollusks and sea cucumber (Sanders and Kedidi, 1989, Mishrigi, 1993). In artisanal fisheries, the nine following taxa account for 60-70 percent of the catches: gushar (grouper, *Epinephelus* spp.), bohar (twinspot snapper, *Lutjanus bohar*), asmoot (humpback snapper, *Lutjanus gibbus*) shaoor (emperor, *Lethrinus* spp.), bayad (jacks, Carangidae), najil (roving grouper, *Plectro-*

pomus maculatus), farisi (green jobfish, *Aprion* sp.), abu garin (bluespine unicornfish, *Naso unicornis*), arabi (bluespot mullet, *Valamugil seheli*) and sharks (mainly Carcharhinidae and Sphyrnidae).

According to the Fisheries Administration, the estimated Maximum Sustainable Yield (MSY) of artisanal fisheries amounts to 10,000 metric tons, while the present annual production is only around 1,200 metric tons. Annual production increased significantly from 555 metric tons in 1975 to 1,489 metric tons in 1984. After the 1984 peak, a decline of almost steady magnitude was recorded, with landings dropping to 1,048 metric tons in 1994-95 (Figure 2). This is a 30 percent decrease within ten years (O'Riodan, 1982; Mishrigi, 1990-93, 1993). Possible explanations are:

- Within this period, development projects (FAO, 1980-85, ODA, 1975-90) were phased out. Most of the paid services that these two projects provided to the development of the artisanal fisheries sector were discontinued, and sustainability had not been built into the projects.
- Production costs (for example, for fuel, boat maintenance, ice) increased constantly, and imported equipment, such as engines, spare parts and fishing gear, were less readily available. Fishermen had no choice but to use huris, 4 meter dug-out sailing canoes, limiting their efficiency.
- Credits, which were mainly available from the Agricultural Bank of Sudan, became too expensive.

The Fisheries Administration and local fishermen at Suakin reported that catches of bohar, farasi and koraib (crimson jobfish, *Pristipomoides filamentosus*) decreased by about 50 percent. According to the same source, average fish size also declined. These observations, which need to be substantiated by fisheries surveys, might indicate local overfishing. Shark catches, currently a small-scale sector of the Sudanese artisanal fisheries, show a declining trend. Landings decreased from 90 metric tons in 1982 to just 13 metric tons in 1992. Shark catches by foreign vessels are not included in these statistics (Mishrigi, 1990-1993).

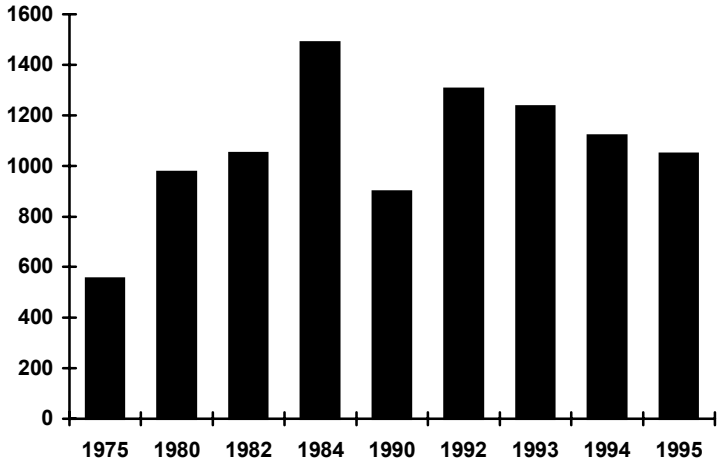

Figure 2. Total artisanal finfish landings (in metric tons) between 1975 and 1995.

Five fishing companies, including a semi-public one, are currently operating as fish traders. None has experience in fisheries management and they are unable to assist in developing the fisheries sector. Better fishing methods and services are required in order to improve catch rates. Most fishing companies, however, limit their activities to the exploitation of renewable resources by hiring local artisanal fishermen with minimum investment. In some cases, for example in Mohammed

Gol, they monopolize the market, benefiting from their "no-competition" status. Most of the products they collect are exported. Najil is the key target species of the export market.

Another important renewable resource is kokian, or giant spider conch (*Trochus dentatus*). Traditionally, the Suakin area was the center of kokian fisheries, but it seems that the main production area recently shifted to Mohammed Gol. Annual export rates of kokian during the 1991-95 period varied between 306 and 535 metric tons. The former ODA project introduced the exploitation of sea cucumber (bêche-de-mer) along the Sudanese coast. Production is mainly based on two species (*Holothuria* sp. and *Actinopyga* sp.). In 1981, 15 metric tons of dried sea cucumber were exported. Thereafter, production stopped because of low prices on export markets and difficulties in collecting. However, in the present situation of declining fish and kokian landings, sea cucumber exploitation has resumed in the Marsa Ashat area south of Suakin.

The sadaf or pearl oyster (*Pinctada margaritifera*) is a valuable resource. Traditional production areas are Dongonab and Mohammed Gol. In 1971 a peak production of 118 metric tons was reached, but the average annual landing of wild oysters declined to 25 metric tons in subsequent years. Oyster farming flourished in Dongonab, where up to 65 family farms, with 130 local beneficiaries, were established. Following mass mortalities in 1969, large-scale farming stopped although export continued, mainly based on wild populations. Between 1966 and 1989, the average annual export rate was 37 metric tons. In 1992-93 production amounted to about 40 metric tons. During the last two years, the Dongonab oyster culture scheme has been revived and Mohammed Gol added as an additional site. Local villagers were entrusted with operating thirty-six farms in Dongonab and fifteen in Mohammed Gol. The farms, which grow some 6,000 oysters each, are supervised by scientists. Improved growth rates allowed for partial cropping after only two years, rather than 3-4 years as was the case in the past. Fishermen from the Dongonab area obviously rely on an expansion of oyster culture as their main source of income. Market prices, which were at SDD1,600 per kilogram at the time of the study, are encouraging. However mortalities are still high (up to 50 percent) and it is recommended to shift from the present bottom culture to floating rafts, despite the high costs in establishing this technique. The traditional oyster culture site at Dongonab has limited carrying capacity. Exceeding maximum densities leads to mass mortalities, as happened in 1969. This has to be considered when planning future expansion of oyster cultures. OXFAM UK/Ireland currently funds oyster farms under the supervision of the Marine Fisheries Research Center (FRC) as part of a community development project (FRC/FAO, 1985, Mishrigi, 1993).

Industrial fisheries are underdeveloped. There are some 700 square kilometers of trawlable grounds off the southern coast of Sudan, mainly in the Tokar delta and Gulf of Agig areas. In 1990, experimental trawls by twenty-seven foreign vessels (fifty-two trips within a three month period) produced 544 metric tons, 75 percent of which was lizard fish (Synodontidae). In 1991, two shrimp trawlers did seventeen trips within nine months. Maximum shrimp catches amounted to 14.7 metric tons, plus 14 metric tons of cephalopods. Six shrimp species of potential commercial importance were recorded: *Penaeus semisulcatus* (56.2 percent), *P. latisulcatus* (21.3 percent), *P. japonicus, P. monodon* and *Metapeneus monocerus* (19.3 percent), with *M. stebbingi* accounting for the rest. The projected annual shrimp catch has been calculated at 30 metric tons. Over the past ten years, most trawlers pulled out of the area, because shrimp catches, the major target group, were considered too low. Only Egyptian trawlers remained in the area fishing for

lizard fish. Egypt is the only market for this resource.

There is a commercial potential for purse-seine fisheries. Fishing grounds are mainly in the northern areas, including Foul Bay near the border with Egypt. The present annual landings amount to some 1,300 metric tons and the MSY is estimated at 2,300 metric tons. Catches are mainly composed of spotted sardinella (50.8 percent), Indian mackerel (18.5 percent), gold striped sardinella (12.9 percent), horse mackerel and scads (12.9 percent) (Brandford, 1979; Feidi, 1981; Sanders and Kedidi, 1981, 1989).

A Sudan Integrated Fisheries Project (SIFP) has been proposed by the "German-Arab Fisheries Company," which includes the establishment of several industrial facilities along the Red Sea coast, in particular near Port Sudan. A tuna cannery with a capacity of 40,000 metric tons per year, a shrimp processing plant (30,000 metric tons per year), a fishmeal plant (24,000 metric tons per year), a feed plant producing 60,000 metric tons of shrimp feed per year, and an ice plant producing 200 metric tons per day are included in this project. Another component of the SIFP is the establishment of ten shrimp farms, including hatcheries and growing ponds. These ponds will cover an area of 4,500 hectares between the north of Port Sudan and the Tokar delta. The project requires fifty-six months to construct ponds and industrial facilities (CFCL, 1995).

Marketing of fisheries products is a serious problem, partly because of a lack of cold storage. Most facilities are owned by the private sector and have limited capacity. Transportation is an additional problem, particularly for fishermen far from Port Sudan, the main fish market of the State. A number of companies and individual merchants buy fish from fishermen and sell it in Port Sudan. These companies provide ice, cold storage and transport to fishermen and small-scale fish traders.

The potential for agriculture in the coastal zone is limited. The most important agricultural scheme of the Red Sea State is based at Tokar. About one third of the total area of the Tokar delta is flooded annually and can be cropped. The extent and location of the flood water, which originates in the Baraka River, are unpredictable. Depending on the area flooded, land is distributed in small tenancies. The number of tenants varies from year to year, averaging about 10,000, mostly from the indigenous Beni Amer and Hadandawa tribes. The major crops grown are cotton, sorghum, millet and vegetables. The delta has a great potential to produce food and cash crops, but requires improvements in infrastructure, flood control, water and environmental management and institutional services.

Animal husbandry is the primary economic activity of much of the population in the State. Seasonal movement of livestock is relatively low. While some herds remain permanently in the coastal area, most livestock descend from the Red Sea hills in November to graze on the coast until April when they return to the hills where they rely on water from wells and wadis.

NON-LIVING RESOURCES

Exploitation of mineral resources along the Red Sea in Sudan is still minimal. Metalliferous mud is a promising resource. Studies for joint exploitation by Sudan and Saudi Arabia in Sudanese territorial waters have been completed (Thiel and others, 1986), but no steps toward implementation have been taken thus far.

The Red Sea State is one of the best prospective areas for hydrocarbons in Sudan. Oil exploration began in the early 1970s. Natural gas was found in the Tokar and Suakin areas. Offshore reserves are located in the Suakin Archipelago. Exploitation amounted to 16.1 million cubic feet per day.

Most of the demand for salt in Sudan is met by solar evaporation plants in the Red Sea area, where climatic conditions are ideal for this process. Production of freshwater through seawater desalination is still very limited in Sudan. Currently, only two industrial installations have desalination plants.

MARITIME TRANSPORT

Maritime transport is the major commercial sector in the Red Sea coastal area of Sudan. In 1994-95 a total of 920 vessels called at Port Sudan harbor, of which 111 were oil tankers. Passenger ferries link Suakin with Jeddah and Massawa, with an average of four ships a day arriving at Suakin. Imports through Sudanese ports ranged from 3.7 million metric tons in 1990-91 to 2.6 million metric tons in 1994-95, while exports ranged from 0.1 to 1.0 million metric tons over the same period. Oil imports dropped slightly from 1.5 million metric tons in 1990-91 to 1.4 million metric tons in 1994-95. Over the same period the number of passengers increased from 86,000 to 182,000. A new oil terminal and a new container terminal for the next generation of container ships are in the planning stage.

MARINE AND COASTAL TOURISM

In general, the Red Sea State has a great potential for tourism. There are numerous and widely diversified tourist attractions. The main activity is SCUBA diving and Sudan has several of the best diving sites in the entire Red Sea and even worldwide. In addition, there are beaches and opportunities for a variety of water sports; recreational areas in the Red Sea hills; and a number of historical and archaeological sites, the old town of Suakin being the most important.

Although Port Sudan is accessible by sea, air, road and railway, connections are irregular and unreliable. Most hotels are located at Port Sudan, where a five star hotel is under construction. The tourist village at Arous, which had been planned for 3,000 to 4,000 persons per year, is not operational at present and hotels in other coastal towns are below the standard expected by international tourists. Most tourists are transferred directly from the airport to diving yachts, because of a lack of infrastructure on land. In spite of outstanding attractions, tourism is not well developed and plays a very limited economic role. During the 1993-94 season 600 foreign tourists came to the State; in 1994-95 the number increased to 1,000, and in 1995-96 to 1,200. In 1996-97, however, the number dropped to almost zero.

Legal and Institutional Framework

Sudan has ratified the following Conventions and Protocols relevant to the marine environment:

- Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (1993).
- Convention Concerning the Protection of World Cultural and Natural Heritage (1974).
- Convention on Biological Diversity (1995).
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (1982).
- Protocol Concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1984).
- Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (1984).
- United Nations Convention on the Law of the Sea (1985).

See also Table 1.

MARPOL has not yet been ratified, because of a lack of port reception facilities. In 1994, Sudan attended the Meeting of African Environment Ministers in Nai-

robi and a year later the Arab Environment Ministers' Meeting in Cairo that discussed environmental conservation issues in the Red Sea area. At these conferences participating countries agreed to environmental conservation programmes for the Red Sea.

Table 1: National Laws and Regulations related to Coastal and Marine Environments and Resources

Law, Ordinance, Regulation	Year (in force)	Government Agency Concerned
Marine Fisheries Ordinance	1937	Marine Fisheries Administration
Amendments to Marine Fisheries Regulations	1975, 1978	Marine Fisheries Administration
Sudan Marine Conservation Committee Regulations	1975, 1995	Ministry of Environment and Tourism
Environmental Health Act	1975	Ministry of Health and Local Councils
Sudan Maritime Law	Draft proposal 1996	Maritime Administration
Environmental Policy Act	Draft proposal 1996	HCENR and Attorney General

Sudanese Fishery Ordinances and Regulations date back to 1937 and were amended in 1975 and 1978. They prohibit overfishing, collection of corals, shells and aquarium fish, and dumping of any refuse, including oil, into the sea. In Port Sudan, Suakin and Sanganeb, signs have been erected informing visitors of these regulations. The Sudan Marine Conservation Committee played an important role in formulating the amendments. The Environmental Health Act of 1975 prohibits the dumping into the sea of any item that is harmful to humans or animals. Vessel owners or captains are being informed and have to sign forms. The Marine Fisheries Ordinance gives police, customs officers, and local authorities the right to board and search a vessel, and detain any craft accused of violating the regulations. A Maritime Law for Sudan has been drafted by the Maritime Administration. It is still awaiting approval and implementation. According to the Comprehensive National Strategy (CNS, 1992-2002), Sudan is committed to the pursuit of sustainable development and environmentally sound resource management.

The following institutions are directly involved in the use and management of coastal and marine areas and resources:

- The Ministry of Environment and Tourism was established in 1994 with the mandate of coordinating environmental conservation and promoting tourism. The following institutions operate under this Ministry:

  ◊ The Higher Council for the Environment and Natural Resources (HCENR) is the technical branch in charge of coordination, policy making, and international cooperation. It has two branch offices so far and it is planned to set up branches in all states.

  ◊ The National Tourism Corporation is responsible for planning and promotion of tourism.

  ◊ The General Administration for Wildlife Conservation is charged with the protection and management of wildlife, including protected areas. This administration, however, lacks experience in the marine field. Its efficiency is hampered by the fact that it is technically under the Ministry of Environment and Tourism, but administratively under the Ministry of Interior (employees are part of the police force).

  ◊ The Antiquities and Museums Corporation is in charge of historical and archaeological sites, among them the old town of Suakin and archaeological excavations on offshore islands.

- The Ministry of Animal Wealth is in charge of animal production and fisheries. The following agencies belong to this Ministry:
  - ◊ The Marine Fisheries Administration, which is under the Red Sea State Ministry of Animal Wealth, manages fisheries resources and controls the observation of fisheries regulations.
  - ◊ The Marine Fisheries Research Center (FRC), which is under the Federal Ministry, provides scientific information for the management of fisheries resources. Over the last 15 years, it has been concentrating on pearl oyster production.
  - ◊ The Wildlife Research Center is in charge of providing the scientific background for wildlife conservation and management.
- In Port Sudan, the Ministry of Transport has the following branches:
  - ◊ The Sea Ports Corporation is in charge of all aspects of maritime transport. It is linked to the Maritime Administration, which had been based in Khartoum until it moved to Port Sudan in March 1996. It is responsible for the implementation of Coastal Zone Management Plans which cover maritime transport.
  - ◊ Sudan Line is a commercial shipping company that plays an important role in observing maritime traffic at high sea. In the absence of a surveillance system, this is of major importance.
- The Ministry of Energy and Mining coordinates coastal and marine mining activities, oil and gas explorations.
- The Ministry of Agriculture and Forests is in charge of mangrove stands and agricultural projects in the coastal zone.
- The National Forests Corporation (NFC) is responsible for the management of mangrove areas. A recent FAO mission recommended a conservation programme for the mangroves to be implemented by NFC.
- The Plant Protection Directorate supervises, among other activities, the locust control programme. It controls the use of pesticides.
- The Tokar Agricultural Corporation conducts the largest agricultural scheme in the Red Sea State in the Tokar Delta, which opens into the Red Sea.
- The Ministry of Defense is in charge of the Naval Forces in the Red Sea area. The Navy is responsible for security in coastal and marine areas. It is the most experienced and effective institution in enforcing fisheries and maritime laws and regulations. More specific training in marine conservation issues and public awareness would be desirable. The Navy has a boat and two soldiers stationed at Sanganeb Marine National Park; giving more responsibility to the Naval Forces for the policing of Marine Protected Areas (MPAs) should be considered.
- The Naval Academy includes marine environmental conservation in its curriculum.
- The Ministry of Aviation and Survey is in charge of aerial surveys along the Red Sea coast.
- The Ministry of Industry, Standards and Meteorology is entrusted with checking all imports before they enter the country.
- The Sudan Meteorology Corporation provides weather forecasts for the area.
- In the Red Sea area, the Ministry of Commerce is represented by two institutions:

- ◊ The Sudan Free Zones and Markets Corporation.
- ◊ The Quality Control Laboratory.

- The Ministry of Interior is in charge of the Police Forces. The Wildlife Force is under administrative supervision of this Ministry (see above).
- The Sudan Marine Conservation Committee (SMCC) is a coordination body with representatives of all government institutions, the private sector, and some NGOs concerned with the Red Sea environment. It has played an important role in raising awareness and in formulating regulations, particularly in the 1970s. The SMCC is in need of reactivation and capacity building. It is at present the only avenue for the private sector and NGOs to participate in policy making and law enforcement.
- The Red Sea University at Port Sudan was founded in 1993. Some of its subunits are active in marine research and education:
  - ◊ The Faculty of Marine Sciences and Fisheries grew out of the former Institute of Oceanography. It trains undergraduate students in marine and fisheries sciences. Students have to conduct small research projects for graduation.
  - ◊ The Faculty of Earth Sciences.
  - ◊ The Faculty of Economics and Maritime Transport Studies.
  - ◊ The Marine Research Institute is being established to revive the research activities of the former Institute of Oceanography (see above).
- The University of Khartoum has a laboratory in Suakin. The Departments of Zoology, Botany and Geology train students and conduct research in the Red Sea area:
  - ◊ The Suakin Marine Laboratory is engaged in marine biological research and training of undergraduate and graduate students from the Universities of Khartoum, Juba, El Nilain, and Omdurman Ahlia. The laboratory has reasonable facilities but no resident research staff because of a lack of funding.
  - ◊ The Institute of Environmental Studies conducts research on environmental issues and supervises graduate students.
  - ◊ The Faculty of Economic and Social Studies has several departments that conduct research on resources and development, including coastal and marine areas. The Faculty trains students at the undergraduate and graduate level.
  - ◊ The Departments of Geology and Botany have also been involved in studies in the Red Sea area.
- Active NGOs in the Red Sea area include the Sudanese Environment Conservation Society which has branches at Port Sudan and Suakin, the Sea Friends Association at Port Sudan, and OXFAM United Kingdom/Ireland with offices in Port Sudan and Tokar.

Threats to the Environment

The Sudanese Red Sea environment is still in a largely pristine state. However, with present growth rates of the coastal population, marine transport and industrial development, threats are increasing rapidly (see Table 2). Anthropogenic pressure is particularly high in the vicinity of the two coastal cities, Port Sudan and Suakin, and in the mangrove areas.

Table 2: Threats to the Coastal and Marine Environment and Resources

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Habitat Destruction					
Coastal development	Dredging and filling, destruction of coral reefs	Urban, industrial and port development	Inadequate environmental planning, limited use of environmental assessment	Local, in Port Sudan and Suakin areas	Severe
Mangrove destruction	Deterioration of mangrove habitat, decreased fish and shrimp catches, reduced water quality	Grazing by camels, wood collection, decreased freshwater supply,	Lack of regulations and management, lack of awareness, lack of alternative fuel, damming of wadis	Throughout the area, especially south of Port Sudan	Severe
Physical damage to coral reefs	Loss of coral habitat and decline in reef associated fauna	Anchor damage, ship grounding, damage by fishing nets	Poor navigational control systems, lack of moorings, destructive fishing methods	Local, throughout the area	Low to moderate
Damage to coral reefs by visitors	Coral breakage, decline in reef associated fauna	Trampling of shallow reef flats, coral breakage, marine souvenir collecting, anchor damage	Lack of management and enforcement, lack of environmental awareness	Localized	Currently low
Living Marine Resources					
Potential overfishing of najil (*Plectro-pomus*) for export markets	Decrease in average size	Increased fishing efforts, landing beyond MSY	Lack of stock assessment and reliable statistics hampers management	Throughout the area	Moderate
Illegal shark fisheries for foreign shark fin market by foreign vessels	85% decline in national landings over past 10 years, carcasses on islands, bycatch of turtles, dolphins and finfish, damage to reefs from nets	Increasing fishing effort, use of nets in shark fisheries, high profits	Lack of surveillance and enforcement of existing regulations	Throughout the area	Severe
Potential overfishing of kokian (*Trochus, Strombus, Lambis*) for local and export markets	80% decline in annual landings over past 3 years	Increased fishing effort	Lack of stock assessment hampers resource management	Southern coast and Mohammed Gol area	Severe
Potential overfishing of sea cucumber for export markets	Decrease in average size	Increased fishing efforts in limited areas	Lack of stock assessment hampers resource management	Localized, southern coast	Moderate
Collection of turtle eggs by artisanal fishermen	Decrease in nesting populations	Need for subsidiary food supply	Lack of public awareness, lack of alternative food sources, lack of enforcement	Offshore islands	Low to Moderate
Planned shrimp and fish farming	Irreversible conversion of coastal habitats, mangrove destruction, declining water quality	Pond construction, mangrove destruction, possible use of chemicals, hormones and nutrients	Poor planning and inadequate EAs	Localized, with growing potential	Currently low, may become severe
Navigation and Maritime Risks					
Navigation risks	Extensive and routine risks of ship collisions and grounding	Limited navigational devices and poorly separated traffic	Complex navigational hazards, heavy maritime traffic	Throughout the area, particular in port areas, emerging problem near proposed Free Zone	Moderate to severe

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Marine vessel sewage	Localized marine and beach pollution	Discharge from ships	Inadequate on-board treatment, lack of port reception facilities	Throughout the area	Moderate
Ship discharge of solid waste	Solid waste on shoreline, in mangrove areas and coral reefs	Discharge of solid waste from ships	Inadequate disposal facilities, inadequate surveillance and enforcement, lack of port reception facilities	Throughout the area	Moderate
Petroleum Development and Transport					
Small oil spills (< 20 mt)	Beach contamination, damage to coastal and marine biota	Tanker cleaning, discharge of ballast and bilge water, discharge of waste oil, bunker oil spill	Lack of reception facilities at ports, inadequate control, lack of enforcement	Localized, throughout the area	Moderate
Medium oil spills (20-100 mt)	Beach contamination, damage to coastal and marine biota	Discharges from terminals, small accidents at sea	Inadequate control and monitoring of procedures, equipment and personnel, inadequate training	Localized, throughout the area	Moderate to severe
Potential large oil spills and disasters (> 100 mt)	Destruction of coastal and marine habitats and biota, devastation of beaches	Rupture of oil tanks in collision or wreckage	Insufficient tanker safety specifications, poor navigation aids	Localized, throughout the Region	Severe
Industrial Activities					
Surface and groundwater use	Excessive exploitation of surface and groundwater for industrial use	Excessive pumping, inadequate concern for water conservation	Poor regulation of water exploitation	Localized in industrial areas, emerging issue in Free Zone	Moderate
Industrial pollution	Decline in water quality	Chronic release of pollutants	Lack of enforcement, inadequate technology	Localized, emerging issue in Free Zone	Currently moderate
Waste oil disposal	Soil and groundwater pollution	Improper disposal of used motor oil	Lack of proper oil disposal and recovery options, lack of effective regulations and enforcement	Localized	Currently low to moderate
Urban Development					
Surface and groundwater	Excessive exploitation of surface and groundwater for municipal use, saltwater intrusion into coastal aquifers	Excessive pumping of groundwater,	Allocation of water resources with inadequate concern for water conservation, inadequate maintenance of distribution systems	Localized	Moderate to severe
Discharge of untreated or insufficiently treated sewage	Groundwater impacts, eutrophication and alteration of marine environment, threats to public health	Lack of sewage treatment plants, lack of maintenance of existing plants	Inadequate pollution control regulations, monitoring and enforcement	Localized, urban areas	Moderate to severe
Disposal of solid waste	Damage to coastal and marine life, deterioration of aesthetics	Improper garbage disposal	Lack of adequate waste disposal regulations and enforcement, lack of a waste management system, inadequate public awareness	Localized	Low to moderate
Other Concerns					
Sedimentation from agriculture and grazing	Destruction of vegetation cover, dune mobilization, coral smothering	Grazing by livestock, fuelwood collection	Inadequate management of coastal grazing	Localized	Low to moderate
Use of pesticides in the coastal zone	Contamination of soils and water	Large-scale use of pesticides for locust control	Inadequate planning and surveillance, lack of awareness	Throughout much of the area	Moderate to severe

HABITAT DEGRADATION AND DESTRUCTION

Habitat destruction as a result of coastal development is still rather localized. The extension of the two ports, Port Sudan and Suakin, including the construction of new port facilities involving dredging and filling, resulted in severe pressure on coral reefs. A new port has been constructed at O'Seif and a fourth one is planned at Agig. Small vessels and fishing boats will call at these ports. Minerals from nearby mines will be shipped through O'Seif. In Suakin, parts of the coastal fringing reef are being removed for the extension of the port. The Suakin Marine Laboratory collected ecological data in the area before the port was built (El Hag, 1995). These may serve as a baseline to assess the environmental effects of port construction.

The implementation of the Sudan Integrated Fisheries Project is expected to cause major destruction of coastal habitats. At the entrance of Port Sudan harbor 5-8 hectares of land will be reclaimed from the sea by landfill for the construction of industrial processing plants. This will cause loss of coastal and marine habitats and coral reef areas such as Wingate and Towartit. Effluents from the tuna and shrimp processing plants will pose additional threats to the marine environment. The risk of immediate and cumulative impacts is very high, unless appropriate environmental precautions are taken.

Pressure is expected to increase soon with the planned implementation of industrial projects and the establishment of an Economic Free Zone (EFZ), which will cover 600 square kilometers of coastal zone between Port Sudan and Suakin, including three major mangrove areas. Highly diverse coral reefs, such as Towartit, are located immediately in front of the planned EFZ. Heavy industries, petrochemical industries, fish processing factories, slaughter houses with a capacity of 3,000 heads per day, tanneries and warehouses will be established in the area. The environmental impact is expected to be very severe and the area is likely to be become a source of serious concern along the Sudanese coast, unless appropriate environmental precautions are taken.

Physical damage to coral reefs, resulting in a loss of coral habitat and decline of reef associated fauna, is caused by anchorage. Wingate and Towartit reefs are still the main anchorage areas for large vessels waiting to enter the port for unloading and loading. Fishing vessels and tourist boats are also damaging reefs with anchors and fishing nets. There is an urgent need of moorings. Wading in shallow reef areas by artisanal fishermen and tourists to collect corals and invertebrates results in coral breakage. There are signs of coral die-off at several sites on the fringing reef, for example parts of Wingate reef. The causes are unknown and this phenomenon needs urgent investigation.

Mangrove habitats are deteriorating rapidly along much of the Sudanese coast, resulting in reduced water quality and a decline in fish and shrimp catches as well as bird populations. In the absence of alternative affordable energy sources, mangrove wood is used as fuel. As a result of several years of drought, more than 50,000 nomads together with their camels moved into the coastal zone. In the southern part of the country in particular, camels are browsing heavily on mangroves. The damming of wadis diverts already scarce freshwater away from the mangrove habitat. Some mangrove areas have been completely destroyed. Mangrove destruction must be considered a priority issue. The construction of an asphalt road linking Suakin with Tokar will increase human activities in the area.

LIVING MARINE RESOURCES

At present, commercial fisheries are of minor importance, but with the promotion of investments this situation may change rapidly. In the past, non-selective trawls did considerable damage to the seafloor

and its biota. Without available data on stocks, it is impossible to determine MSY.

Limited availability of boats, engines and fishing gear have led to low fishing efforts and restriction to small fishing areas, leaving most finfish resources targeted by artisanal fisheries under-exploited. Catches of najil, however, involve a high percentage of undersized specimens. According to the Fisheries Administration, fishermen increasingly tend to use nets with small mesh sizes in order to meet the demands of the export market.

Shark resources are being depleted and catches by local fishermen are declining rapidly because of large-scale shark fisheries from other countries of the Region for the foreign shark fin market. Some of these fishermen operate with licenses, but many exploit the resource illegally. Sharks are caught by hook and line or nets, damaging coral reefs. The fins are cut off, usually while the shark is still alive. The carcass is thrown back into the sea or deposited on offshore islands. Large amounts of by-catch, including turtles, dolphins and finfish are discarded, almost invariably dead. Because of this alarming situation, it has been decided to stop commercial shark fisheries and no new licenses will be issued.

Reduced finfish catches in the areas accessible to artisanal fishermen have a major impact on other resources. Many fishermen resorted to kokian as an alternative source of income. Near Suakin, which was once the most important production area, kokian stocks are declining rapidly, with the annual harvest dropping from 163 metric tons in 1990-91 to just 26 metric tons in 1992-93. This is more than an 80 percent decline within just two years. According to local fishermen, harvest per launch and trip dropped from 4 metric tons to just 1.5 metric tons. As a consequence, 324 fishermen from the Suakin area quit fisheries or diverted to sea cucumber collection. This, in turn, increases pressure on sea cucumbers, which are currently fished in very limited areas. The uncontrolled exploitation of this resource is expected to create problems in the future.

Local fishermen, who are in need of subsidiary food sources, continue to collect turtle eggs on the offshore islands. The overall pressure on turtle populations in the Sudanese Red Sea is unknown.

Feasibility studies for large scale shrimp and fish farming projects along the Sudanese Red Sea coast have been completed. This is anticipated to become a major environmental problem in the future. Shrimp farms may result in irreversible conversion of coastal habitats, destruction of valuable mangrove habitats and declining water quality. Daily effluents from all shrimp farms between Marsa Halot and Marsa Ashat would be on the order of 4.5 to 6 million cubic meters per day. The mass discharge of nutrients will have a serious impact on several mangrove areas and on fringing reefs. The construction of channels to divert seasonal freshwater runoff from the mountains to protect the ponds will adversely impact coastal habitats. Freshwater resources, which are already scarce, will be further depleted, causing serious problems for the local population and their livestock.

Many of the present problems can be attributed to a general lack of law enforcement, a lack of awareness even among law enforcement authorities, weak institutions, and the absence of surveillance. Recently, power was transferred from the central government to federal states. The new system is not yet well established, resulting in an unsatisfactory legal situation and inadequate enforcement of existing regulations.

NAVIGATION AND MARITIME RISKS

The extensive coral reef systems of the Sudanese Red Sea coast pose severe problems to navigation. These complex navigational hazards, combined with heavy maritime traffic and limited navigational devices, result in constant risks of ship colli-

sions and grounding. Problems are particularly severe near the ports of Port Sudan and Suakin, both of which have to be approached through channels among large reef complexes.

Marine vessel sewage and discharge of solid waste pose additional threats. In the absence of waste reception facilities at the ports, ships dispose of their waste offshore. Passenger ferries are reported to throw large plastic bags with garbage overboard once they reach international waters. The plastic bags float over coral reefs and are washed ashore on the coast and offshore islands. Once they break, they release their contents into the marine environment.

Petroleum Development and Transport

There is a constant threat of oil spills of any magnitude. Oil leaks on a regular basis from the oil terminal and tankers in Port Sudan harbor, which is already seriously polluted by oil. The oil film may extend as far as the edge of Wingate reef. Oil pollution seriously affects productivity and fauna in the harbor area, and at some sites intertidal biota have disappeared completely (Abu Bakr, 1995).

Industrial Activities

Industry, which is mainly located in the vicinity of Port Sudan (Figure 3), is a major consumer of freshwater, resulting in extensive exploitation of surface and groundwater, and eventually the intrusion of saltwater into coastal aquifers. In an arid zone with a constant shortage of freshwater these problems are particularly severe.

The chronic release of industrial pollutants results in a decline in water quality. The Port Sudan power plant and shipyard, for example, discharge their waste oil directly into the sea. Outdated, inadequate technology and a lack of enforcement of existing regulations are the main reasons for this alarming situation. At present, these problems are localized, but the establishment of the planned EFZ will severely aggravate the situation.

Urban Development

Allocation of the limited freshwater resources with inadequate concern for water conservation and insufficient maintenance of distribution systems affects surface and groundwater reserves in the same way as described under industrial activities. The discharge of untreated or insufficiently treated sewage results in groundwater impacts and alteration in the marine environment. Near human habitations, especially in Port Sudan (Figure 3), solid waste is dumped on the shore and into the sea, causing damage to coastal and marine life and a deterioration in aesthetic quality. The main cause of the problem is a lack of efficient waste collection and disposal systems, aggravated by a general lack of awareness.

Other Concerns

Overgrazing near the coastal zone results in the destruction of vegetation. Formerly stabilized sand sheets and dunes are mobilized, increasing siltation and smothering coral reefs. Diversion of freshwater courses may have similar effects.

The Locust Control Programme of the Sudanese Red Sea area is probably the largest in Africa and the Middle East. Along much of the coastline, substantial amounts of insecticides are sprayed every year. Occasionally, chemicals are used without investigation into residues and resulting environmental impacts. This was aggravated during recent years after discontinuation of foreign assistance (FAO). This problem needs urgent attention.

Most mining activities in Sudan are far from the coast. However, the concentration of mining products in the coastal area, such as gypsum, salts and cement, and the storage and transport of chemicals like cyanide and mercury that are used for gold mining, may have serious impacts on the coastal and marine environment. Open storage of large amounts of cyanide poses a serious threat.

Mesquite (*Prosopis fuliflora*), a shrub of Central American origin, has been introduced into the coastal zone where it has been spreading rapidly in recent years. It successfully competes with indigenous plants and takes up considerable amounts of groundwater. The spread of mesquite is of major concern.

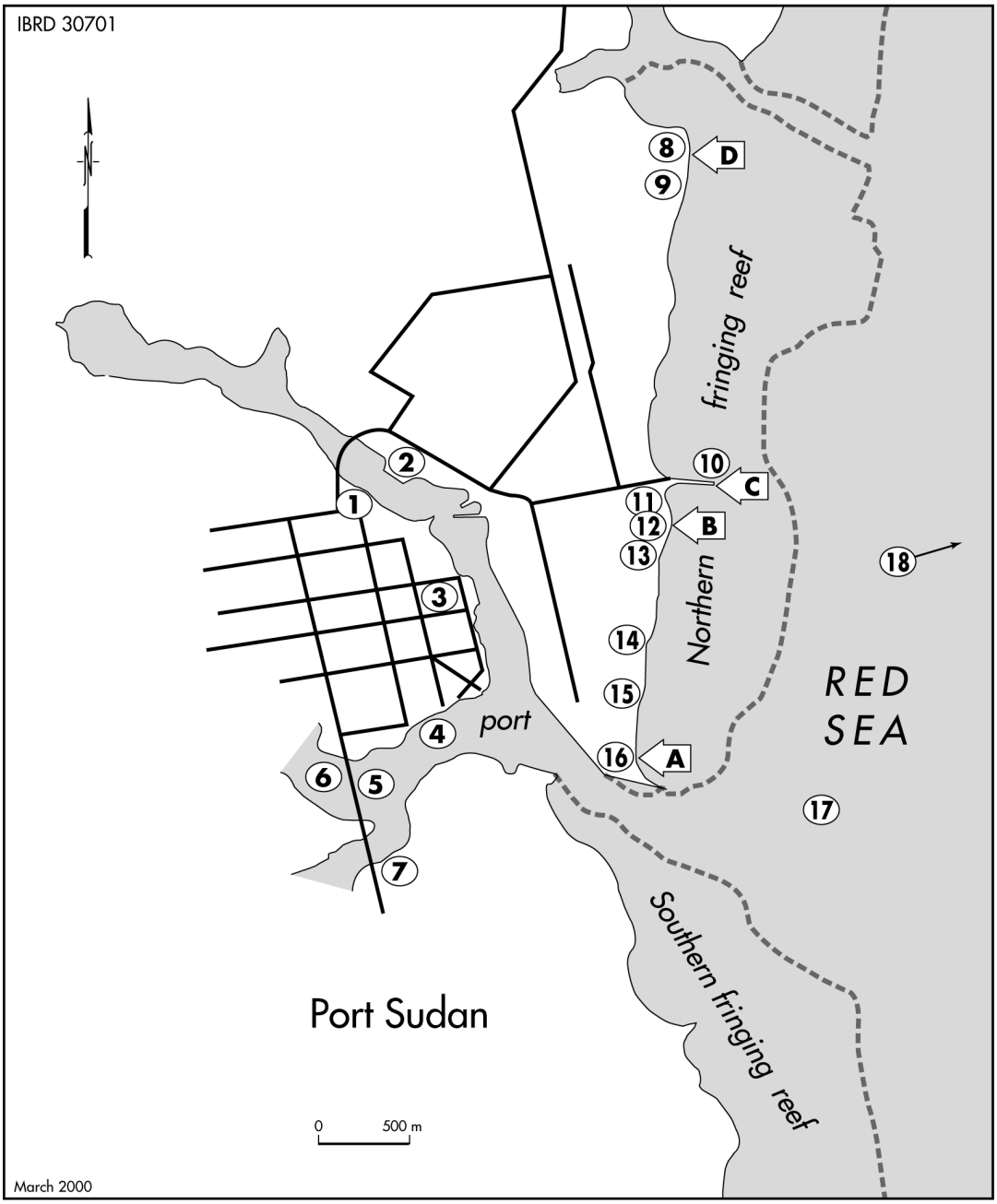

Figure 3. Pollution and land reclamation in the vicinity of Port Sudan.

Sources of pollution: 1. Power plant; 2. Boatyards; 3. Tourist boats, yachts; 4. Khor Kilab rims; 5. Khor Kilab truck loading area; 7. Power plant; 8. Tire factory; 9. Tannery; 10. Abu Hashish dam; 11. and 12. Oil mills; 13 and 14. Beaches, partly used as storage area; 15. Molasse trucks; 16. and 17. Garbage dumps; 18. Anchorage area.

Reclamation sites: A. Seaports Corporation garbage dump; B. Oil mill extensions; C. Abu Hashish dam; D. Tire factory, dam and beach (from Schröder, 1983, modified).

Recent, Current and Planned Environmental Initiatives

At present the number of environmental initiatives in the Red Sea area of Sudan is rather limited. The most important initiatives are summarized in Table 3:

Table 3: Recent, Current and Planned Environmental Initiatives, Programmes and Projects

Programme / Project	Period	Budget (USD)	Implementing Agency
Development of Oil Spill Contingency Plan for Port Sudan	1994-95		Sea Ports Corporation and Port Sudan refinery
Development of Marine Conservation Laws and Regulations	1995-96		Sudan Marine Conservation Committee, Ministry of Environment and Tourism
Development of National Maritime Law	1995-96		Maritime Administration, Sudan Line, Navy
Research on local pollution and mangrove ecosystems	1995-97		Red Sea University, Faculty of Marine Science and Fisheries
Species inventory and ecosystem research at Sanganeb Marine National Park	1989-94	65,000	Red Sea University, Faculty of Marine Science and Fisheries
Development of Management Plan for Sanganeb Marine National Park	1996		Red Sea University, Faculty of Marine Science and Fisheries
Research on oil pollution and mangrove ecosystems	1992-95	ca 8,000	University of Khartoum, Suakin Marine Laboratory

- In 1995-96, the Maritime Administration, in conjunction with Sudan Line and the Navy, drafted a National Maritime Law that is awaiting ratification and implementation.
- The Sudan Marine Conservation Committee and the Ministry of the Environment and Tourism recently drafted marine conservation laws and regulations.
- A limited Oil Spill Response Contingency Plan has been developed by the Sea Ports Corporation and Port Sudan refinery. It covers the area of Port Sudan.
- A communication network among all Sudanese ports—Port Sudan, Suakin and O'Seif—and between these ports and the headquarters of the Sea Ports Corporation is in the process of being established. Additionally, INMARSAT allows for direct communication with ships and foreign ports. A Global Maritime Distress and Safety System (GMDSS) and HF-DSC (High Frequency Distress and Safety Communication) is being installed according to regulations of the IMO (International Maritime Organization and ITU (International Tanker Union). The Coastal Survey and Monitoring Unit, which patrols the Sudanese coast, will receive fixed and mobile radar equipment. After completing the installation of the new communication system, Port Sudan will be in a position to assume the role of a Rescue Coordination Center (RCC).
- Since 1992 the Faculty of Marine Science and Fisheries of the Red Sea University and the Suakin Marine Laboratory have conducted research programmes on oil pollution and the mangrove ecosystem. The data are an important basis for a mangrove conservation programme.
- Between 1989 and 1994 the Faculty of Marine Science, Red Sea University,

in conjunction with the Senckenberg Research Institute, Frankfurt, Germany, conducted biodiversity studies and ecosystem research at Sanganeb Marine National Park. This project was funded by Volkswagen Foundation (Krupp and others, 1994 a, b). It forms the basis for the development of a management plan of this unique Marine Protected Area.

Priority Actions

Priority actions which have been identified for the Sudanese coast of the Red Sea are summarized in Table 4:

- The National Maritime Law, which is currently being drafted, should be ratified and implemented. Related laws and regulations, including the Marine Fisheries Ordinances and Regulations, should be revised within the context of the Environmental Policy Act drafted by the Higher Council for the Environment and Natural Resources, the Attorney General and UNEP. It is important to strengthen enforcement of existing regulations relating to the management of coastal and marine areas and resources.
- Mangroves are in urgent need of protection. A management programme for sustainable use of this resource should be developed and implemented for the benefit of the traditional resource users. All mangrove areas should be declared as Reserved Forests.
- A National Integrated Coastal Zone Management Plan is urgently needed. Special attention must be given to urban planning. Institutions involved in the management of coastal and marine resources and in law enforcement need strengthening.
- A management programme should be developed for MPAs. Sanganeb, Sudan's first Marine National Park, must be given highest priority. Management should then be extended to other protected areas within a national system which forms part of a regional network of MPAs. See Table 5.
- A framework and programme for visitors to coral reef areas should be developed. This should include maps, moorings and guidelines for boats. It is suggested to produce a guide to coral reef areas and major dive sites.
- A Fisheries Management Plan should be developed. This plan should also consider marketing. Any management programme for finfish, including sharks, as well as for shellfish and sea cucumber, must be based on a comprehensive stock assessment.
- A poverty alleviation programme should be developed for fishing communities. This should include the provision of basic fishing gear and reasonable access to markets.
- A review of current navigation charts should be made, hydrographic re–surveys conducated and updated charts prepared for key areas along shipping routes and in vicinity of key ports.
- Monitoring of vessels passing through Sudanese waters, communication with vessels and the installation of navigational markers, above all along major shipping channels, must be improved.
- A national Oil Spill Response Contingency Plan needs to be developed and implemented, including response capacity building.
- MARPOL should be ratified and waste reception facilities installed at ports. A feasibility study on waste management and the development of port reception facilities and waste management systems are urgently needed. Related conventions, such as the London Convention, should be considered.
- A framework should be developed and implemented to guarantee the operation of the EFZ in an environmentally sound manner. Management decisions

should be based on environmental assessments. Environmental management plans should be at hand before the plans to establish an EFZ are implemented.

- Wastewater collection and treatment and solid waste management and disposal should be upgraded in coastal areas, especially in Port Sudan and Suakin.
- A database containing information on biological resources and environmental information should be developed. A monitoring programme should be set up to support management and enforcement activities. Institutions involved in applied research and monitoring, such as the FRC, the Marine Research Institute of the Red Sea University, and the Suakin Marine Laboratory need institutional strengthening.

Table 4: Priority Actions

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Legislation	Strengthened enforcement of legislation related to management of coastal and marine areas	National	Capacity building Technical development	***
Legislation	Issuance of National Maritime Law and revision of related laws	National	Legislative framework	**
Environmental management	Declaration of all mangrove stands as Reserved Forest, development and implementation of a management programme	National Local	Legal framework Management information Management programme	***
Environmental management	Preparation and implementation of a Coastal Zone Management Plan	National	Legal framework Capacity building Planning framework	**
Environmental management	Development of management programme for MPAs (including Sanganeb Marine National Park and proposed protected areas at Shuab Rumi, Meshairifa, Magarsum and some islands in Suakin Archipelago)	National Local	Legal framework Management information Technical development	**
Tourism management	Development of a framework and programme for visitors to coral reef areas, including guidelines for boats and moorings	National Local	Legal framework Management programme Technical development Public awareness	***
Living marine resources	Stock assessment and management programme for finfish, shellfish and sea cucumber, including *Trochus*, *Strombus* and Najil	National	Management information Management programme	***
Living marine resources	Development of a fisheries management plan, including marketing	National	Technical study Management information Management programme Production programme	*
Community development	Development and implementation of poverty alleviation programmes in fishing communities, including provision of basic fishing gear	National Local	Feasibility studies Technical assistance Technical development	**
Navigation risk	Review of current navigation charts, conduct of hydrographic re–surveys and preparation of updated charts for key areas along shipping routes and in vicinity of key ports	Regional National Local	Capacity building Technical development Management information	***
Navigation risk	Improved navigational aids and radio communication, especially along major shipping lanes	National Local	Capacity building Technical development	***
Petroleum transport	Development and implementation of Oil Spill Contingency Plan	National Local	Capacity building Technical development	***

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Industrial development	Preparation of feasibility study and development of port reception facilities	Local	Feasibility study Capacity building Technical development	***
Industrial development	Framework for development and operation of Free Zone in environmentally sound manner	National Local	Environmental studies Capacity building Technical development	***
Urban development	Upgrading of wastewater collection and treatment in coastal areas, especially Port Sudan	Local	Feasibility study Capacity building Technical development	**
Urban development	Upgrading of solid waste management and disposal in coastal areas, especially Port Sudan	Local	Feasibility study Capacity building Technical development	**
Applied research	Development of database for biological resources and environmental information; monitoring programme to support operations and enforcement activities	National	Management information	***

Table 5: Coastal and Marine Protected Areas in Sudan

Protected Area	Size (km^2)	Year	Major habitats and significant species	Management	Global Recognition
Sanganeb Marine National Park	12	1990	Atoll with highly diverse and complex coral reefs, diverse reef associated fauna, sharks, marine mammals, manta rays	Low	IUCN Category II
Shuab Rumi	ca 4	Proposed	Highly diverse offshore reef with unique reef associated fauna, sharks, marine mammals	None	None
Mukawwar Island and Dongonab Bay	300	Proposed	Coral reefs, whale sharks, manta rays, seabirds, including crab plover, oyster beds	None	None
Suakin Archipelago Reserve	100 (length)	Proposed	Coral reefs, rich and diverse fish fauna, sharks, turtles and seabird nesting sites	None	None
Jebel Elba		Proposed	Terrestrial wildlife and coral reefs	None	None
Khor Kilab Bird Sanctuary	ca 2	Proposed	Migratory birds	None	None
Abu Hashish Recreational Park		Proposed	Coral reefs, fishes	None	None

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Country Report

Republic of Yemen

Introduction

The Red Sea and Gulf of Aden represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism. This narrow band of water shared by a number of coastal states is also an important shipping lane linking the world's major oceans. While large parts of the Region are still in a pristine state, environmental threats—notably from habitat destruction, over-exploitation and pollution—are increasing rapidly, requiring immediate action to protect the Region's coastal and marine environment. To this end, a Strategic Action Programme (SAP) has been prepared through a continuous, consultative and cooperative process among the coastal states, coordinated by the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA).

The SAP is a programmatic approach to the development of country based regional environmental projects, providing and benefiting from linkages with ongoing regional seas initiatives and major international waters projects. This will assure a concerted approach to transboundary problems, and the realization of regional and global benefits. The SAP has been prepared by a Task Force including PERSGA member states, the Islamic Development Bank, the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank. Financial support has been provided by the countries of the Region, the Global Environment Facility (GEF) and selected donor organizations. The GEF has approved support for implementation of the SAP, which will be complemented by funding from a variety of international and domestic resources.

The present country report provides background information to the SAP process at the national level. It is based on information from publications and reports, listed at the end of this document, and a rapid assessment survey by the authors of this report.

Background

The Republic of Yemen lies in the southwestern part of the Arabian Peninsula. It is bordered by the Kingdom of Saudi Arabia to the north and the Sultanate of Oman to the east. The coastline of Yemen is about 2,200 kilometers long; the Gulf of Aden takes up about two thirds of this, with the remainder bordering the Red Sea.

The climate in the Red Sea coastal plain, the Tihama, is very dry, with an av-

erage annual rainfall of 100-200 millimeters and humidity of about 60 percent. There are no perennial surface streams discharging into the Red Sea, although flash floods are a widespread feature following torrential rains. In some places groundwater seepage supports coastal wetlands and palm growth. This seepage is estimated at about 390 million cubic meters per year (DHV, 1983). Much of the groundwater occurs close to the surface and is lost through evaporation. Climatic conditions in the Red Sea area—high temperatures and low rainfall—are not favorable for extensive vegetation growth. For most of the year strong south-southwesterly winds prevail. Most of the coastline lies exposed, limiting the growth of mangroves and seagrass beds.

Estimates of the length of the Red Sea coastline vary between 450 kilometers (FAO, 1976) and 765 kilometers (IUCN, 1987). At al-Hudaydah the diurnal tidal range is about 0.5 meter, while the monthly mean varies between about 1.3 meters in January and 1.0 meter in July. Wind-driven water currents along the exposed sandy beaches are stronger than in the central and northern Red Sea and the seasonal influx of waters from the Gulf of Aden through the Strait of Bab-al-Mandab results in relatively lower surface salinities and higher levels of nutrients. About 75 percent of the coastline consists of soft sediments. More than half of the shores are covered by sabkhas (salt pans) and salt marshes. On low profile shores sabkhas may extend far inland. Dense mangrove stands cover about 12 percent of the coast. Mangroves are rather common in the north and south, and rare in the central section. Only two species have so far been recorded, *Avicennia marina* and *Rhizophora mucronata*, although the latter is rather uncommon. Seagrass beds are found in shallow and sheltered areas in about 40 percent of the coastline. They are most extensive north of Salif. Nine species of seagrass have been recorded for the Yemeni Red Sea coast. The rarity of hard substrates and the relatively high turbidity of the waters covering the wide and shallow continental shelf create unfavorable conditions for coral growth. Hard substrates are often covered by macroalgae, mainly *Sargassum* spp., and calcareous algae. Only 25 percent of the coastline supports coral reefs. Nearshore reefs are more extensive and diverse south of al-Khaukha than further north. The best developed reefs occur offshore, mainly in the vicinity of the many islands that characterize the Yemeni Red Sea coast (IUCN, 1987, Sheppard and Wells, 1987, Sheppard and others, 1992, see Map of Yemen at end of volume).[1]

The Gulf of Aden coast is dominated by the Indian Ocean monsoon system. From January to March the northeast monsoon blows in a southwesterly direction. During this period the highest annual rainfall occurs and after flash floods the wadis discharge into the sea forming the alluvial fans that are a characteristic feature of the region. Between May and September the southwest monsoon generates winds in a northeasterly direction. The relatively warm surface water of the Gulf of Aden is blown offshore and replaced by cooler, nutrient-rich water from deeper layers. These upwellings limit the growth of coral reefs, but they trigger high primary production which supports the region's rich pelagic fish stocks.

In the past, surveys along the Gulf of Aden coast of Yemen—which is about 1,400 kilometers long and has a continental shelf area of 20,225 square kilometers (almost twice that of Yemen's Red Sea shelf)—concentrated on oceanography; information on coastal and marine habitats and biota is very limited. The southern coast is characterized by rocky cliffs alternating with stretches of sandy beach. The cliffs normally terminate in shallow water. Most of the nearshore areas are soft substrate high energy environments. Other

1 For updated descriptions and impacts to the coral reefs and associated habitats for Yemen, refer to Wilkinson, 2000, pp 35-54.

typical features are alluvial fans formed by wadi mouths, raised beaches with wave-cut platforms and pediments, headlands, escarpments and dunes. Beaches usually consist of sand on underlying rock. In the Bir Ali area, volcanic activity has resulted in lava intrusions (EU and MFW, 1995, Watt, 1996). The tidal range varies between about 1.5 and 2 meters. There are no mangroves along the mainland coast of the Gulf of Aden east of the Bab-al-Mandab area, except for Kharif Sha'ran, a crater lake fringed by *Avicennia marina*, a unique feature. Due to the high nutrient levels, algal growth is relatively abundant. Ormond and Banaimoon (1994) report about 160 species of macroalgae. The major growth period is in August and September, with a lesser period in February and March. Only three species of seagrass beds have been reported in the area, although information about extent is inadequate. Large seagrass beds have been recorded at Khor Umaira and Ras Imran (Hirth and others, 1973). Coral growth is limited by seasonally low temperatures as a result of the upwellings. Only 5 percent of the coast has fringing reefs. Corals have been reported at Perim Island, Ghuraira, Shuqra and Bandar Barum. Extensive reefs near a group of six small islands lying off Bir Ali are briefly described by Watt (1996).

The Socotra Archipelago lies 400 kilometers south of Yemen on the Carlsberg Ridge, an extension of the mid-Indian Ocean ridge system. The Archipelago has many unique features. Measuring 125 by 42 kilometers, Socotra is the largest of four islands long isolated from the mainland and surrounded by waters more than 3,000 meters deep. The Archipelago is highly exposed to the monsoonal wave climate of the Indian Ocean. Annual rainfall is around 200 millimeters, mainly falling in June, November and December and the average air temperature ranges from 17°C in January to 37°C in July. Most of the coast consists of cliffs or sandy beaches with some gravel shorelines near alluvial fans. Permanent freshwater streams form estuaries in the coastal zone. The southern side is characterized by huge storm berms, with large stands of black mangroves occurring behind them. Seagrass beds are not common around Socotra Island, although substantial areas of *Halodule* spp. and *Cymodocea serrulata* have been reported. Corals are widespread throughout the Archipelago, with cover varying from less than 5 percent to 80 percent (UNDP/GEF, 1996). Most of the coastal and marine areas surrounding these islands are still in a pristine state and in 1996, the Government of Yemen declared Socotra a special natural area in need of protection. Other areas along the Red Sea and Gulf of Aden coast have been proposed as MPAs. They are listed in Table 1.

According to the 1994 census the total population of Yemen is around 15 million, of which about 7.6 million live in the eight coastal governorates (Table 2), where the annual growth rate is 3.7 percent. Part of this rate should be attributed to the large number of returnees from the Gulf countries following the 1991 Gulf crisis. About 1,080,000 people live in major coastal settlements. Aden is the largest coastal city with 620,000 inhabitants, followed by al-Hudaydah with 160,000 and Mukalla with over 50,000.

Coastal and Marine Resources

Historically, the coastal ports of Yemen, such as al-Hudaydah, Mokha, Aden and Mukalla, were famous for transit trade, boat-building, ship repairs and bunkering. Before the closure of the Suez Canal in 1967, Aden was the third largest bunkering port in the world. Besides port related activities, major economic resources in the coastal zone are fisheries, maritime traffic

Table 1: Coastal and Marine Protected Areas of Yemen

Protected area	Size	Year declared	Major habitats and significant species	Impacts and conflicts	Manage-ment	Global recognition
Socotra Islands	3,625 km²	1996	Island group with outstanding terrestrial plant and animal diversity and endemism, diverse and largely pristine marine environments and biota	Fishing, increasing tourism pressure anticipated	Currently low, expected to become high	Nominated Biosphere Reserve, GEF biodiversity project
Ras Sharma	Not defined	Proposed	Beach and steep rocky headlands, internationally important nesting site for green turtles	Turtle egg collecting, possible slaughter of turtles	None	None
Dhobba (Shihr)	Not defined	Proposed	Sandy beaches, important turtle nesting site	Turtle egg collecting, possibly slaughtering of turtles	None	None
Balhaf and Bir Ali area	Not defined	Proposed	Group of high aspect islands, scenic coastline, extensive coral reefs and rich fishing area, bird and turtle nesting, crater lake with mangroves	Tourism development, fishing activities	None	None
Ras Isa/ Kamaran Island	Not defined	Proposed	Coral reefs with diverse reef associated fauna, mangroves	Oil terminal and chronic oil pollution, threat of major oil spill, reef fisheries for aquarium trade	None	None
Khor Umaira	Not defined	Suggested	Mixed seagrass and coral habitat, semi-enclosed lagoon with turtle nesting beaches	Fisheries	None	None
Bab-al-Mandab and Perim Island	Not defined	Suggested	Extensive mangrove stands, dense seagrass beds, hawksbill turtle nesting site of global importance	Major shipping lane, pollution, siltation, cutting of mangroves	None	None

Table 2: Population of the Coastal Governorates (Source 1986/88 and 1994 censuses)

Governorate	Area in km²	Population in 1986/88	Population in 1994	Growth rate per year	Population density
al-Hudaydah	13,326	1,294,359	1,749,944	3.45	132
Aden	6,980	418,755	562,162	4.36	81
Abyan	21,489	337,706	414,543	3.04	19
Shabwa	73,908	253,836	377,080	5.86	5
Hadhramaut	155,376	703,151	870,025	3.15	6
Mahra	66,350	97,834	112,512	2.07	2
Taizz	11,245	1,643,901	2,205,947	3.34	196
Hajjah	10,195	897,814	1,262,590	4.17	124
Total/Average	**358,869**	**5,647,356**	**7,554,804**	**3.68**	**70**

and oil and gas exploitation. Coastal and marine tourism has so far played a minor role. Yemen is among the poorest countries of the world, with a GNP of about USD217 per capita (1995 estimate). Fish production constitutes an important component of the GDP. Between 1990 and 1995, the income from the fisheries sector increased from YR98 million to YR294 million. The total value of exportable marine products has been estimated at more than USD40 million per year.

LIVING COASTAL AND MARINE RESOURCES

Fishing is a traditional profession for thousands of Yemenis, who are reputed for their dexterity in using various types of fishing gear and fishing techniques. These fishermen operate from bases and landing sites spread along the mainland coastline and from a number of islands.

Total annual catches vary between 90,000 and 95,000 metric tons and more than 90 percent of the total fish production is landed by artisanal fishermen. However, landing statistics are not reliable because of the following:

- The catch is auctioned and sold individually in the case of large species, or in bundles of smaller fish. Only fishery products destined for export are weighed.
- The relevant fishermen's cooperative society takes 2 percent of the auction's value and 3 percent is taken by the National Corporation for Services and Fish Marketing (NCSFM).
- Species quantity is estimated by dividing the total auction value of that species by an assured price per kilo for the species that was obtained in the past.
- At Gulf of Aden landing sites this presumed price per kilo is based on a fixed price set up in 1980. At Red Sea landing sites, the price per kilo was established in 1988. No revision has been made, and no random seasonal or monthly sampling is undertaken to find approximate weights of various species. Furthermore, there are no accurate figures on fishing effort. The Ministry of Fish Wealth (MFW) is currently preparing a programme to register fishing boats and fishermen and issue licenses.

Red Sea Fisheries Resources

Compared to other parts of the Red Sea, the shallow, nutrient rich waters above Yemen's wide continental shelf are rich fishing grounds. Most resource information from this area dates back to the 1970s and early 1980s, focusing on demersal fishes and shrimps. Estimates of standing stocks and Maximum Sustainable Yield (MSY) were based on landing statistics. The trawlable grounds cover about 6,200 square kilometers, 550 of which are shrimping areas (Sanders and Kedidi, 1981). Sanders and Morgan (1989) estimated the standing stocks in the Yemeni Red Sea at roughly 23,000-32,000 metric tons. No more recent data on stocks are available.

There are five main landing centers along the Red Sea coast of Yemen: Maidi with two landing places, al-Khauba with four, al-Hudaydah and al-Khaukha with eight landing places each, and Mokha with four. Fisheries data should be collected daily at each of these sites, including species, vessel type and gear. It is likely, however, that some landings are not recorded. Shrimps are sold by weight at the landing sites and wholesale fish markets. As noted above, fish are sold by bundle or individually. The auctions are run by representatives of the NCSFM. Some fishery products, particularly sea cucumbers, are not recorded because they are processed and sold directly to fish traders for export markets. However, the quantities are small and some are brought from Eritrea for re-export. Thus statistics are generally unreliable. Catches in the Red Sea and Gulf of

Aden between 1986 and 1994 are summarized in Figure 1.

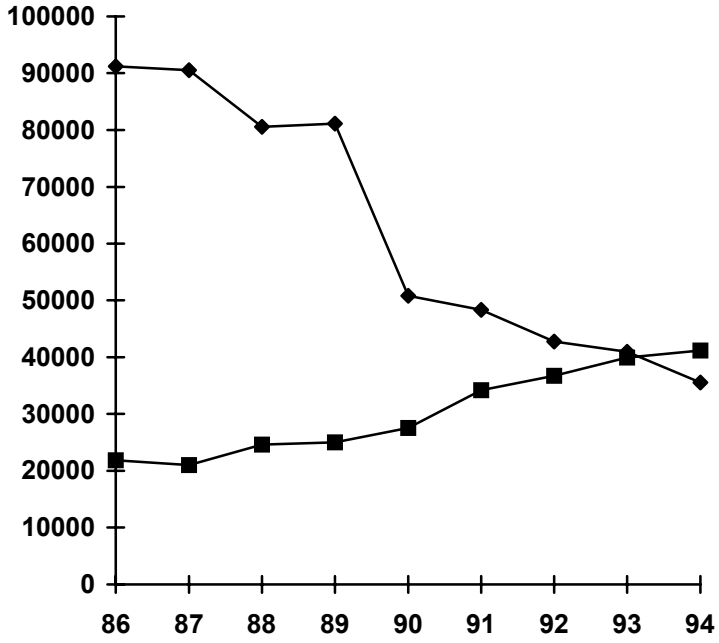

Figure 1. Total Catches of Fish and Shellfish from the Red Sea and Gulf of Aden between 1986 and 1994 (■ = Red Sea; ♦ = Gulf of Aden)

The main shrimp species caught in the Red Sea is *Penaeus semisulcatus*, followed by *Penaeus indicus*. The shrimping season is October to April. In the early 1970s, shrimps were of no interest to the local fishermen. From 1970 to 1974, commercial exploitation was undertaken by the United Fishing Company of Kuwait. The total annual whole weight catch during this period was approximately 3,000 metric tons. During 1993-1994, a local private company chartered two Lithuanian double-rigged shrimpers. The same company then entered into a joint venture with an Australian company using two double-rigged shrimpers but these operations ceased in May 1994. Two other local private companies also entered the business in 1993-1994.

At present, shrimping is done by local fishermen using sanbuks equipped with surface trawl nets. The current official shrimp catch from the Red Sea (Figure 2) is still below the highest MSY estimate of 2,000 metric tons per season made in the 1970s. However shrimpers from other countries of the Region and elsewhere often are caught fishing for shrimp illegally.

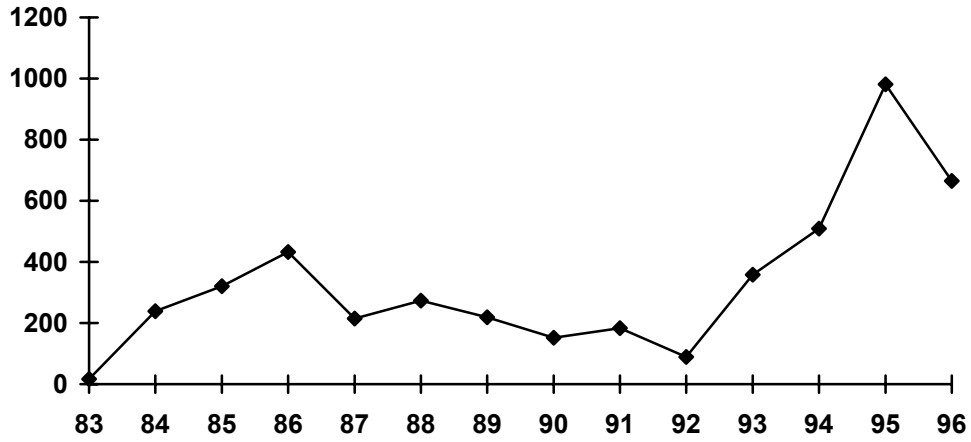

Figure 2. Shrimp Catches in the Red Sea between 1983 and 1996
Source: MFW 1997, UNDP/GEF 1996

Gulf of Aden Fisheries Resources

Over the past two decades several resource surveys were conducted along Yemen's Gulf of Aden coast, providing valuable information on demersal and pelagic stocks. The R/V "Ibn Majid" of the Marine Science and Resources Research Center (MSRRC) continued some of these surveys in 1990-1992. However, these do not provide sufficient information on artisanal fisheries. In addition, most of the surveys disregard stocks in adjacent countries. This is especially relevant with regard to migratory pelagics. Some studies did consider Japanese and Indian mackerel stocks throughout the Arabian Sea and other areas. The surveys have been analyzed by various scientists who have provided different estimates of standing stocks and annual MSY of pelagic and demersal fishes.

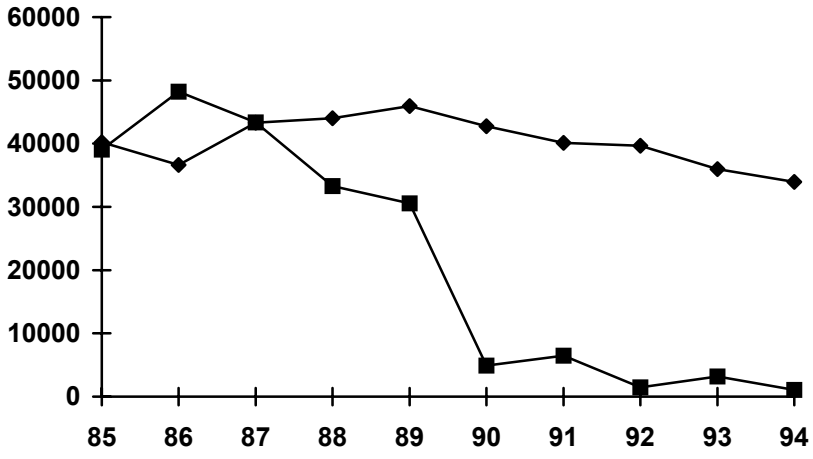

Figure 3. Catches of Demersal and Pelagic Fishes in the Gulf of Aden between 1985 and 1994 (■ = demersal resources; ♦ = pelagic resources
Source: MFW, Aden Branch 1996

Meso-pelagic fishes, particularly Myctophidae, are quantitatively significant but the technology for their exploitation is expensive. Among the exploitable stocks, pelagics are more abundant than demersal resources. In addition, several invertebrates form the most valuable resources for export markets. Pelagic stocks are closer to the shore during the months preceding the upwelling and migrate offshore after the upwelling to avoid the oxygen-depleted coastal areas. Their distribution and abundance is closely related to the time and magnitude of the upwelling, particularly during the monsoon season. It is evident that some stocks like chub mackerel (*Scomber japonicus*) are part of larger stocks more widespread in the Arabian Sea and Indian Ocean. Species composition varies seasonally and from place to place.

Small pelagics include sardines, anchovies, mackerels and scads. Two species of sardines are of commercial importance in the Gulf of Aden, namely the Indian oil sardine (*Sardinella longiceps*) and the fringe scale sardine (*Sardinella fimbriata*). Dried sardines and anchovies were exported from Aden to southeast Asian countries during the 1960s and the mid 1970s. In 1962, the catch of sardines and anchovies reached a high of 42,800 metric tons. *Sardinella fimbriata* was later the basis of a fishmeal industry with annual landings of 10,000 metric tons. The fishmeal plant closed in 1981. Artisanal fishermen land around 6,000 metric tons annually. The catch is mostly sun-dried on the beach to be used as fertilizer or fed to camels, especially in Mahra Governorate. Recently some quantities of dried sardines have been exported to the United Arab Emirates

Large pelagics include tunas, Spanish mackerels, sharks, jacks and marlins. Data on the distribution of demersal stocks and their densities are given in Edwards and others (1984). Catches of pelagic and demersal fish species between 1985 and

1994 are shown in Figure 3. The two main species of mackerel are *Rastrelliger kanagurta* and *Scomber japonicus*. The Spanish mackerel *Scomberomorus commerson* is widespread throughout the area. Catches in the Yemeni Gulf of Aden amount to about 1,000 metric tons annually. Landings of horse mackerel of the genera *Trachurus* and *Decapterus* ranged between 5,000 and 8,000 metric tons annually during the 1980s. There are four main species of tuna: yellowfin tuna (*Thunnus albacares*) which is highly migratory throughout the Indian Ocean, longtail tuna (*Thunnus tonggol*), skipjack tuna (*Katsuwonus pelamis*), and bonito (*Euthynnus affinis*).The frigate tuna (*Auxis thazard*) is mainly exploited in the eastern part of the Gulf of Aden. Important genera of jacks (family Carangidae) include *Caranx, Carangoides, Megalaspis, Elagates* and *Seriola*. Sail fish and marlins are incidentally caught in trolling operations by local artisanal fishermen. There has been a slow but gradual decline in catches of pelagic species following a peak in 1989. Demersal fish stocks, on the other hand, have been declining sharply since 1987 (Figure 4). This is due to the reduced number of trawlers fishing these resources, especially after 1990.

Sharks are caught using trolling and surface longlining. The main families are Carcharinidae and Sphyrnidae. During the 1980s, annual catches were on the order of 7,000 metric tons. Sharks are eaten along the Yemeni Gulf of Aden coast either sun-dried or dried and salted or cooked. Dried shark fins are an important commercial commodity for export to Southeast and East Asia.

The cuttlefish (*Sepia pharaonis*) fishery operates from April to October with two peaks in the catches during May-June

deep sea lobster fishery. Catches rose from 50 metric tons in 1980 to 400 metric tons in 1986.

An important fishery for spiny lobsters (*Panulirus* spp.) exists mainly in Hadhramaut and Mahra and around the Socotra Archipelago. The fishery was controlled by the Coastal Fishing Corporation (CFC) using artisanal small fishing vessels made of Glass Reinforced Plastic (GRP) and traps. Catches remained at about 200 metric tons (whole weight) between 1972 and 1983. Only 5 percent came from Socotra, but catches from the Archipelago could increase to about 120 metric tons annually. Landings rose to a peak of 1,150 metric tons in 1987 but dropped to around 600 to 700 metric tons in 1991, because of increased fishing effort. Sanders (1979) considered the annual MSY to be 300 metric tons (whole weight) but in 1988, Soviet scientists estimated the MSY at about 1,000 metric tons. Management measures since 1970 and later in 1983 restricted the lobster fishing season to between October and April, required tail lengths to be at least 7 centimeters and forbade catching females with eggs. Gradually since 1983, fishermen have been encouraged to use lobster traps, eventually replacing nets. Recently private companies were allowed to enter the lobster market through a vice-presidential decree, which means that CFC is no longer in sole control of the market.

Sea cucumbers are mainly caught by local fishermen in the western part of the Gulf of Aden. The holothurians (*bêche-de-mer*) are boiled, processed and dried on the coast for export. They are of local commercial importance although annual catches are small.

Socotra Archipelago Fisheries Resources

Resource surveys made in the late 1960s and 1970s reported rich fishery resources in the waters surrounding the Socotra Archipelago. Kesteven and others (1981), from findings of the RV "Dr. Fridtjof Nansen" in 1974 and 1976, estimated biomass for demersal resources at 55,000-116,000 metric tons and pelagics at 112,000-224,000 metric tons with yield estimates of 10,000-20,000 and 39,000-78,000 metric tons, respectively. Fish, turtles and lobsters are important resources in the Archipelago and abalone is a potential resource for future exploitation. More recent information is provided in UNDP/GEF (1996).

Fishing Activities

In this report, artisanal fisheries are considered as fishing activities carried out by local fishermen using traditional methods and operating small open deck boats without processing facilities. In some cases, old techniques are used for drying and salting fish. Artisanal fishing boats are essentially of two types, the huri and the sanbuk, with some recently improved versions. The huri is a traditional dug-out canoe made of wood, usually 6 meters long, and powered by 9 to 15 horsepower outboard engines. The number of huris is declining. Large 9-meter GRP huris are used in the western part of the Yemeni Gulf of Aden coast. Larger huris called qadifas measure 7-12 meters and are made of GRP; they are powered by outboard engines with 25 to 75 horsepower. Sanbuks are still larger boats, 13 to 15 meters long in the Gulf of Aden or 12 to 18 meters or longer in the Red Sea. They are powered by inboard diesel engines ranging from 52 to 115 horsepower or more.

In the Gulf of Aden region many artisanal fishermen are organized in cooperatives. There were thirteen fishermen's cooperatives until 1993. These cooperatives are still operating but after 1994 a few fishermen's societies were also established. However, there are no official figures available on their numbers or membership. A total of 7,880 artisanal fishermen were reported to be active in the Gulf of Aden area, consisting of 4,808 members of fishermen's cooperatives and 3,076 private fishermen (Table 3).

Table 3: Number of Fishermen and Fishing Boats in the Gulf of Aden Region

Cooperative area	No. of coop. members	No. of private fishermen	Total no. of fish-ermen	No. of sanbuk	No. of qadifa	No. of Huri	Total no. of boats
Ras al-Ara	268	118	386	1	1	102	104
Aden	249	1,000	1,249	25	702	55	782
Socotra Isl.	720	N/A	720	1	174	6	175
Shuqra	193	N/A	193	N/A	N/A	N/A	98
al-Bandar	105	15	120	0	12	34	46
Bir Ali	265	15	280	0	39	73	112
Mukalla	756	260	1,016	14	185	300	499
Shihr	493	729	1,222	0	166	180	346
Dis/al-Hami	546	0	546	19	82	15	116
Qusayir	224	489	713	27	132	64	223
Sayhut	285	150	435	0	83	0	83
Qishn	350	200	550	0	60	0	60
al-Gaida	350	100	450	3	22	49	74
Total	**4,804**	**3,076**	**7,880**	**90**	**1,708**	**926**	**2,724**

Source: Fisheries IV Report, 1992

Yemeni artisanal fishermen use the following methods:

- Handlining: 1.6 to 1.8 millimeter diameter nylon lines with 2-6 hooks per line ending with a lead sinker. Live Indian mackerel or sardines serve as bait. They are used on huris and sanbuks to catch kingfish, carangids, groupers and emperors at depths of 5 to 200 meters.
- Surface long lines: These are used by sanbuks to catch sharks, tunas and other large pelagic species. The lines are 60-80 millimeters in diameter, made up of synthetic fiber and are 300-500 meters long with floats attached at 1-2 meters distance.
- Trolling: Huris use two trolling lines to catch large pelagic fish with whale bone jigs as lure.
- Rock lobster traps: Huris and qadifas are used in this entirely artisanal fishery. The traps are locally made of a rectangular metal rod frame covered with plastic coated wire mesh.
- Cast nets: Huris use nylon cast nets of 1.5-2.0 centimeter mesh size for catching sardines and small pelagics.
- Gill nets: Surface gill netting is used by huris and sanbuks usually at night to catch Indian mackerel and kingfish. The nets are made of synthetic fiber with mesh sizes varying according to the target species.
- Round-haul nets: These are purse-seine nets used in the open sea by qadifas and sanbuks for schooling pelagics. The nets are made of 2.5-5 centimeter mesh nylon material.
- Shrimp trawling: Shallow inshore shrimping is carried out by sanbuks. The trawl net is operated manually without the use of a winch. The outer-boards are of basic design and the nets are usually made locally from leftover small mesh-size gill nets.

In the Red Sea fishermen use huris to fish in sheltered inshore areas. Sanbuks travel longer distances to fishing grounds that are about twenty nautical miles off-shore. When the winds are strong many boats fish around the numerous small islands. The fishing seasons depend on wind conditions. From October to December the sea is rough, resulting in poor catches. The major fishing season is from April to September.

In the Gulf of Aden fishermen use huris to exploit nearshore areas. Fishing takes place within four kilometers of the shore. In the western part, the continental shelf is narrower and drops off sharply to deeper waters, whereas the eastern shelf is wider with more shallow water fishing areas. Sanbuks use fishing grounds extending to twelve kilometers offshore. Fisheries operations largely depend on the monsoonal wind patterns.

Apart from the shrimp fisheries in the past, there are no industrial fisheries in Yemeni Red Sea waters. Most shrimps are caught by sanbuks and sold to local companies which process, freeze and select the shrimps for export at their shore-plants. In the Gulf of Aden, commercial/industrial fisheries began in 1967-68. During the past twenty-five years, foreign vessels operating in the area have targeted lucrative species for export. These resources were exploited by medium and large stern trawlers equipped with freezing and cold stores for processing and packing the products on board. The trawlers ranged in size from 1,000 to 3,000 gross register tons (GRT). From 1979 to 1992, the semi-autonomous Yemen Fishing Corporation (YFC) operated in the area. In 1992, two fishing companies were established, the Yemen Fishing Company and the Fisheries Investment Company (FI). In both companies, the government is an equity partner with a share of 40 percent and 20 percent respectively. In 1996, the two companies had seven stern trawlers. Two companies, one Chinese and one Somalian, were licensed to fish in the Yemeni Gulf of Aden waters in 1994 and they operated the following year, each using six small trawlers. In addition, the state-owned CFC (established in 1979) operates twelve fishing vessels. The CFC manufactures GRP boats and sells them to local fishermen. It has two rock lobster processing plants. In 1991, in a joint venture with a private partner, it established another GRP boat-building yard in Shihr with 40 percent equity.

In Hadibo, the capital of Socotra, a joint company was established in 1991 between the Socotra Fisheries Cooperatives which contributed 20 percent of the total shares in kind, and private investors, who contributed USD75 million in cash. The objective of the company is to collect the catches from Socotran fishermen and process them for marketing. The Socotra Fisheries and Sea Foods Company (SOFISCO) has a complex with a cold store, freezer, ice plant with ice-store generators and fuel station at Hadibo.

The MFW has two fish canning plants for sardines, mackerel and tuna. The first one was built in 1996 at Shuqra based on Japanese technology. The second cannery was built in 1979 at Mukalla, through a soft loan from the former Soviet Union. The total capacity is 13.8 million cans annually. The two plants operate independently but cooperate in exchanging supplies. Both plants have always faced problems of low supplies of fish and shortage of foreign exchange to import raw materials. The production of the Shuqra canning plant was 2,975,000 cans in 1994, but it dropped to 1,700,000 cans in 1995 due to long periods of low supplies. The canning plant in Mukalla, which has a small fishmeal unit for reduction of offal, has increased its production by 19 percent from 1,719,000 cans 1994 to 2,132,500 cans in 1995. Fishmeal production in 1995 was 59,130 metric tons (MFW Statistical Report Sana'a, July 1996). Small quantities of canned tuna in oil are annually exported, mainly to Saudi Arabia.

Landing Sites and Onshore Facilities

Along the Red Sea coastline there are about forty landing sites, the main ones being: Maidi, al-Luhayyah, al-Khauba, Ras Isa, Urj, al-Hudaydah, al-Khaukha, Makha, Dhubab and Bab-al-Mandab. Similarly, there are numerous landing sites along the Gulf of Aden coast, such as Ras al-Ara, Imran, Fukum, Crater (Aden), Zinjibar, Shuqra, Bandar Ahwar, Bir Ali, Mukalla, Shihr, Dis, al-Hami, al-Qarn,

Qusayir, Musaini'a, Sayhut, Qishn, Muhaifif, (al-Gaida), Yarub, Faidami, Damqawt, and Hawf.

The main fisheries port facilities are in Aden, Mukalla, Nishtun, al-Hudaydah and al-Khauba. The industrial trawler fleet is based in the Aden fishing port, which is situated within the commercial port area. The total area is 8.5 hectares with a wharf length of 620 meters. Facilities include a 2,000 metric ton capacity cold storage complex within a building which also contains a 100 metric ton per day ice maker; a general fish handling/processing area and a fishing gear manufacturing and repair area; a large ship repair complex including a 1,500 ton capacity floating dock; extensive engineering, repair and general service workshops; a fiberglass boat factory; and a large, multistory management and administration building. Dockyard infrastructure, operated by the National Dockyards Corporation, includes large multi-purpose engineering workshops; two floating drydocks of 4,500 metric tons and 1,500 metric tons; and a 500 metric ton capacity slipway.

Khalf Port at Mukalla was constructed about fifteen years ago as a fishing harbor and cargo port. It has a cold store with ice making facilities and a fishmeal plant. The port consists of two berths with space for a third one. The existing berths are in deep water, there is a rock shelf that would have to be removed to make a third birth for cargo ships or large fishing vessels. There are plans to construct a new port at Bandar Burum, 25 kilometers west of Mukalla, to provide the improved port facility required by Hadhramaut.

Nishtun Port is situated 60 kilometers west of the city of al-Gaida, the capital of Mahra Governorate. Port construction was completed in 1984. It offers facilities for fish receiving, frozen seafood production and cold storage, and support services for regional cargo vessels. The infrastructure includes a wharf of 210 meters with a depth of 4.5 meters and a small ship wharf of 150 meters; a small craft slipway and engineering and carpentry workshops; a desalination plant and power station; fuel tank installations; a 40 metric ton per day sliced ice plant; a fisheries complex with processing area, chill room, three 10 metric tons per day blast freezers; four 200 metric ton cold stores; and a 160 metric ton ice store.

Al-Hudaydah's commercial port is well established and over-committed for shipping; facilities are not generally available for fishing vessels. Al-Hudaydah Fishing Harbor was constructed in 1982-83. It was designed for sanbuks, with a minimum dredged depth of 2.5 meters and a 140-meter berth. Infrastructure includes a chill store, auction hall, workshop and office. Facilities are limited; fuel and water are available at the berth. The harbor has become a center for sanbuk fishery and is used to full capacity.

Al-Khauba Harbor consists of a pier with berthing space of 45 meters on either side and a depth of 3 meters at the outer end. The port has an ice plant of 15 metric tons per day and freezing facilities for 5 metric tons per day with storage capacity, auction hall, workshop, and a shrimp handling and processing plant. The shrimp plant has not operated since it was completed.

Fish Processing Shore Facilities and Fish Marketing

Traditional methods of sun-drying sardines and anchovies on the beach, and of sun-drying, salting and hot smoking shark, tuna and kingfish are still practiced in Yemen. Until the mid-1970s fresh fish was consumed only in the coastal areas, with most of the salted, dried and smoked fish eaten in the hinterland. With the expansion of asphalt road networks, the marketing of fresh fish in ice has grown rapidly in the main towns in the interior and continues to expand. Along the southern coast of Yemen, a number of processing plants were constructed and run by the State-owned National Corporation for Fish Mar-

keting (NCFM). In 1992, a new corporation, the NCSFM, was formed under the supervision of the MFW. At present, the NCSFM operates the old ice-making plants on the southern coast.

After unification, the entry of private entrepreneurs into fish trading resulted in an increasing demand for ice. One older ice plant in Aden is beyond repair, but another built with Chinese support has been rehabilitated. Neither the Ahwar nor the Nishtun plant are currently in operation. Along the Red Sea coast there are 16 small ice block plants owned by the private sector. The total capacity is 338 metric tons per day at the al-Hudaydah fishing port and 5 metric tons per day at Maidi.

The network of cold stores and freezing plants owned by the NCSFM in the ex-PDRY is shown in Table 4. It should be noted that the cold store at Aden Fish Harbor is in poor condition, while the cold stores at Imran and Nishtun are not operating. The Mukalla cold store is often full to capacity, since it is the major storage point for frozen fish in the eastern Governorates. Smaller cold stores are scattered about the municipal markets in the major population centers. Aden has small cold stores at Tawahi, Crater, Maala and Sheikh Othman.

Marketing

Most artisanal fishermen do not use ice at sea. They return their catch to landing centers ungutted. No chilling is done until after sale by auction. Auctions are run by traditional private auctioneers in some places, by fishermen cooperatives of the NSCFM in other places. The buyers then transport the fish in ice to urban areas where it is sold to retailers. Small pelagic fish like sardines and anchovies are normally sun-dried on the beach and sold dried as animal feed and fertilizer. There is no systematic collection of data from auction records to monitor internal fish marketing. Local marketing in Yemen faces the following problems:

- Lack of a code of practice and instructions on proper handling of fish.
- Lack of appropriate hygienic conditions in the wholesale and retail markets.

Table 4: Network of Cold Stores and Freezing Plants along the Gulf of Aden Coast

Governate	Location	Storage Capacity (mt)	Freezing Capacity (mt/day)	Origin/ Year Built
Aden	Fish Harbor	2,000	25	USSR, 1986
	Aden branch	800	30	China, 1979
	Maalla	1,000		Denmark, 1976
	Aden Markets	6 stores/5 mt		GDR, 1981-3
	Yaffa	15		
	Imran	15		France, 1978
Lahej	Alhota	30		GDR,* 1978
	Alhota Market	5		GDR, 1982
	Al-Dali	15		Denmark, 1978
Abyan	Zanzibar	15		Denmark, 1979
	Ahwar	60		France, 1981
Shabwa	Bir Ali	60		Denmark, 1982
	Nisab	15		Denmark, 1978
Hadramaut	Mukalla	800	20	Denmark, 1978
	Qusayir	150	15	Denmark, 1983
	Shihr	15		Denmark, 1978
	Seyoun	15		Denmark, 1978
Mahra	Nishtun	800	20/30	Denmark, 1984
Total Capacity		**4,825**	**110/140**	

Note: Cold store at Aden is in poor condition and the ones in Imran and Nishtun are not operating.
**GDR = German Democratic Republic*

- Lack of functional apparatus for controlling hygiene or quality of fish.
- Lack of guidelines from MFW or the municipalities on fish quality control.

The NCSFM trades in frozen fish utilizing the government-owned chain of cold stores. Since 1987, following changes in policies in the fisheries sector aimed at liberalization of prices, spread of the auction system and encouragement of the private sector to enter the fish trade, trading in frozen fish has been open to investors. Sometimes frozen fish are defrosted and sold as fresh in the local market. Marketing of frozen fish faces the following problems:

- Preference for fresh fish or fish in ice by local consumers.
- Absence of guidelines for handling and storing frozen fish and fishery products.
- Lack of managerial skills in storing frozen fish.
- Lack of promotion.

Traditionally, only dried or salted and dried fishery products were exported from Yemen. Fishmeal and fish oil were exported from Aden and Mukalla in the 1960s and early 1970s. The main markets then were East Africa and East Asia. With the start of cuttlefish and demersal fish exploitation by the industrial fleet, more frozen fishery products were exported, mainly to Japan, Spain, Italy and the former Soviet Union. The most important export product from artisanal fisheries is frozen rock lobster tails, destined mainly for the USA and France. Most of the exports are from the southern coast and are still handled by the NCSFM. Yemen regularly supplies frozen cuttlefish, frozen rock lobster tails and deepsea lobster to foreign markets. Limited quantities of frozen and canned fish and fresh tuna on ice are exported to Middle Eastern countries and Europe. Dried shark fins and sea cucumber are exported to Southeast Asia.

The growth of exports of fish and other seafood from Yemen is hampered by:

- Inadequate facilities for handling, processing, freezing and transporting fish.
- Lack of fisheries extension work to promote use of ice at sea.
- Lack of information on requirements of foreign markets.
- Shortage of facilities to communicate with potential markets.
- Lack of appropriate transportation to meet demands.

According to the annual statistical report on fisheries published by the MFW, 6,228 metric tons of fishery products were exported in 1995. The total value of these exports was USD18.3 million, as compared to 1,906 metric tons worth USD13.7 million in 1994.

Human Resources and Socio-Ecoonomics in the Fisheries Sector

Whereas in the former PDRY, the fisheries sector was largely controlled by the government, Red Sea fisheries in the ex-YAR developed with a minimum of government interference, and were largely left to the private sector. The changes in policies following unification are still continuing and will have a deep impact on the fisheries sector, particularly in the Gulf of Aden region where large infrastructure investments were made and many people were trained in the past two decades. The programme of economic, financial and administrative reform under implementation since 1995, the privatization programme, and the trend towards more authority in local Governorate administration will all influence the direction in which the fisheries sector develops in the future. At present, staff members of the MFW, the MSRRC, the FI, the NCFM and CFC in senior management number about 3,000, without including those in the two canning plants in Shuqra and Mukalla.

There are no accurate figures on the number of local fishermen involved in artisanal fisheries in Yemen nor on their technical qualifications, whether private fishermen or members of fishermen's cooperatives or fishermen's societies. For 1991-92 the estimated figure given for the total number of fishermen along the southern coastline was 7,880 and those along the Red Sea coastline numbered 5,823, for a total of 13,703. The actual number may, however, be higher.

Traditionally, tribal affiliations and influence were weak in the coastal areas in Yemen. The growth of ports and sea-trade with distant countries led to exchange with the cultures of visiting seafarers and new settlers in the main ports, and among the Yemeni coastal communities themselves. People fished along both Yemeni coastlines. There were ten fishermen's societies along the Red Sea coast and thirteen registered fishermen's cooperatives along the southern coast. The cooperatives in general owned large sanbuks, fishing gear and a number of small huris. All cooperatives provided outlets for fish catches and offered welfare benefits. In certain areas, the fishermen's cooperative would also control consumer cooperatives in the fishing communities, providing food stuffs at wholesale prices. The cooperative formed avenues through which credits were provided by the MFW.

Since 1989, liberalization of fish marketing and the auction system have marginalized the role of cooperatives near urban centers, although they still provide a wide range of services in the fishing communities along the Gulf of Aden coast, specifically sale of fishing gear and equipment, workshop services, transportation of fish by insulated trucks, sale of ice, cold storage capacity, fuel supplies, and shark fin and sea cucumber processing.

Along the Red Sea coast, the fishermen's societies operate somewhat differently. They are not involved in fishing, marketing or providing supplies. They provide some social security functions and occasionally give limited loans to their members, from funds accumulated by charging 2-5 percent of the total value of the fish landed. Fishery loans provided by the CACB are given in Table 5.

Table 5: Fishery Loans provided by CACB between 1991 and 1995

Aden, Mukalla, Abyan, Shabwa and Seyoun				Sana'a, Ta'izz and al-Hudaydah			
Year	Loans	Beneficiary families	Value [1000 YR]	Year	Loans	Beneficiary Families	Value [1000 YR]
1991	246	738	9,329	1991	200	1,427	7,740
1992	199	797	10,617	1992	21	309	1,206
1993	355	1,416	20,486	1993	606	3,389	28,524
1994	276	1104	30,668	1994	190	1,221	13,037
1995	227	903	28,920	1995	31	117	10,450
Total	**1,302**	**4,958**	**100,020**	**Total**	**1,048**	**6,463**	**60,957**

Source CACB, 1995. Note: For 1995 only the period from January to September is given.

Often fishing communities are made up of a few interrelated families. Those near urban areas mix well with town people and some intermarry. Fishing boats are usually manned by crews of the same family. However, with development of schools and education, a number of the young people, especially in the Gulf of Aden area, leave to take other jobs although they keep their own boats for fishing or work in their families' boats whenever they have time. Many fishing boats along the Red Sea coast are owned by the *muqaddam* or sheikh, who normally provides informal loans to crew members, sells the catch and acts as a *kafeel* or sponsor for any crew member who needs credits from elsewhere. However, with the expansion of formal credits and the increasing number of fish traders from urban areas, the role of the kafeel boat owner is diminishing. Normally, the system of sharing revenues

from the catch—after deducting costs of auctioning, fuel, food, ice, knives and other items—is 50 percent for the fishing boat and gear; with the rest divided equally among the crew; the captain has two shares, one from the boat's share and the other as a crew member.

Average net incomes of fishermen along both coasts vary with the types of fishing boats, gear, target species and demand in the market plus the vicinity of the fishing ground to the landing site. Not all of the catch goes through auction as some fish traders have arrangements to collect catches directly. Since 1990, with pricing dependent on the market, fish prices have risen. There are no official data or average fish prices available. Fishermen in Yemen earn an average equivalent to the monthly wage of a new university graduate joining the civil service (YR6,000 to 7,000 per month). However, this estimate should be considered only as indicative since no survey was carried out.

Aquarium Trade and Mariculture

At present two companies are licensed to collect coral reef fishes for the aquarium trade. More licenses are expected to be issued in the future.

Mariculture is at the level of research. Currently the Mariculture Research Center in Little Aden has the following facilities: an administration and research building; a seed production building; a building for mechanical works and repairs; a running seawater system and seawater pump house; four outdoor ponds; and various fiberglass tanks.

Other Living Marine Resources

The distribution, status and nesting activities of marine turtles in Yemen are insufficiently known. Altogether, five species have been recorded in the area, but only two species are common and known to breed in Yemeni waters, the green turtle (*Chelonia mydas*) and the hawksbill turtle (*Eretmochelys imbricata*). Intertidal and sub-tidal seagrass beds of the Red Sea and Gulf of Aden are important feeding areas of Green and juvenile hawksbill turtles. They are also likely to support populations that nest outside the territorial waters of Yemen. There are no confirmed records of turtle nesting sites along the Red Sea coast of Yemen (IUCN, 1987). In the Gulf of Aden, green turtle nesting has been reported from Khor Umaira, Ras Imran, the Aden Peninsula, near Mukalla and Ras Sharma (MSRRC, 1994, EU and MFW, 1995), the last site being of international importance. It is the second largest nesting site in the entire Region, second only to Ras al-Hadd in Oman. An estimated 10,000 females nest annually at Ras Sharma (Hirth and Carr, 1970). Green turtle nesting on Socotra has yet to be confirmed. The most significant nesting site for hawksbill turtles in the entire Arabian Peninsula is Jabal Aziz Island westward to Perim, where, according to Ross and Barwani (1982) 500 females nest annually. Other nesting sites are Khor Umaira, Ras Sharma and Socotra (Gasperetti and others, 1993). UNDP/GEF (1996) reported turtle nesting beaches at Socotra Island, Abd al-Kuri and Samha.

Due to the high productivity of the southern Red Sea and Gulf of Aden, and the presence of many offshore islands, the coastlines of Yemen provide prime feeding and breeding sites for numerous seabirds, such as Jouanin's petrel (*Bulweria fallax*), Persian shearwater (*Puffinus persicus*), red-billed tropicbird (*Phaethon aethereus*), masked booby (*Sula dactylatra*), brown booby (*Sula leucogaster*), Socotra cormorant (*Phalacro-corax nigrogularis*), red-necked phalarope (*Phalaropus lobatus*), sooty gull (*Larus hemprichi*), white-eyed gull (*Larus leucophthalmus*), swift tern (*Sterna bergii*) and white-cheeked tern (*Sterna repressa*). Important coastal and island bird areas are the Maidi/al-Luhayyah area, the islands north of al-Hudaydah, Ras Isa, al-Zubair Islands, al-Urj, Nukhaila, al-Fazza, Hanish al-Kabir, Mokha/al-Khaukha area, Bab-al-Mandab, Hiswat al-Hugaima, Aden wetlands, is-

lands off Bir Ali, Wadi Hajar, Qishn, Ras Fartak, Abdullah Gharib Lagoons and the Socotra Archipelago (Evans, 1994). The Aden wetlands are among the most important in the Region, regularly holding over 10,000 waterfowl including three globally threatened species, and twelve species with regionally important populations (al-Saghier and Porter, 1996). More information on seabirds in Yemen is found in IUCN (1987), EU and MFW (1995) and UNDP/GEF (1996).

Information on marine mammals in the territorial waters of Yemen is very limited. During the IUCN survey in 1987, only the humpback dolphin (*Sousa chinensis*) was observed along the Red Sea coast, although the common dolphin (*Delphinus delphis*) and the bottlenose dolphin (*Tursiops truncatus*) are expected to occur in the area as well. Bryde's whale (*Balaenoptera edeni*) has been recorded at a nearby site in Saudi Arabia. There are no confirmed records of dugong (*Dugong dugong*), although there are suitable habitats and the species is likely to occur in low population densities (IUCN, 1987). There are hardly any data available on marine mammals along the Gulf of Aden coast of Yemen. UNDP/GEF (1996) recorded a skull of a sperm whale (*Physeter macrocephalus*) and common dolphin in the Socotra Archipelago.

NON-LIVING RESOURCES

Exploration and exploitation of oil and gas and the construction of terminals and pipelines at al-Hudaydah, Ras Isa, Bir Ali and Mukalla provide important employment opportunities for the coastal population. Oil production amounts to around 350,000 barrels a day, of which 70 percent is exported. There are minor beach mining activities. At present, there is no exploitation of deep sea metalliferous muds.

MARITIME TRANSPORT

Aden, the largest and most important port of Yemen, has a long history. During the 1950s and 1960s, it competed with New York for the title of the world's most important bunkering port. Located on one of the busiest trading routes between Europe and East Asia, around 7,000 vessels called at Aden every year for refueling. Following the closure of the Suez Canal in 1967 and the independence of the former PDRY, the importance of Aden's port rapidly declined. In the late 1980s, Ma'alla terminal was built with alongside berths that are able to handle ocean-going vessels of up to 38,000 DWT. At the same time the ports of al-Hudaydah, Mokha, Mukalla and Nishtun were developed. Berths at Little Aden were increased to handle larger tankers and a Roll-On/Roll-Off berth was built. Efforts are currently underway to further improve facilities at Aden, which has the potential to regain world-class status as a transshipment port (Aden Port Development, 1996). Table 6 lists the number of ships calling annually at Yemeni ports between 1994 and the first half of 1996.

Table 6: Number of Ships Calling at Yemeni Ports and Volume of Oil Operations

	1994		1995		First half 1996	
	No of ships	Oil oper. [mt]	No. of ships	Oil oper. [mt]	No. of ships	Oil oper. [mt]
Aden	878	2,548,563	1,164	4,201,809	696	4,112,120
al-Hudaydah	523	1,350,524	583	1,326,711	392	108,807
al-Mokha	84	263,447	97	230,254	159	19,304
Mukalla	224	229,100	186	248,404	183	116,084
Ras Isa	83	7,639,899	84	7,411,011	46	3,543,541

A 409,000 DWT floating storage and offloading vessel is moored 4.8 nautical miles offshore of Ras Isa on Salif peninsula. Crude oil is supplied by pipeline from the shore, then transferred from the vessel

to tankers. Export crude oil tankers are normally below 100,000 DWT. Al-Hudaydah Port has facilities for cargo ship loading and unloading and grain unloading from bulk carriers. It also has a container terminal. A barge is available for transport of ship based garbage and oily waste, which is carried by lorry to a municipal landfill where it is burned. The port and entrance channel are dredged regularly and dredge spoil is dumped offshore.

Mokha has general cargo loading and unloading facilities. Product tankers with a maximum size of about 10,000 DWT call at this port, which has no waste reception system. In Aden, two private companies hire barges from Aden Bunkering Department (ABD) to collect garbage and oily waste from ships. The waste is delivered to ABD and transported by lorries to a desert area. At Little Aden, ballast from small tankers is pumped ashore. Mukalla port, which handles cargo ships of up to 10,000 DWT, has no waste reception system established. Al-Shihr export terminal, which is used by Canadian Petroleum International Resources Ltd., has a single mooring buoy for loading crude oil tankers of up to 400,000 DWT. This port has no waste reception system (DNV, 1996).

MARINE AND COASTAL TOURISM

Due to its impressive landscapes and numerous historic sites, Yemen is an important destination for foreign tourists. The General Tourist Authority established a Marine Department, but coastal and marine based-tourism still plays a minor role. On the Red Sea coast, al-Khaukha has limited tourist facilities at the beach, with two low standard hotels and another one under construction. There are extensive plans for tourism development in the Balhaf-Bir Ali area and the construction of five hotels is planned. A SCUBA dive base recently opened at Mukalla.

Legal and Institutional Framework

INTERNATIONAL AGREEMENTS

Yemen is party to several international conventions, agreements and treaties with implications for the marine environment. Treaties or conventions that were signed by the ex-YAR and the ex-PDRY are still in force according to the unification decree. In 1995 alone, four conventions relevant to environment, including the Biodiversity Convention, were ratified. Yemen has signed but not yet ratified the MARPOL Convention due to lack of funds to purchase the necessary port waste reception facilities. Yemen is party to the following conventions:

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1996).
- Convention on Biological Diversity (signed 1992, ratified 1996).
- Montreal Protocol on Substances that Deplete the Ozone Layer (1996).
- Protocol Concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1992, updated 1994). Yemen cooperates with Djibouti and Somalia in combating oil spills. Oil pollution control equipment for the Gulf of Aden area (Yemen, Somalia and Djibouti) has been stored at the Marine Emergency Mutual Aid Center (MEMAC) in Djibouti. Yemen and Djibouti are currently negotiating a bilateral agreement regarding the use of such facilities.
- Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (Jeddah Convention 1982, updated 1994). Yemen is a party to this regional Convention under the umbrella of the Arab League.
- United Nations Convention on the Law of the Sea (signed 1982, ratified

1987, entry into force 1994, updated 1995).

- United Nations Framework Convention on Climate Change (signed 1992, ratified 1996).
- Vienna Convention for the Protection of the Ozone Layer (1996).

NATIONAL LAWS AND REGULATIONS

In the last few years a number of environmental laws and regulations were issued. The Environment Protection Law (EPL) was enacted in May 1995. This was followed by the formulation of draft environmental assessment guidelines and regulations (Euroconsult 1996). Relevant laws and regulations are:

- Prime Ministerial Decree No. 4 of 1996 establishes Socotra as a protected area and a High Committee for Development of Socotra headed by the Deputy Prime Minister, Minister of Planning and Development.
- Law No. 11 of 1993 for the protection of the sea from pollution is mainly concerned with pollution by oil and from passing ships. The law determines procedures for prosecuting, penalizing and requiring compensation from ships that violate the law. It gives the Public Corporation for Maritime Affairs the legislative power to deal with oil pollution at sea. In its article No. 35, the law prohibits any form of discharge of pollutants of any kind and from any source into the sea without prior treatment.
- Law No. 4 of 1993 (the Free Zone Law) in its Article 10(d) prohibits any activities or practices carried out in contradiction with special directives regarding the protection of the environment.
- Fisheries Law No. 42 of 1991 is the main legal framework for "Organization, Exploitation and Protection of Fishing and Aquatic Resources". This law deals with protection of fisheries resources and regulation of fishing activities. The law prohibits destructive fishing methods such as poisons, chemicals, etc. It also indicates means of limiting and/or dealing with pollution.
- Law No. 37 of 1991 defines territorial waters, Exclusive Economic Zones of 200 nautical miles, and island boundaries. It also regulates free passage in the Bab-al-Mandab. It emphasizes the prohibition on dumping any wastes into these zones.

A full list of the relevant laws and regulations is given in Table 7.

INSTITUTIONAL FRAMEWORK

A large number of government agencies have some control over resource management and many hold responsibility for coastal and marine areas. There is no authority solely in charge of coastal zone management in Yemen. Relevant agencies and institutions are listed below:

- Environment Protection Council (EPC). The EPC was established in 1990 by Prime Ministerial Decree 94/1990. It reports to the Cabinet of Ministers. The Chairman of the EPC is a state minister. Ministries with primary responsibilities over natural resources management and environmental conservation are represented in the EPC. Initially the EPC consisted only of a council of vice or deputy ministers, but in 1992 it was expanded to include a Technical Secretariat. The mandate of the Technical Secretariat (TS) is to coordinate and monitor responsibilities regarding planning, implementation, environmental protection and natural conservation policy. Implementation at field level is under the responsibility of the line ministries. Within the TS, three departments were established:

Table 7: National Laws and Regulations regarding Coastal and Marine Environments and Resources

Law, Ordinance, Regulation	Year in force	Government Agency concerned
Presidential Resolution on the Territorial Sea, Adjacent Waters, the Exclusive Economic Zone and the Continental Shelf (Law No. 37)	1991	Ministry of Defense, MFW
Presidential Resolution on Fishing, Exploitation and Protection of Living Aquatic Resources (Law No. 42)	1991	Ministry of Fish Wealth
Free Zone Law (Law No. 4)	1993	Free Zone Authority
Protection of the Marine Environment from Pollution (Presidential Decree No. 11)	1993	Public Corporation for Maritime Affairs
The Maritime Law for the Republic of Yemen (Presidential Decree No. 5)	1995	Public Corporation for Maritime Affairs
Environment Protection Law	1995	Environment Protection Council
Ministerial Decree for Specifications of Fishing Vessels and Gear (No. 101)	1995	Ministry of Fish Wealth
Prime Ministerial Decree No. 4 of 1996 establishing Socotra as a protected area	1996	Ministry of Planning and Development

- ◊ Environment Protection Department.
- ◊ Planning and Data Department.
- ◊ Administration and Financial Affairs Department.

A Marine Environment Officer has been appointed within the Environment Protection Department. The EPC has a branch in Aden and an office in Mukalla.

According to the Environmental Protection Law, the EPC is the official government agency that is responsible for preparation of the general national policy for environmental protection and control. It coordinates with concerned bodies to execute such policy. Furthermore, the law states that "Each concerned body shall adhere to and be obliged to implement the decisions, resolutions and recommendations that are issued by the Council".

- Ministry of Higher Education. Established in the late 1970s, the Department of Oceanography, University of Sana'a, has more than ten staff members specialized in various marine sciences including marine ecology, chemistry, geology and fish biology. Its main responsibilities are teaching, research and advising the government on marine issues. It has a capacity for and is carrying out research and training in the fields of coastal surveys, pollution monitoring and analysis. The University of Aden has several departments involved in research and training in the marine sciences. In 1996, this university organized the first international symposium on Socotra Island. There are also colleges in al-Hudaydah and Mukalla.
- Ministry of Fish Wealth. According to the Fisheries Law, the MFW has authority to regulate fishing, issue licenses, supervise processing and marketing of fish and fisheries products for local consumption and export. Imports and/or manufacturing of fishing gear and other relevant equipment must be in accordance with specifications of the MFW. The Ministry is responsible for the management and development of Yemen's fish resources. It has a branch in Aden and offices in al-Hudaydah and Mukalla. The MFW, through its department of monitoring and surveillance, is responsible for the enforcement of laws and regulations concerning marine resources.

- Marine Science and Resources Research Center, Aden. The MSRRC is the advisory body for the MFW. It advises the Ministry on fish stock assessment and management, fish landings, fishing seasons etc. It is located in Aden and was established with the assistance of UNESCO and the Islamic Development Bank. It consists of three departments: Fisheries, Oceanography and Benthos. It has also a newly established small pollution control center at al-Buraiqa (Little Aden), an experimental mariculture station and a small laboratory in Mukalla. The MSRRC operates a 37-meter research vessel (Ibn Majid) which is currently in need of maintenance. The center receives some technical assistance from the Fourth Fisheries Development Project and has collaborated with this Project to execute a coastal habitat survey of the Gulf of Aden.
- Ministry of Transport:
  - ◊ Public Corporation for Maritime Affairs (PCMA). This is the main governmental body concerned with maritime safety and marine pollution control. It also plays an important role in developing a legislative framework to protect the marine environment. It plans to formulate a national Contingency Plan and produce a sensitivity atlas.
  - ◊ The Maritime Training Center (MTC) in Aden was established in 1989. Its mandate is to conduct training courses in port operations and maritime transport, maritime safety and pollution control. It offers courses on the MARPOL Convention and oil spill response. It currently receives assistance from UNDP.
- Ministry of Culture and Tourism:
  - ◊ General Tourism Authority (GTA). The GTA is responsible for tourism activities throughout the country including eco-tourism. Permits for building tourist villages along the coast or on the Yemeni islands are issued by the GTA. In 1995, with the increasing number of diving tourists, the GTA issued a set of regulations and guidelines for tourists while snorkeling and/or diving. A tourist guide from the GTA must accompany tourist groups and report any violations. The GTA has a Marine Department and an Eco-tourism Department.
- Free Zone Authority (FZA). This Authority is in charge of planning and establishing the Free Zone in Aden. It is also mandated with overseeing environmental management within the free zone area.
- General Investment Authority (GIA). The GIA is a newly established governmental body mandated with encouraging and increasing investments in Yemen. The Investment Law provided many incentives for large-scale projects. Unfortunately, environmental considerations have often come second in such projects. Environmental assessments are required only if the investor states on the investment form that project activities will be harmful to the environment.

Threats to the Environment

A summary of threats to the marine environment is provided in Table 8.

HABITAT DEGRADATION AND DESTRUCTION

Coastal Development

Strong population growth, rural to urban migration are causing coastal cities and towns to expand at accelerating rates. This has resulted in unplanned settlements around main cities, especially around al-Hudaydah, that may eventually lead to loss of critical habitats such as mangroves and

coral reefs. Mukalla is rapidly expanding to the west and significant coastal development already extends over 20 kilometers along the coastline. The ongoing development of the Aden Port and Aden Free Zone is expected to have a major impact on the environment. Reclamation for port development and expansion and for construction of industrial areas is already underway in Aden where lagoons and intertidal areas, both important for birds, may be reclaimed. Landfill has covered 20 hectares thus far (Aden Port Development, 1996).

In Socotra, harbor and airport developments are planned. Unless appropriate environmental precautions are taken, this is likely to cause considerable local impacts.

Degradation of mangrove habitat along the coast of Yemen is still low to moderate, but needs attention. Wood collection and grazing occur in several mangrove areas. Degradation will result in lowered fish and shrimp catches and a decline in water quality.

Reef based tourism is still in its infancy in Yemen and impacts from visitor are minimal to date. However, this may soon become an important issue in the Gulf of Aden where corals are already living under stressful conditions and have become particularly sensitive to disturbance. Fish collecting for the aquarium trade should be monitored carefully to prevent damage to the reef habitat and a decline in reef associated fauna.

Over-exploitation of Living Marine Resources

As already mentioned, there are very clear signs of over-exploitation of some high profile resources, although without stock assessment this cannot be confirmed.

Catches of important pelagic stocks in the Red Sea, such as Indian mackerel *(Rastrelliger kanagurta)*, indicate a sharp decline from a high of 7,301 metric tons in 1991 to only 720 metric tons in 1996. Due to lack of any management measures concerning seasons, allowable catches, types of gear, etc., some species are obviously threatened. Another important commercial species, the kingfish (*Scomberomorus commerson)*, has shown a decline in catches from 3,207 metric tons in 1991 to 2,218 metric tons in 1996. This may be attributed to the growing demand for this species in inland markets where it fetches high prices. Some of the catch is exported to neighboring Saudi Arabia. Other major pelagic resources also have shown a regular decline since 1993-94. This is partly due to greater numbers of fishermen following the return of many Yemeni nationals after the 1991 Gulf crisis.

In the Red Sea area, sharks are mainly caught for their fins, which are exported and fetch high prices on international markets. Intensive fishing effort and the use of gill nets brought shark catches in the Red Sea to a peak of 6,537 metric tons in 1993; it then dropped gradually to 3,556 metric tons in 1996. Shark fishing with nets is indiscriminate; turtles and dolphins are taken as bycatch and discarded. In the Gulf of Aden, there are no signs as yet of undue pressure on shark stocks.

Although the fishing effort has remained largely the same over the past few years, catches of spiny lobsters have dropped by more than 60 percent in the last two years. Although it was illegal until recently to sell the catch outside the CFC, unknown quantities of lobster were sold directly to the private market since it offered higher prices. Illegal entry of unregistered and unlicensed boats put further pressure on the stocks. At present, there is inadequate enforcement capacity. If exploitation continues at current levels, stocks will soon be depleted and the quality of the product will deteriorate, leading to the loss of export markets.

Shrimp catches in the Red Sea increased until 1995, but dropped significantly in 1996. This is probably a result of greater fishing effort spurred by a sharp rise in shrimp prices. Although natural

fluctuations in shrimp stocks are common, this resource might already be exploited beyond the MSY, largely due to illegal fisheries.

Exploitation of cuttlefish (*Sepia pharaonis*) in former PDRY waters began in 1967 and continued in 1970 with Japanese trawlers. The operations lasted until 1980-81. From 1972 to 1984, a joint Yemeni-Soviet Fishing Expedition caught cuttlefish and deep sea lobsters. The increased fishing effort led to overfishing and the decline of the fishery in 1982-1983. Recent declines likely indicate a recruitment collapse. For details on catches of cuttlefish between 1971 and 1984 see Hariri (1985).

Recreational use of beaches by local tourists may be responsible for the death of nesting turtles. Electric light along nesting beaches is known to interfere with the ability of newly emerged hatchlings to enter the sea safely. Feral dogs, common along the coast, especially near with human habitation, are thought to prey on turtle eggs and hatchlings. These problems are apparent in Dhobba (near Shihr) and Ras Sharma, both in the Gulf of Aden. Consumption of turtle meat, oil and eggs is widespread in the Red Sea and Gulf of Aden, including Socotra (IUCN, 1987; UNDP/GEF, 1996).

Navigation and Maritime Risks

Owing to their unique location, the waters of Yemen contain major shipping routes. About 16,000 ships pass through Strait of Bab-al-Mandab each year and many call at Yemen's main ports (Aden Port Development, 1996). Although Yemen controls the Bab-al-Mandab, it does not benefit financially from the passing ships. The Red Sea and Gulf of Aden have been designated a Special Sea Area, making any kind of dumping strictly illegal under international regulations, yet ships continue to dump their wastes in Yemeni waters. Dirty ballast waters lead to formation of tar balls that have been found throughout the coastline of the Gulf of Aden (EU and MFW, 1995) and some parts of the Red Sea coast (Rushdi and others, 1991). Up to 200 tarballs per 10 meter transect were recorded at Bandar, east of Aden. Additionally, solid waste from ship based sources may be found on beaches. The threat of a major accident involving one of the thousands of oil tankers passing through Yemeni waters every year is very real and could result in serious habitat destruction and oil pollution. Main ports lack reception facilities (see above). In addition, there is limited contingency planning and sensitive areas have not been mapped.

Petroleum Development and Transport

There are three oil export terminals: one on the Red Sea coast at Ras Isa, and two on the Gulf of Aden coast (Bir Ali and Shihr). Export pipelines extend several kilometers offshore. Oil companies operating these terminals have produced baseline biological studies for Ras Isa and Shihr (Canadian Occidental, 1993). In addition, they prepared local contingency plans and developed minor oil spill response capacity. Nevertheless, the risk of small operational spills during loading is highly possible. Current daily bunker supplies in the Port of Aden are around 40,000 metric tons. Poor maintenance has resulted in low level, locally significant leaks from bunkering facilities into the port. One bunker barge sank in 1995, causing considerable localized oil pollution in the Tawahi area (Aden Port Development, 1996), the impact of which is still evident: a thick layer of oil covers the intertidal and lower supralittoral zones of the area. In 1995, the Aden Refinery unloaded 4.9 million metric tons of crude oil and loaded 4.2 million metric tons of refined products for transport by sea. The oily water resulting from the refining process is separated, and the effluent water discharged into Khor Ghadir.

Industrial and Urban Development

Wastewater from the main coastal cities and industries is discharged directly into

the sea. In the large coastal cities, only about 30-40 percent are served by public sewage networks. In Aden there is little sewage treatment and raw organic matter is discharged directly to the sea. Many outfall pipes are corroded or broken. The Aden discharge point is located near the port and the smell of sewage is widespread in the area, especially during the northeast-monsoon. Problems of bacterial contamination are apparent (EU and MFW, 1995). In al-Hudaydah, wastewater is carried to a series of stabilizing ponds and eventually discharged into the sea. Water in these ponds is monitored monthly for physical parameters such as conductivity, pH and total solids. No tests for nutrients or microbes at the discharge point are being carried out. In Mukalla and the smaller towns, sewage is discharged directlly to the sea without treatment. Power stations at Mokha, Ras Katheeb and Hiswa (Aden) discharge saline high-temperature water directly into the sea, raising the temperature of the surrounding waters, the effect of which has not yet been quantified.

Expansion of urban areas and unplanned and uncontrolled construction place considerable pressure on coastal and marine environments.

Non-biodegradable hospital and industrial wastes including lubricants are often disposed of near the shoreline and pollution is likely to occur through underground seepage. In addition, tin cans, broken glass, plastic bags, nets and many other items can be found in waters near fishing harbors and coastal villages along the coast. Waterborne human litter was recorded at 63 percent of sites investigated along the Gulf of Aden coast (EU and MFW, 1995)

OTHER CONCERNS

The use of fertilizers and pesticides to increase agricultural production is widespread throughout the country. Agricultural runoff containing these substances eventually ends up in the sea. Increasing sediment load from soil erosion, sand dune encroachment and desertification may affect coral reef communities, especially along the Tihama coast of the Red Sea.

Table 8: Threats to Coastal and Marine Environment and Resources

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Habitat Destruction					
Coastal development and reclamation	Dredging and filling, destruction of coral reefs, loss of productive lagoons	Urban, industrial and port development, expansion of coastal population	Inadequate environmental planning, lack of ICZM, limited use of environmental assessment	Localized, above all in vicinity of large settlements	Severe
Mangrove destruction	Deterioration of mangrove habitat, decreased fish and shrimp catches, reduced water quality	Grazing by camels, wood collection, decreased freshwater supply,	Lack of regulations and management, lack of awareness, lack of alternative fuel and affordable building materials	Localized but widespread	Low to moderate
Damage to coral reefs	Loss of coral habitat and decline in reef associated fauna, coral breakage	Anchor damage, ship grounding, damage by fishing nets, trampling of shallow reef flats, collecting of marine souvenirs	Poor navigational control systems, lack of moorings, destructive fishing methods, lack of enforcement, lack of awareness	Localized	Moderate
Living Marine Resources					
Potential overfishing of pelagic and demersal fish stocks	Decline in landings, decrease in average size	Increased fishing efforts, landing beyond Maximum Sustainable Yield	Lack of stock assessment and reliable statistics that hampers management	Throughout the area, above all in Gulf of Aden	Severe

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Potential overfishing of shark resources	Decline in landings	Increasing fishing effort, use of nets in shark fisheries, high profits	Lack of surveillance and enforcement of regulations	Throughout the area	Severe
Potential overfishing of lobsters	60% decline in annual catches over past two years, decrease in average size	Increased fishing effort, illegal lobster fisheries	Lack of stock assessment hampers resource management, inadequate enforcement capacity	Mahra, Hadhramaut and Socotra	Severe
Potential overfishing of shrimps	Decline in landings	Increased fishing efforts in limited areas, illegal shrimp fisheries	Lack of stock assessment that hampers resource management, lack of enforcement	Red Sea coast	Moderate to severe
Overfishing of cuttlefish for export markets	Sharp decline in landings, population breakdown	Fishing efforts far beyond MSY, destructive fishing methods	Lack of stock assessment that hampers resource management, lack of monitoring and enforcement	Gulf of Aden including Socotra area	Very severe
Capture of turtles and collection of turtle eggs	Decrease in nesting populations, carapaces on the beach	Need for subsidiary food supply	Lack of public awareness, lack of alternative food sources, lack of enforcement	Throughout the area	Moderate
Navigation and Maritime Risks					
Navigation risks	Extensive and routine risks of ship collisions and grounding	Limited navigational devices and poorly separated traffic	Navigational hazards, heavy maritime traffic	Red Sea coast, especially Bab-al-Mandab area	Moderate to severe
Marine vessel sewage	Localized marine and beach pollution	Discharge from ships	Inadequate onboard treatment, lack of port reception facilities	Throughout the area	Moderate
Ship discharge of solid waste	Solid waste on shoreline, in mangrove areas and coral reefs	Discharge of solid waste from ships	Inadequate disposal facilities, inadequate surveillance and enforcement, lack of port reception facilities	Throughout the area	Moderate
Petroleum Development and Transport					
Small oil spills (< 20 mt)	Beach contamination, damage to coastal and marine biota	Tanker cleaning, discharge of ballast and bilge water, discharge of waste oil, bunker oil spill	Lack of reception facilities at ports, inadequate control, lack of enforcement	Localized, near ports and terminals throughout the area	Moderate
Medium oil spills (20-100 mt)	Beach contamination, damage to coastal and marine biota	Discharge from terminals, small accidents at sea	Inadequate control and monitoring of procedures, equipment and personnel, inadequate training	Localized, near ports and terminals throughout the area	Moderate to severe
Large oil spills and disasters (> 100 mt)	Destruction of coastal and marine habitats and biota, devastation of beaches	Rupture of oil tanks in collision or wreckage	Insufficient tanker safety specifications, inadequate navigation aids	Localized, throughout the area	Severe
Industrial Activities					
Surface and groundwater use	Excessive exploitation of surface and groundwater for industrial use	Excessive pumping, inadequate concern for water conservation	Poor regulation of water exploitation	Localized in industrial areas, emerging issue in free zone	Moderate

Issue	Symptoms / Impacts	Immediate Causes	Root Causes	Extent	Severity
Industrial pollution	Decline in water quality	Chronic release of pollutants	Lack of regulations and enforcement, inadequate technology	Localized, emerging issue in free zone	Currently low to moderate
Waste oil disposal	Soil and groundwater pollution	Improper disposal of used motor oil	Lack of proper oil disposal and recovery options, lack of effective regulations and enforcement	Localized	Currently low
Urban Development					
Surface and groundwater	Excessive exploitation of surface and groundwater for municipal use, saltwater intrusion into coastal aquifers	Excessive pumping of groundwater	Allocation of water resources with inadequate concern for water conservation, inadequate maintenance of distribution systems	Localized	Moderate
Discharge of untreated or insufficiently treated sewage	Groundwater impacts, eutrophication and alteration of marine environment, threats to public health	Insufficient capacity of sewage treatment plants, lack of maintenance of existing plants and discharge pipes	Inadequate pollution control regulations, monitoring and enforcement	Localized, urban areas	Moderate to locally severe
Disposal of solid waste	Damage to coastal and marine life, deterioration of aesthetics	Improper garbage disposal	Lack of adequate waste disposal regulations and enforcement, lack of a waste management system, inadequate public awareness	Localized	Moderate to locally severe
Other Concerns					
Sedimentation from agriculture and grazing	Destruction of vegetation cover, resulting in mobilization of dunes and sand sheets, smothering of coral reefs	Grazing by livestock, fuelwood collection	Inadequate management of coastal grazing	Localized	Low
Use of pesticides and fertilizers in the coastal zone	Contamination of soils and water, presence of pesticides in marine organisms	Large-scale use of pesticides and fertilizers for agricultural purposes	Inadequate planning and surveillance in use of pesticides, lack of control and awareness	Localized	Low

Recent, Current and Planned Environmental Initiatives

The National Environmental Action Plan (NEAP) was completed in 1996 following two workshops with participants from various government agencies and nongovernmental organizations. In the first workshop, priority issues and problems pertaining to the environment were identified and priority actions were defined during the second one. Of the approximately twenty actions, five are particularly relevant to the marine environment:

- Development and implementation of a mangrove management programme involving protected mangrove reserves, regulatory mechanisms and identification of alternative sources of fuel.
- Development and implementation of a master plan for conservation and sustainable development of Socotra Archipelago.
- Preparation and implementation of a coastal zone management plan.
- Strengthening the capacity of GTA, GIA and the Free Zone Authority for environmental management.

- Development and establishment of a system of representative Marine Protected Areas with effectively implemented management plans.

The USD2.9 million GEF-funded Project for Protection of Marine Ecosystems of the Red Sea began in 1996 with the overall objective of increasing national capacity for the sustainable use of marine resources of the Red Sea, especially with regard to fisheries and coral reefs. It is conducting coastal surveys, identifying potential sites for protection, and establishing monitoring stations and programmes for the Red Sea coast of Yemen.

The EU Fourth Fisheries Development Project for the Gulf of Aden is funded by the European Union and the World Bank. It is currently assessing fish stocks and recommending monitoring, control and surveillance methods, reporting on the coastal environment of the Gulf of Aden and Socotra Island, supporting improvement of fishing vessel construction and providing further significant support to fishing communities in the eastern part of the Gulf of Aden.

A Turtle Management Proposal has recently been developed by the MSRRC, but funding has not yet been secured. The work is divided into two phases. First, a survey and assessment of current turtle populations, critical habitats and nesting sites, analysis of socio-economic importance of turtles for coastal populations, and a feasibility study for the protection and monitoring of sea turtles. This will be followed by implementation of protection measures and monitoring programmes.

A Project for the Conservation and Sustainable Use of Biodiversity of Socotra Archipelago was recently approved. The total budget is estimated at about USD13 million, to be co-financed by the Government of Yemen, GEF, several UN organizations and the British Government. The project objective is to conserve the indigenous and globally significant biodiversity of Socotra Archipelago through promotion of sustainable use of biodiversity and establishment of a zoning system. The project emphasizes the importance of Socotran marine resources (UNDP/GEF, 1996).

The Norwegian Government has provided funds for a study of the current environmental standards of Yemeni ports. The objective of the project is to assess the current situation in four sea harbors (al-Hudaydah, Mukalla, Aden and Mokha) with regard to facilities for, treatment and disposal of hazardous, toxic and other wastes. Quantity, type and costs of equipment needed for improvement is being identified.

A full list of environmental initiatives including budgets is given in Table 9.

Priority Actions

Based on the above information, the following priority actions for the Republic of Yemen have been identified (see also Table 10):

- Development of rules, regulations and human resources to implement the existing Maritime Law and the Law for the Protection of the Marine Environment from Pollution.
- Finalization and implementation of environmental assessment procedures and guidelines.
- Development and implementation of a protected area law.
- Strengthening of the institutional capacity of the Environmental Protection Council to coordinate and monitor activities affecting the marine environment.
- Strengthening of the capacity of the Public Corporation for Maritime Affairs to enable it to carry out its duties in protecting the marine environment from pollution, and ensuring shipping safety, including Port and Flag State duties.

Table 9: Recent, Current and Planned Environmental Initiatives, Programmes and Projects

Programme / Project	Period	Budget (USD million)	Implementing Agency
Bilateral Cooperation between Djibouti and Yemen for use of reception facility at Port of Djibouti	1996-ongoing	Tbd	EPC, PCMA
Development of National Biodiversity Strategy, Action Plan and National Report to CBD	1997-98	0.29	UNDP/GEF
EC/IFAD Fisheries Development Project	1996-98	39.0	EC, World Bank, Government
Protection of Marine Ecosystems of the Red Sea Coast	1996-99	2.8	GEF and Government
Conservation and Sustainable Use of Biodiversity of the Socotra Archipelago	1997-2001	4.9	GEF and Government
Agricultural and Environmental Management for the Tihama Region	1997-2001	30.0	IFAD
Conservation and Management of Turtles	proposed	Tbd	
Assessment of Yemeni Ports	1996	0.12	World Bank, Ports Authorities, PCMA
Purchase of three boats for surveillance	proposed	Tbd	PCMA
Global Environment Facility Grant: Coastal Zone Management TF -23492	2000-20003	0.75	World Bank
Global Environment Facility Grant: Protected Areas Management TF -23491	2000-2003	0.75	World Bank

- Strengthening of institutional capacity for enforcement of environmental and fisheries regulations.
- Development and implementation of a mangrove management programme, involving protected mangrove reserves, regulatory mechanisms and provision of alternative sources of building materials and fuel.
- Development and implementation of a master plan for conservation and sustainable development of the Socotra Archipelago.
- Preparation and implementation of a coastal zone management plan.
- Strengthening the capacity of GTA, GIA and the Free Zone Authority for environmental management.
- Development and establishment of a system of Marine Protected Areas with effectively implemented management plans.
- Design and execution of inventory surveys, habitat mapping and sensitivity analyses of the entire coastline including distribution of rare and endangered species.
- Development and implementation of a turtle conservation programme, involving protection of nesting and feeding sites, monitoring of nesting activities and public awareness programmes.
- Stock assessment and management programme for finfish (including shark), cuttlefish, shellfish and sea cucumbers.
- Improvement of navigational aids and radio communication in Yemeni waters, especially along major shipping lanes.
- Review of current navigation charts, conduct hydrographic re–surveys and prepare updated charts for key areas along shipping routes and in vicinity of key ports.

- Development and implementation of an Oil Spill Contingency Plan, in the framework of the MEMAC in Djibouti.
- Establishment of a framework for the development and operation of the Aden Free Zone in an environmentally sound manner.
- Development and implementation of a port reception facilities plan.
- Upgrading of wastewater collection and treatment in coastal areas, including Aden, al-Hudaydah and Mukalla.
- Upgrading of solid waste management and disposal in coastal areas, including Aden, al-Hudaydah and Mukalla.
- Development of a database for biological resources and environmental information and establishment of a monitoring programme to support operations and enforcement activities.
- Development of training programmes for marine resource surveys, monitoring and management, and GIS applications.
- Design and implementation of a programme to evaluate potential impacts from agricultural chemicals on the Tihama coastal zone.
- Promotion of broad based participation of NGOs in environmental protection activities.

Table 10: Priority Actions

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Legislation	Development of rules and human resources to implement the Maritime Law and the Law for Protection of the Marine Environment from Pollution	National	Legislative framework	***
Legislation	Finalization and implementation of environmental assessment procedures and guidelines	National	Legislative framework	***
Legislation	Development and implementation of a protected area law	National Local	Legislative framework	**
Institutional strengthening	Strengthening of the institutional capability of the Environment Protection Council to coordinate and monitor activities affecting the marine environment	National Local	Capacity building Management information Enforcement	***
Institutional strengthening	Strengthening of the Public Corporation for Maritime Affairs to enable it to protect the marine environment from pollution and promote the safety of shipping, including Port and Flag State duties	National Local	Capacity building Management information Enforcement	***
Institutional strengthening	Strengthening of institutional capacity for enforcement of environmental and fisheries regulations	National	Capacity building Enforcement	***
Environmental management	Development and implementation of a mangrove management programme involving protected mangrove reserves, regulatory mechanisms and identification of alternative sources of fuel	National Local	Legal framework Management information Management programme	***
Environmental management	Development and implementation of a master plan for conservation and sustainable development of Socotra Archipelago	National Local	Legal framework Management information Management programme Technical development	***
Environmental management	Preparation and implementation of a Coastal Zone Management Plan	National	Management information Management programme Capacity building	***
Environmental management	Strengthening the capacity of GTA, GIA and the Free Zone Authority for environmental management	National Local	Management programme Capacity building	**

Environmental Issue	Priority Action	Scale	Emphasis	Urgency
Environmental management	Development and establishment of a system of representative Marine Protected Areas with effectively implemented management plans	National Local	Legal framework Management information Management programme	**
Habitat conservation	Design and execution of inventory surveys, habitat mapping and sensitivity analyses of the entire coastline, including distribution of rare and endangered species	National Local	Management information Capacity building	**
Living marine resources	Development and implementation of a turtle conservation programme, involving protection of nesting sites, monitoring of nesting turtles and public awareness	National Local	Management information Management programme Public awareness Enforcement	***
Living marine resources	Stock assessment and management programme for finfish (including cuttlefish and sharks), shellfish and sea cucumbers	National	Management information Management programme Public awareness	***
Navigation risk	Improvement of navigational aids and radio communication in Yemeni waters, especially along major shipping lanes	National	Capacity building Technical development	***
Navigation risk	Review of current navigation charts, conduct of hydrographic re–surveys and preparation of updated charts for key areas along shipping routes and in vicinity of key ports	Regional National Local	Capacity building Technical development Management information	***
Petroleum development and transport	Development and implementation of Oil Spill Contingency Plan, in the framework of the Marine Emergency Mutual Aid Center (MEMAC) in Djibouti	National Local	Capacity building Technical development	***
Industrial development	Establishment of framework for development and operation of the Aden Free Zone in an environmentally sound manner	National Local	Environmental studies Capacity building Technical development	***
Industrial development	Development and implementation of a port reception facilities plan	National Local	Technical studies Capacity building Technical development	**
Urban development	Upgrading of wastewater collection and treatment in coastal areas, including Aden, Hudaydah, and Mukalla	Local	Feasibility studies Capacity building Technical development	**
Urban development	Upgrading of solid waste management and disposal in coastal areas, including Aden, Hudaydah, and Mukalla	Local	Feasibility studies Capacity building Technical development	**
Applied research	Development of database for biological resources and environmental information and establishment of a monitoring programme to support operations and enforcement activities	National	Management information	***
Applied research	Development of training programmes for marine resource surveys, monitoring and management, and geographic information systems applications	National	Management information Capacity building	**
Applied research	Design and implementation of programme to evaluate potential impacts from agricultural chemicals on the Tihama coastal zone	Local	Management information Management programme	*
Public participation	Promotion of broad–based participation of nongovernmental organizations	National Local	Public awareness	*

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Abréviations

ACPM	Association de Coopératives des Pêches Maritimes
BaDAP	Base de Données d'Aménagement de Pêche
CITES	Convention sur le commerce international des espèces de faune et de flore sauvages menacées d'extinction
CNE	Comité National pour l'Environnement
DATE	Direction de l'Aménagement du Territoire et de l'Environnement
DAM	Direction des Affaires Maritimes
DEP	Direction de l'Elevage et des Pêches
EDD	Électricité de Djibouti
FAO	Organisation des Nations Unies pour l'alimentation et l'agriculture
FEM	Fonds pour l'environnement mondial
FD	Franc djiboutien
FIDA	Fonds international de développement agricole
GTZ	Gesellschaft für technische Zusammenarbeit (Office allemand de la coopération technique
ISERST	Institut Supérieur d'Etudes et de Recherches Scientifiques et Techniques
MCTT	Ministère du Commerce, du Tourisme et du Transport
MEN	Ministère de l'Éducation Nationale
MPAM	Ministère du Port et des Affaires Maritimes
MSY	Maximum Sustainable Yield (rendement équilibré maximal)
MTT	Ministère des Transports et des Télécommunications
ONTA	Office National du Tourisme et de l'Artisanat
PAID	Port Autonome International de Djibouti
PAS	Programme d'action stratégique (pour la mer Rouge et le Golfe d'Aden)
PERSGA	Organisation régionale pour la conservation de l'environnement de la mer Rouge et du golfe d'Aden
PIB	Produit intérieur brut
PNB	Produit national brut
PNUD	Programme des Nations Unies pour le développement
PNUE	Programme des Nations Unies pour l'environnement
TJB	Tonneau de jauge brute

Rapport de pays

République de Djibouti

Contexte

La mer Rouge et le golfe d'Aden constituent un écosystème tropical marin complexe et unique au monde, possédant une extraordinaire diversité biologique et un degré d'endémisme remarquablement élevé. Cette étroite masse d'eau, partagée par des États côtiers divers, est également une voie de navigation importante qui relie les grands océans du monde. Si de vastes zones de la région sont toujours intouchées, des menaces pour l'environne-ment, résultant notamment de la destruction des habitats, de la surexploitation et de la pollution, augmentent rapidement, ce qui nécessite des mesures immédiates en vue de protéger l'environne-ment côtier et marin de la région. À cette fin, l'élaboration d'un Programme d'action stratégique (PAS), produit d'un processus continu de consultation et de coopération entre les États riverains, est coordonné par l'Organisation régionale pour la conservation de l'environnement de la mer Rouge et du golfe d'Aden (PERSGA). Le PAS constitue une démarche programmatique visant à l'élaboration de projets d'environnement régionaux à base nationale, établis en relation avec les initiatives en cours ayant trait aux mers régionales et aux grands projets dans le domaine des eaux internationales et bénéficiant des relations établies. Il assurera l'application de mesures concertées aux problèmes transfrontières, et l'obtention d'avantages régionaux et mondiaux. Le PAS a été établi par un Groupe de travail qui réunit des représentants des États membres de la PERSGA, de la Banque islamique de développement, du Programme des Nations Unies pour le développement (PNUD), du Programme des Nations Unies pour l'environnement (PNUE) et de la Banque mondiale. Un appui financier a été fourni par les pays de la région, le Fonds pour l'environnement mondial (FEM) et divers organismes donateurs. Le présent rapport de pays contient des informations documentaires sur le processus du PAS à l'échelon national. Il est fondé sur des renseignements provenant de publications et de rapports, dont la liste figure en fin du présent document, et sur une évaluation rapide effectuée par les auteurs du rapport.

Introduction

Djibouti, à la jonction de la mer Rouge et du golfe d'Aden, a une superficie terrestre de 23 200 km^2 et une façade maritime d'environ 370 km. La côte nord, entre la frontière de l'Érythrée et Ras Bir, fait face au détroit de Bab el-Mandeb de faible largeur. Cette côte aux eaux généralement peu profondes est sablonneuse, ponctuée

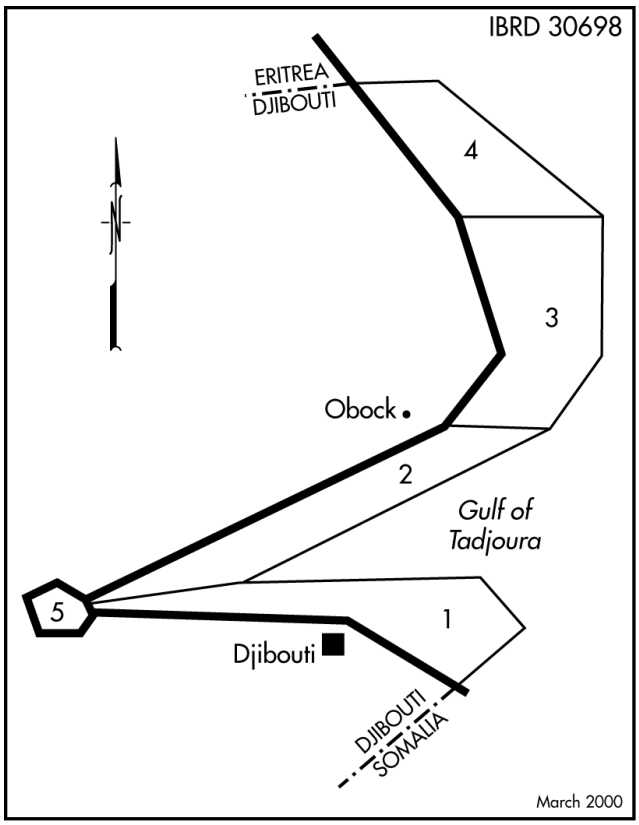

Figure 1. Présentation schématique de la définition des secteurs du plateau continental
Le secteur 1 correspond à la rive sud du golfe de Tadjoura.
Le secteur 2 correspond à la rive nord du golfe de Tadjoura.
Le secteur 3 s'étend du nord du secteur 2, jusqu'au Cap Ras Siyan.
Le secteur 4 s'étend du nord du secteur 3, jusqu'à la frontière avec l'Érythrée.
Le secteur 5 correspond à la région du Ghoubet el-Kharab.
(D'après Künzel et al. 1996).

de quelques formations rocheuses telles que le cap Ras Siyyan et Kadda Gueini; elle possède deux grands estuaires, à Khor Angar et à Godoriya, bordés par des mangroves. Sur une plate-forme rocheuse en eaux peu profondes, à l'est du cap Ras Siyan se trouve l'archipel des Sawabi (Sept Frères), entouré de récifs coralliens. La majeure partie des côtes de Djibouti longe l'étroit golfe de Tadjoura, fosse d'orientation est-ouest d'une profondeur maximum de 883 m (Laughton et al. 1970). Un détroit resserré et de faible profondeur le sépare du bassin semi-fermé de Ghoubet el-Kharab, qui présente des taux de salinité élevés et des récifs coralliens à faible diversité spécifique. Le bassin du Ghoubet a une profondeur de 200 m. Le golfe de Tadjoura et le bassin de Ghoubet el-Kharab sont tous deux bordés de montagnes et de falaises, avec de temps à autre des plages de sable et de galets. À l'entrée du golfe de Tadjoura, au nord de la ville de Djibouti, un vaste plateau de récifs forme l'assise des îles de Musha et de Maskali, qui sont entourées d'importantes formations coralliennes. La côte du sud-est entre la capitale et Loyada à la frontière somalienne a des eaux de faible profondeur; cette côte sablonneuse possède plusieurs estuaries (voir la carte du pays à la fin du volume). Elle se trouve dans une zone de remontée d'eaux riches en nutriments où les récifs coralliens sont peu développés. L'espace maritime national s'étend sur une superficie d'environ 7190 km^2 dont 2563 km^2 appartenant au plateau continental, d'une largeur moyenne de 8 km, relativement large dans le nord et le sud mais plutôt étroit dans le golfe de Tadjoura. Du point de vue halieutique, le plateau continental se divise en cinq secteurs ainsi qu'il est indiqué à la figure 1 (Künzel et al. 1996). Sur la majeure partie de la côte, la pente continentale est généralement abrupte et descend à des profondeurs de plusieurs centaines de mètres. Il n'existe pas de cours d'eau permanent qui se jette dans la mer, mais un certain nombre de wadis apportent de grandes quantités d'eau douce après les pluies torrentielles.

Djibouti est située dans une zone chaude et semi-aride. La température de l'air moyenne varie de 25 /C en hiver à 35 /C en été. Les précipitations annuelles sont de 50 mm à 215 mm, la moyenne s'établissant à 130 mm. Le régime hydrographique est influencé par la mousson.

Durant les mois d'été, les vents du nord dominent. À cette époque de l'année, la mousson du sud-ouest produit un déplacement des eaux superficielles du golfe d'Aden dans le golfe Arabe et celles-ci sont remplacées par les eaux provenant de la mer Rouge. D'octobre à mai, la mousson s'oriente dans une direction nord-est ce qui a pour effet d'inverser la direction des eaux superficielles. Pendant la majeure partie de l'année, le taux de salinité des eaux de surface est d'environ 36,5 ppt., mais lorsque les eaux superficielles sortent vers la mer Rouge, il peut atteindre 38 à 39 ppt. (Edwards 1987). La température moyenne des eaux superficielles varie de 25 /C à 29 /C. En mars, on relève la présence d'un thermocline à des profondeurs de 60 à 85 m. En été, le thermocline remonte et cette remontée est suivie d'une augmentation explosive de la productivité primaire. La turbidité relativement élevée limite généralement la croissance des coraux dans la zone des 15 à 25 m, encore qu'il ait été fait état de coraux à plus de 35 m de profondeur.[1]

En 1993, la population de la République de Djibouti a été estimée à 557 000 habitants dont 75 % vit dans la capitale, Djibouti. Le taux de croissance démographique moyen est de 4,9 %. La communauté des expatriés varie de 10 000 à 15 000 personnes. Hormis la capitale, deux autres villes sont implantées sur le littoral, à savoir Tadjoura et Obock. Cinquante et un pour cent de la population a moins de 20 ans et l'espérance de vie moyenne est de 49 ans. Le produit national brut (PNB) de 1993 était de 448 millions de dollars EU; en 1991 le produit intérieur brut (PIB) était de 67 078 millions de FD (soit 379 millions de dollars EU). En raison de la situation écologique du Sahel saharien, les ressources renouvelables n'ont qu'une importance minime dans l'économie locale. L'agriculture, l'élevage et la pêche ne rapportent que de 2,2 à 2,4 % du revenu national. Avec des revenus annuels moyens d'environ 15 millions de dollars EU, le port international de Djibouti apporte une contribution significative à l'économie nationale. Le tourisme côtier et marin en est encore à ses tout premiers stades de développement.

Ressources marines et économie

Les principaux secteurs économiques de la zone littorale sont les transports maritimes et les activités portuaires. Les pêcheries et le tourisme ont un rôle limité, bien que la pêche de subsistance soit importante au niveau local. Le potentiel de ces deux derniers secteurs n'est pas exploité à son maximum.

RESSOURCES BIOLOGIQUES

Il y a actuellement quelque 90 bateaux de pêche artisanale en activité dans les eaux djiboutiennes (Künzel 1996). Ce sont pour la plupart de petites embarcations non pontées de 6 à 8 m de long, propulsées par un moteur hors-bord et employant un équipage de 3 hommes. Environ 15 % des bateaux sont équipés d'un moteur intérieur; ils ont, eux, de 10 à 14 m de long et un équipage de cinq hommes. Les petits bateaux sortent pour la journée tandis que les plus grands partent généralement en mer pour quatre jours. Le nombre de départs de bateaux varie selon la saison : le maximum se situe au mois de mai avec 438 départs et le minimum est de 187 départs en février. On note généralement l'absence de pêcheurs professionnels, la plupart des pêcheries fonctionnant au niveau de la subsistance et l'effort de pêche étant relativement bas.

La plupart des pêcheurs pêchent à la ligne et emploient à un moindre degré le filet maillant et l'épervier. La pêche de la langouste, pratiquée par plongée en apnée, est d'une importance mineure. Les prises consistent presque exclusivement de gros poissons comestibles qui sont vendus à bon prix dans les marchés. Le poisson se vend frais et il n'existe pratiquement pas

1 Pour une description actualisée de la situation et des impacts sur les récifs coralliens et les habitats associés pour Djibouti, voir Wilkinson, 2000, pp. 35-54.

d'industrie de traitement quelle qu'elle soit. Il semblerait que le secteur des pêcheries emploie, selon les estimations, entre 1000 à 1500 personnes. Environ 75 % de toutes les prises sont amenées à terre à Boulaos, à proximité de la capitale. Il existe quelques autres lieux de débarquements de moindre importance : Escale (5 %), Tadjoura (5 %) et Obock (10 %). Le point de débarquement du Club Nautique est réservé exclusivement à la pêche sportive, qui ramène 3 % des prises totales. Les 2 % restants sont consommés par les pêcheurs eux-mêmes. Un nouveau système de collecte des apports des pêcheurs a été mis en place dans les années 80. Au cours de cette période, 90 % des pêcheurs débarquaient leurs prises dans l'enceinte de l'Association coopérative des pêches maritimes (ACPM). Les principales espèces exploitées sont le mérou, *Epinephelus chlorostigma* (23 %), le thazard, *Scomberomorus commerson* (14 %), la dorade, *Lethrinus lentjan* (13 %), l'antak, *Pristipomoides* sp. (12 %), la bonite *Katsuwonus pelamis* (5 %) et la carangue, *Carangoides bajad* (4 %). Les autres espèces sont de moindre importance. L'ancien système de collecte des données de statistiques n'était plus représentatif lorsqu'un grand nombre de pêcheurs ont abandonné l'enceinte de débarquement de l'ACPM (voir plus bas).

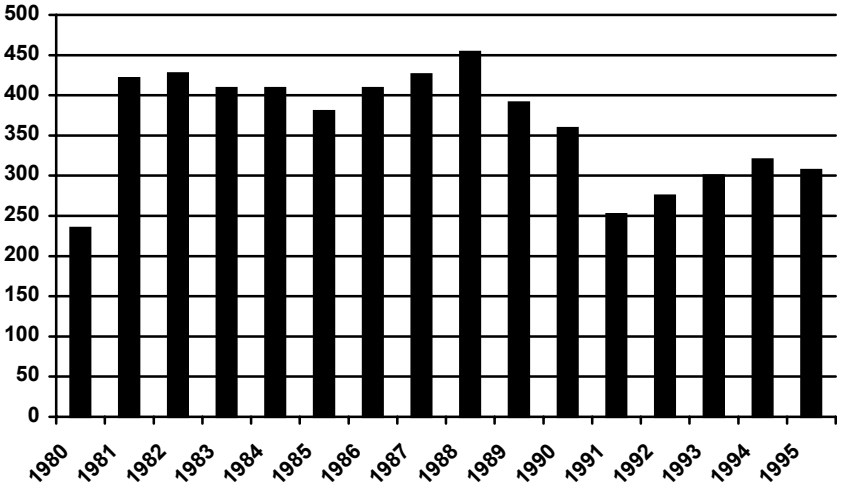

Figure 2. Estimation de la production nationale de poisson entre 1980 et 1995, en tonnes *(Sources : 1980-1984 débarquements à l'ACPM; 1985-1994 FAO 1994; 1995 Künzel et al. 1996).*

Un nouveau système a été mis en place par le projet de la GTZ. Des bascules ont été installées aux principaux points de débarquement à des fins statistiques.

La production nationale de poisson est passée de 235 tonnes en 1980 à 409 tonnes en 1984 et à 454 tonnes en 1988. De 1988 à 1991, cet accroissement s'est ralenti. La faiblesse de la structure de commercialisation des produits poissonniers produisit un goulet d'étranglement pour l'ensemble du secteur. En 1991-1994, la production a accusé une chute considérable; en 1991, elle était revenue à 252 tonnes (figure 2). Les troubles dans le nord du pays durant cette période sont la raison de cet état de choses. La production mensuelle atteint des pics en mai, juin et septembre. Durant la période quinquennale 1986-1990, alors que la production était relativement stable, la plus forte production a été enregistrée en mai (44 522 kg) et la plus faible en février (25 110 kg).

Les principales espèces vivant dans les eaux djiboutiennes ont fait l'objet de plusieurs études (FAO 1984, Bouhlel 1988,

Abbes 1989, Beurier 1992, Darar 1996). La plus récente et de loin la plus vaste d'entre elles a été effectuée dans le cadre d'un projet intitulé "Evaluation des ressources halieutiques et des rendements exploitables à Djibouti", financé par la République fédérale d'Allemagne et mis en oeuvre conjointement par la Direction de l'Elevage et des Pêches et par l'Office allemand de coopération technique (GTZ). Quelque 192 espèces de poissons ont été recensées au total au cours de ce projet qui a procédé à des estimations de la biomasse (tableau 1) et du taux de capture optimal des espèces de l'ichtyofaune commercialement exploitables dans les zones du plateau continental de Djibouti. Les données ont été utilisées pour déterminer les taux d'exploitation optimaux des ressources halieutiques en plaçant la production annuelle à des niveaux qui favorisent une bioproductivité maximale du stock ichtyologique (tableau 2).

Après des opérations de chalutage expérimentales, il a été établi que la biomasse annuelle moyenne pour les poissons démersaux était de 28 000 tonnes. Ceci se traduit par une production annuelle potentielle de 15 000 tonnes. Toutefois, 10 000 tonnes sont les espèces des familles des Leiognathidae (sapsaps) et des Balistidae (balistes), pratiquement sans intérêt économique. Pour les espèces importantes du point de vue économique, les prélèvements annuels pourraient être portés du niveau actuel qui est de 200 tonnes à environ 1300 tonnes (tableau 3). On relève des différences significatives de répartition spatiale des espèces démersales : le secteur 1 est essentiellement habité par des petits démersaux, dont 67 % de Leiognathidae. Les secteurs 3 et 4 sont dominés par les grands démersaux, dont 50 % ont une valeur commerciale, le reste étant constitué de Balistidae.

Les stocks de petits poissons pélagiques ont été estimés sur la base des résultats d'une croisière du RV Fridtjof Nansen dans le golfe d'Aden en 1981. Les évaluations des grandes espèces pélagiques ont été réalisées d'après des prélèvements effectués par la FAO sur le plateau continental de la Somalie, du Yémen et d'Oman. La biomasse des petites espèces pélagiques, qui comprennent des espèces alimentaires importantes et notamment la sardine (*Sardinella longiceps*), l'anchois (*Thryssa baelama*) et le maquereau (*Scomber japonicus*), est d'environ 56 000 tonnes. Les stocks de grands poissons pélagiques sont estimés à 18 à 19 000 tonnes, les espèces les plus importantes étant le thazard (*Scomberomorus commerson*), le thon (*Thunnus tonggol*) et le barracuda (*Sphyraena* spp.). Selon des estimations prudentes, la production potentielle annuelle de poissons pélagiques se situerait aux alentours de 32 000 tonnes, dont environ 4600 tonnes d'espèces importantes sur le plan commercial. Le poisson voilier de l'Indo-Pacifique *Istiophorus platypterus*, dont la longueur peut dépasser 3 m, est commun dans la région. Il n'est pas exploité par les pêcheurs artisanaux mais est particulièrement recherché par les amateurs de pêche sportive.

Ces données permettront à la République de Djibouti de bien gérer les pêcheries et de tirer parti de ces ressources pour répondre aux besoins nutritionnels et économiques du pays. Une augmentation des efforts de pêche, tant en qualité qu'en quantité, sera nécessaire, et notamment une augmentation du nombre de bateaux de pêche assortie de l'utilisation de moyens techniques plus perfectionnés. Il conviendra toutefois de maintenir l'interdiction actuelle du chalutage. On trouvera au tableau 3 des données sur le plan de développement pour la période 1996-2000, au cours de laquelle les prises annuelles de grands démersaux et de grands pélagiques pourraient passer de 400 à 4500 tonnes.

Tableau 1 : Sommaire des biomasses des ressources démersales du plateau continental djiboutien (en tonnes)

Groupes de démersaux	Secteur 1	Secteur 2	Secteur 3	Secteur 4	Secteur 5	Secteur 6
Petits démersaux I	1860	375	865	195	450	3744
Petits démersaux II (Leiognathidae)	8566	50	6	3	0	8625
Grands démersaux I	515	225	3897	2197	206	7039
Grands démersaux II (Balistidae)	186	66	2249	1222	0	3724
Raies et requins	475	337	634	279	106	1832
Autres démersaux	1307	844	618	297	63	3129
Total secteur	12 909	1897	8269	4193	825	28 093

Tableau 2 : Production maximale soutenue (Yopt) des ressources halieutiques de Djibouti, calculée à partir des biomasses et de la mortalité naturelle (M)
(Sources: Künzel et al. 1996; Anon. 1981; Sanders & Morgan 1989)

Groupes de démersaux et de pélagiques	Biomasse (Binf, en tonnes)	M (par an)	Yopt (en tonnes)
Petits démersaux I	3744	1,0	1872
Petits démersaux II (Leiognathidae)	8625	2,0	8625
Grands démersaux I	7039	0,5	1760
Grands démersaux II (Balistidae)	3724	1,0	1862
Autres démersaux	3129	0,7	1095
Total des démersaux	**26 261**		**15 214**
Petits pélagiques	56 000	1,0	28 000
Grands pélagiques	18 500	0,5	4625
Total des pélagiques	**74 500**		**32 625**
TOTAL	**100 761**		**47 839**

Tableau 3 : Plan de développement 1996 à 2000. Résumé de la production annuelle (en tonnes) envisagée pour l'exploitation des ressources démersales et pélagiques

			Plan de développement 1996-2000		
Ressources de pêche	Potentiel maximal soutenu	1995: Production actuelle de la pêche artisanale	Production envisagée pour la consommation alimentaire	Production envisagée pour l'exportation	Production totale
Grands démersaux	1800±30 %	200	500	800	1300
Grands pélagiques	4600±30 %	200	500	2700	3200
Total		400	1000	3500	4500

Boulhel (1986) estime le taux de capture optimal de requins à 70 tonnes et celui des langoustes à 10 tonnes. Les crevettes, les crabes, les huîtres et les céphalopodes font l'objet d'une exploitation sporadique tandis que divers mollusques, les holothuries et les algues sont actuellement inexploités.

Barratt et Medley (1988) ont effectué des recherches sur la possibilité d'exploiter les poissons d'aquarium tropicaux à Djibouti et ont conclu qu'il existait un marché important pour les poissons de bonne qualité de la mer Rouge et de l'océan Indien occidental. Les États-Unis, Hong-Kong, le Japon, l'Allemagne et divers autres pays

européens ont été identifiés comme les principaux marchés d'exportation. Une autorisation d'exploitation a été délivrée en 1992 à une entreprise privée en dépit de l'inexistence d'un cadre juridique réglementant cette forme de pêche. Avec l'aide des collecteurs sri-lankais, il semblerait que cet exploitant prélève chaque semaine 150 à 300 poissons d'aquarium aux fins d'une exportation à destination du Japon et des États-Unis. Il est difficile d'évaluer à l'heure actuelle les effets de cette collecte des poissons d'aquarium sur l'écosystème corallien.

Organisation technique et socio-économique du secteur des pêcheries

Les seules activités de pêche traditionnellement pratiquées à Djibouti relevaient de la stricte subsistance. L'exécution du Programme de développement de la pêche artisanale, lancé en 1980, a apporté une croissance substantielle à ce secteur. Avant 1980, il n'y avait que 50 pêcheurs, pour la plupart d'origine yéménite, qui utilisaient des embarcations en bois de 4 à 6 m de longueur et d'une capacité de charge très limitée. Ces embarcations non motorisées ne leur permettaient que de se maintenir au seuil de subsistance.

Dans le cadre du Programme de développement de la pêche artisanale, les pêcheurs ont été dotés de matériel de pêche, de moteurs hors-bord et d'embarcations en fibre de verre. Dix ans après l'achèvement du programme, c'est-à-dire en 1990, on enregistrait une augmentation significative du nombre de pêcheurs en activité. Cependant l'âge moyen des pêcheurs, patrons et marins confondus varie dans une fourchette de 40 à 55 ans et le rajeunissement des opérateurs de production constitue une nécessité pour le développement du secteur. À cet effet, dans le cadre d'un projet du FIDA, un Centre de formation des pêcheurs professionnels a été créé en 1991. Malheureusement, force est de constater que des facteurs externes au secteur ont entravé le bon déroulement de la formation. A l'heure actuelle un Programme de réhabilitation des zones touchées par les événements est en cours, aux fins d'une relance des activités des zones de pêche situées au nord du pays.

La majorité des pêcheurs fréquentent les mêmes zones de pêche et leurs déplacements sont très limités. Cependant, on observe l'influence relative de la mousson d'hiver sur le déplacement des pêcheurs pourvus de grandes embarcations. Ces derniers exploitent durant la période de novembre à mars les eaux jouxtant la frontière somalienne. Mais il est à noter que quelles que soient les zones fréquentées ou leurs sites natifs, ils débarquent 90 % de leurs prises à Djibouti-ville. Cela est dû à l'inexistence des marchés des autres villes côtières du pays.

À Djibouti, les pêcheurs n'ont pas de possibilités d'emplois de substitution. Cette situation est attribuable à la mentalité conservatrice de cette communauté d'une part et au manque de possibilités offertes par le secteur agricole d'autre part. La pêche est donc leur seule activité. Les pêcheurs ne bénéficient pas de crédits formels. Le crédit informel, par le biais des mareyeurs ou de leur famille, constitue une source de financement possible. Leur stratégie est guidée par des facteurs économiques, c'est-à-dire des espèces qui se vendent sur le marché national. Malheureusement les espèces prisées par les consommateurs djiboutiens se limitent à 3 espèces, à savoir le thazard (espèce saisonnière), la dorade et la carangue. En ce qui concerne leurs revenus, les chiffres varient selon le nombre de sorties de chaque pêcheur et de son statut social c'est-à-dire s'il est propriétaire du bateau ou membre de l'équipage.

On a relevé une légère augmentation des revenus chez les pêcheurs qui ont bénéficié de l'assistance du Programme, mais aucun pêcheur ne disposait un livre de compte d'exploitation. C'est à partir des chiffres obtenus verbalement qu'il a été possible d'établir le tableau 4. Tous les pêcheurs interrogés sur leurs conditions so-

Tableau 4 : Tableau comparatif des pêches de deux types de bateaux
(les sorties en mer des bateaux de 7 et de 10 m sont respectivement d'une journée et de 4 jours)

	Bateau de 7 m	Bateau de 10 m
Frais de carburant	6000 FD	6800 FD
Frais de glace	1000 FD	4000 FD
Frais de nourriture	3666 FD	12000 FD
Poids total pêché	300 kg	950 kg
Valeur totale de la pêche	45 000 FD	142 000 FD
Valeur nette de la pêche	35 334 FD	119 700 FD

ciales expriment clairement le désir de bénéficier d'une couverture sociale et d'un régime de retraite.

Les autres opérateurs du secteur sont les mareyeurs et les revendeurs. Il est à noter que ces opérateurs n'ont obtenu aucune assistance du Programme et que la faiblesse de la chaîne de commercialisation qui en résulte a été un obstacle majeur ces dernières années au développement du secteur. Depuis 1989, citons l'accroissement progressif de l'effectif des femmes djiboutiennes dans la commercialisation du poisson. Leurs activités sont axées à la vente du poisson frais dans les quartiers déshérités.

L'Association coopérative des pêches maritimes (ACPM) avait pour fonctions principales la commercialisation du poisson ainsi que la vente de la glace et du carburant aux pêcheurs (Bjoerklund & Walter-Dahnert, 1983). Elle était considérée comme un organisme d'État et était gérée par des fonctionnaires. À l'heure où nous rédigeons le présent rapport, l'ACPM n'existe plus et les activités de commercialisation de la pêcherie de Boulaos ont été confiées à un opérateur privé.

RESSOURCES NON BIOLOGIQUES

Citons dans cette rubrique le sable marin de la zone supralittorale ainsi que le sel et les saumures du Lac Assal qui sont exploitables théoriquement. Il n'existe pas d'activités de prospection, ni du gaz ni du pétrole, dans l'espace maritime national de Djibouti.

TRANSPORTS MARITIMES

Les transports maritimes sont un secteur d'activité majeur à Djibouti. Depuis la réouverture du canal de Suez, les activités du port de Djibouti ont connu un développement considérable. Le port est doté d'installations de manutention de conteneurs sur deux postes, d'une longueur de quai totale de 400 m avec une profondeur à quai de 12 m, qui ont traité 65 000 TEU en 1993 et 100 000 TEU en 1996. Outre le service conteneurisé, les activités portuaires concernent l'importation et l'exportation de marchandises, le trafic de navires-citernes d'hydrocarbures et le transbordement. Ces dix dernières années, les autorités portuaires ont entrepris d'importants programmes d'investisse-ment visant à renforcer les infrastructures afin d'accroître la compétitivité du port de Djibouti. Le port accueille des navires en provenance directe d'Europe et d'Extrême-Orient. Les conteneurs de Djibouti sont transbordés à destination de la mer Rouge méridionale, du golfe d'Aden et de l'Afrique de l'Est. Une ligne ferroviaire de 780 km relie Djibouti à Addis-Ababa et le trafic de marchandises éthiopien transite par Djibouti. Les recettes du Port autonome international de Djibouti se chiffrent annuellement entre 14 124 300 et 16 949 200 dollars EU, ce qui représente une importante contribution à l'économie nationale. On trouvera au tableau 5 des données plus détaillées sur les transports maritimes dans les eaux djiboutiennes.

TOURISME COTIER ET MARIN

Le tourisme marin est encore à l'état embryonnaire en République de Djibouti, même si dans le passé certains touristes européens venaient pendant la période d'octobre à mars pour effectuer des plongées sous-marines aux Iles de Sept Frères. Sa contribution à l'économie nationale est insignifiante. L'Office national du tourisme et de l'artisanat met en location une

Tableau 5 : Ensemble des touchées de navires au PAID entre 1991 et 1994

Catégorie de navire	1991		1992		1993		1994	
	No	TJN	No	TJN	No	TJN	No	TJN
Conventionnel	325	2 709 415	333	2 650 801	311	1 941 289	309	2 236 970
Polyvalents	13	196 493	5	66 973	1	9 844	0	0
Porte-conteneurs	171	1 861 018	248	2 914 677	320	3 736 546	275	3 486 208
Roro	130	1 832 360	76	998 645	69	721 767	61	639568
Porte-barges	17	445 864	11	285 861	17	430 238	14	372 937
Vraquier	1	30 249	0	0	0	0	0	0
Pétrolier	98	2 186 154	78	1 301 509	82	1 142 841	85	1 241 985
Butanier	42	368 052	38	326 446	4	31 098	4	30 629
Navires à passagers	8	60 747	10	79 806	9	83 234	17	101 596
Pêche	68	54 466	68	69 403	68	47 612	74	36 890
Navires de guerre	224	700 544	136	594 186	98	393 955	92	511 385
Autres	67	113 550	90	206 220	68	141 694	45	53 137
Caboteurs	44	20 383	30	13 926	21	10 629	27	12 440
Total	**1 208**	**10 579 295**	**1 123**	**9.508.453**	**1.068**	**8.690.747**	**1003**	**8.723.745**

soixantaine de cabanons et le secteur privé assure le transport des touristes. Les récifs situés à proximité de la capitale subissent des visites fréquentes de la part de touristes locaux, pour la plupart membres de la communauté des expatriés. Les activités de ces touristes ne sont soumises à aucun contrôle et les pressions imposées aux récifs sont particulièrement élevées.

Cadre juridique et institutionnel

Consciente de l'importance de protéger l'environnement marin et de lutter contre toutes les formes de pollution, la République de Djibouti a adhéré à un certain nombre de conventions internationales, et notamment les suivantes :

- La Convention de Londres de 1954 (modifiée), rendue applicable par la loi 64/83 du 25 août 1983, portant approbation des quatre conventions internationales concernant la navigation maritime.
- La Convention de Londres de 1971 sur le fonds international d'indemnisation (approuvée par la loi 94/AN/89 2/ L du 7 novembre 1989).
- La Convention de Londres de 1973, modifiée en 1978, et ses quatre annexes (approuvée par la loi 94/AN/89 2/ L du 7 novembre 1989).
- La Convention de Bruxelles de 1969 sur l'intervention en haute mer (approuvée par la loi 94/AN/89 2/ L du 7 novembre 1989.
- La Convention des Nations Unies sur le droit de la mer (approuvée par la loi du 11 juin 1985).
- La Convention de Bamako sur l'interdiction d'importer des déchets dangereux et le contrôle de leurs mouvements transfrontières en Afrique (1991).
- La Convention sur la diversité biologique (1992)
- La Convention sur le commerce international des espèces de faune et de flore sauvages menacées d'extinction (1992).
- La Convention-cadre des Nations Unies sur les changements climatiques (1992).

Au niveau régional, il convient de mentionner l'accord tripartite, signé par Djibouti le 27 mars 1990, entre le Yémen, Djibouti et la Somalie, relatif à l'établissement d'un centre sous-régional de lutte contre la pollution dans le golfe d'Aden. Les installations d'intervention sont basées à Djibouti et des négociations bilatérales sont actuellement en cours entre le Yémen et la République de Djibouti concernant l'utilisation du matériel. Par ailleurs, le 20 janvier 1986, la République de Djibouti et la Somalie ont signé un accord bilatéral de pêche.

Outre la loi d'orientation économique et sociale de 1990 à 2000 (loi 150/AN/91 2/ L du 10 février 1991) et le plan d'orientation des projets de développement économique et social de 1991 à 1995 (loi 207/AN/92 2/ L du 14 mai 1992) qui mettent en évidence la volonté du Gouvernement d'inscrire la protection de l'environnement au nombre de ses priorités, la République de Djibouti s'est dotée d'une panoplie de textes régissant l'exploitation et la protection du milieu marin.

La législation actuelle concernant les pêcheries a été adoptée avant l'indépendance, à l'exception de certaines dispositions générales utiles mais insuffisantes, qui font partie du Code d'administration maritime. Il s'agit, entre autres, des articles 148, 149 et 220 à 225 promulgués par la loi 212/AN/82, et des articles 16 à 19 de la loi 52/AN/78 du 18 janvier 1979. Ces diverses dispositions interdisent l'usage de certaines techniques de pêche, telles que les explosifs et les substances toxiques. Elles définissent les conditions de l'exploitation des ressources halieutiques, notamment les zones de pêche et les saisons, et prévoient des sanctions en cas d'infractions commises par les pêcheurs.

Un projet de Code des Pêches, relatif toutes les activités de la pêche, ainsi qu'un projet de textes réglementant l'exploitation des poissons récifaux ont été élaborés par le Service des Pêches en vue d'une gestion durable des ressources halieutiques.

La réglementation nationale visant la protection de l'environnement marin comprend des dispositions ayant trait à la pollution marine, à la protection des espèces menacées et à la création d'aires protégées. Au nombre des textes prévoyant la protection et la lutte contre la pollution du milieu marin figurent (tableau 6):

- La loi 76-599 du 7 juillet 1976, promulguée par l'arrêté 675/SELAG du 21 juillet 1976, relative à la pollution par les navires et les aéronefs ainsi qu'à la pollution marine accidentelle.
- La loi 76-600 du 7 juillet 1976, promulguée par l'arrêté 676/SELAG du 21 juillet 1976, relative à la pollution provoquée par les opérations d'incinération.
- La loi 52/AN/78 du 9 janvier 1979 concernant la mer territoriale, la zone contiguë, la zone économique exclusive, les frontière maritimes et l'excise de la pêche.
- Les lois 9/AN/82 du 15 septembre 1982 et 137/AN/85 1/L du 27 juillet 1985, relatives à la pollution par les hydrocarbures.
- La loi 64/AN/83/1ère L du 25 août 1983 portant approbation de quatre conventions internationales concernant la navigation maritime.
- La loi 137/AN/85/1ère L du 27 juin 1985 portant répression des rejets interdits d'hydrocarbures par des navires battant pavillon djiboutien en dehors des eaux territoriales.

Tableau 6 : Textes réglementaires nationaux ayant trait aux ressources et aux environnements côtiers et marins

Texte réglementaire	Année d'entrée en vigueur	Institution concernée
Arrêté 72-1363/SG/CG établissant le Parc territorial de Musha	1972	DAM
Loi 76-599 sur la pollution provenant des navires	1976	DAM
Loi 76-600 sur la pollution causée par la combustion	1976	DAM
Ordonnance 77-038/PR sur l'immatriculation des bateaux de plaisance	1977	DAM
Loi 52/AN/78 article 16-19, réglementation des pêcheries	1979	DAM
Décret 80-062/PR/MCTT sur la protection de la faune et des fonds sous-marins, établissement de la Réserve intégrale des Iles de Maskali Sud	1980	MCTT
Loi 9/AN/82 sur la pollution par les hydrocarbures	1982	DAM
Loi 212/AN/82, réglementation des pêcheries	1982	DAM
Loi 64/AN/83 portant approbation de 4 conventions internationales sur la navigation maritime	1983	DAM
Loi 137/AN/85 sur la pollution par les hydrocarbures	1985	DAM
Règlement 84-0969/PR/PM sur la sécurité de la navigation de plaisance	1984	DAM
Décret 85/103/PR/AG sur les aires marines protégées	1985	DAM
Ordonnance 86-042PR/PM réglementant les abandons de vaisseaux	1986	DAM
Règlement 86/0717/PR/MCTT sur les huttes de camping sur les plages et les îles	1986	ONTA
Décret 88-013/PR/PM sur l'organisation et coordination des actions de l'État en Mer	1988	DAM
Loi 65/AN/89 sur l'interdiction d'importer des déchets toxiques, radioactifs ou polluants	1989	DAM
Décret 89-085/PR/PM sur le passage des vaisseaux étrangers	1989	DAM
Loi 94/AN/89 sur l'adhésion à quatre conventions internationales sur la pollution des eaux maritimes	1989	DAM
Décret 90-0105PR/AE "Plan Polmer" en cas de pollution marine accidentelle	1990	DAM
Décret 89-085/PR/AE sur les interventions en cas de déversement d'hydrocarbures	1990	DAM
Arrêté 90-0534/MPAM réglementant la navigation en vue de prévenir les pollutions marines accidentelles	1990	DAM
Règlement 90-0534/MPAM sur le passage des vaisseaux étrangers	1990	DAM
Décret 91-018/PR/MPAM sur la création d'une Direction des affaires maritimes	1991	MTT

- L'ordonnance 86-042/PR/PM du 6 mai 1986 portant réglementation des dispositions à prendre en cas d'abandon de navires présentant un danger pour l'environnement marin dans les eaux territoriales.
- Le décret 88-013/PR/PM du 14 février 1988 relatif à l'organisation et à la coordination des actions de l'État en Mer.
- La loi 65/AN/89 2/L du 3 avril 1989 portant interdiction d'importer sur le territoire national des déchets ou résidus industriels toxiques, radioactifs ou polluants.
- La loi 94/AN/89/2/L du 7 novembre 1989 portant approbation de l'adhésion à quatre conventions internationales concernant la pollution des eaux maritimes.
- Le décret 89-085/PR/AE du 29 septembre 1990 concernant la mise en oeuvre d'un plan Polmer en cas de pollution accidentelle résultant d'un déversement d'hydrocarbures.

Tableau 7 : Aires côtières et marines protégées de Djibouti

Aire protégée	Superficie	Année	Principaux habitats et espèces significatives	Gestion	Reconnaissance mondiale
Parc territorial de Musha	ca 10 km2	1972	Récifs coralliens et riche faune piscicole et invertébrée	Minime	Aucune
Réserve intégrale des Iles de Maskali Sud	ca 3 km2	1980	Récifs coralliens et riche faune piscicole et invertébrée associée aux récifs	Minime	Aucune
Iles des Sept Frères et Ras Siyan	Indéterminé	Proposé	Groupe de 6 îlots rocheux et anse avec des mangroves à la jonction entre la mer Rouge et le golfe d'Aden, récifs coralliens et riche faune piscicole et invertébrée, nidification des oiseaux de mer	Aucune	Aucune
Mangrove de Godoriya	Indéterminé	Proposé	Mangrove de grande taille, *Avicennia* et *Rhizophora*, riche faune	Aucune	Aucune

- Le décret 89-085/PR/PM du 29 juin 1989 et l'arrêté 90-0534/MPAM du 11 juin 1990 relatifs au passage des navires étrangers dans les eaux territoriales visant à prévenir la pollution marine et l'introduction de déchets dangereux.
- Le décret 90-0105PR/AE du 29 septembre 1990 relatif au "Plan Polmer" applicable en cas de situation critique provoquée par la pollution marine accidentelle en République de Djibouti.
- L'arrêté 90-0534/MPAM du 11 juin 1990 réglementant la navigation dans les eaux djiboutiennes en vue de prévenir les pollutions marines accidentelles.
- L'arrêté 90-0534/PR du 10 juin 1990 réglementant la navigation dans les eaux djiboutiennes en vue de prévenir les pollutions marines accidentelles.
- Le décret 91-018/PR/MPAM du 10 février 1991 portant création d'une Direction des Affaires maritimes et fixant les attributions respectives de ses services.

S'agissant de la protection des espèces menacées, la République de Djibouti est signataire de la Convention CITES. Le décret 80-62/PR/MCTT du 25 mai 1980 porte sur la protection de la faune et des fonds sous-marins. Sont interdits la capture de mammifères marins et de tortues, le commerce ou l'exportation de ces animaux, le ramassage des oeufs de tortue et la chasse sous-marine.

Les aires protégées se limitent actuellement au Parc territorial de Musha et à la Réserve intégrale de Maskali-Sud (tableau 7). Le Parc de Musha a été établi par l'arrêté 72-1363/SG/CG du 20 septembre 1972 interdisant le ramassage des coraux et des mollusques, puis le décret 80/062/PR/MCTT du 25 mai 1980 est venu étendre la protection à la Réserve de Maskali-Sud, lequel décret a été modifié par le décret 85/103//PR/AG du 28 octobre 1985 qui renforce l'approche conservatrice de ces aires. Seule la pêche artisanale des poissons comestibles est autorisée dans lesdites aires.

La réglementation suivante régit la protection de la zone littorale :

- Règlement 86-0717/PR/MCTT du 14 juin 1986 concernant les déchets résultant des activités de camping sur les îles et les plages.
- Ordonnance 77-038/PR du 8 octobre 1977, imposant l'obligation de l'inscription pour toutes les embarcations de plaisance.
- Règlement 84-0969/PR/PM du 7 juillet 1984 sur la sécurité de la navigation de plaisance et les activités sur les plages.

Les institutions suivantes sont directement concernées par l'utilisation et la gestion des ressources des zones littorales et marines :

- Ministère de l'Agriculture, de l'Élevage et de la Mer :
  - ◊ Direction de l'Élevage et des Pêches (DEP); chargé de la protection de la faune et de la flore marines ainsi que la conservation des fonds sous-marins des eaux djiboutiennes.
- Ministère des Transports et de l'Équipement : Ce ministère a pour attribution la gestion du domaine portuaire, la gestion du PAID, la navigation maritime, la sécurité en mer et la lutte contre la pollution marine par les hydrocarbures. Ce ministère est composé de deux directions :
  - ◊ Direction du Port Autonome International de Djibouti; chargée de la gestion du PAID.
  - ◊ Direction des Affaires Maritimes (DAM); chargée de traiter toutes les questions relatives à la prévention et la répression de toutes les infractions à la législation nationale et internationale concernant la pollution marine, la circulation marine ainsi que la protection des eaux territoriales et de leurs rivages. Une Commission de la faune et de la flore a été établie à la Direction des Affaires maritimes. Elle est chargé de la conservation de la biodiversité marine.
- Ministère de Commerce et du Tourisme:
  - ◊ Office National du Tourisme et de l'Artisanat (ONTA); chargé de la protection des sites et de l'environnement.
- Présidence de la République :
  - ◊ Institut Supérieur d'Etudes et de Recherches Scientifiques et Techniques (ISERST); chargé de la réalisation d'études d'impact sur l'environnement et de la sauvegarde de la faune et des fonds sous-marins.
- Premier Ministre :
  - ◊ Direction de l'Aménagement du Territoire et de l'Environnement (DATE); chargée de l'élaboration de la Politique nationale de l'environnement et de veiller à sa mise en oeuvre notamment l'adoption d'un plan d'action nationale de l'environnement; assure également le Secrétariat du Comité technique pour l'environnement.
- Coordination interministérielle :
  - ◊ Commission pour la protection de la faune et des fonds marins; en vertu d'un décret du 5 mars 1983, cette commission est présidée par le Directeur de l'Administration maritime.
  - ◊ Conseil national de la mer; en vertu d'un décret du 5 juillet, ce conseil est présidé par le Premier ministre.

Menaces pour l'environnement

Un certain nombre de grandes études scientifiques sur l'environnement littoral et l'environnement marin sont en cours. Bien que certaines sections du littoral et des eaux territoriales soient encore essentiellement intouchées par les activités humaines, les quelques études achevées à ce jour révèlent la présence de signes alarmants de dégradation en

plusieurs lieux et d'une aggravation rapide des menaces (tableau 8). Les pressions anthropiques sont particulièrement fortes aux environs de la capitale.

Tableau 8 : Menaces pesant sur les environnements côtiers et marins et les ressources

Problème	Symptômes / Impacts	Causes immédiates	Causes fondamentales	Portée	Gravité
Destruction des habitats :					
Aménagement du littoral	Dragage et remblayage, destruction des récifs coralliens	Développe-ment urbain, industriel et portuaire	Planification environnementale inappropriée Utilisation limitée des évaluations environnementales	Phénomènes localisés près de la capitale	Grave
Destruction des mangroves	Détérioration des habitats des mangroves; réduction des prises de poissons et de crevettes; baisse de qualité de l'eau	Pâturage des chameaux; ramassage de bois	Gestion et sensibilisation insuffisantes; application des règlements insuffisante, manque de combustible de substitution, barrage sur les oueds	Dans la plupart des mangroves, en particulier à proximité de la capitale	Modérée à grave
Dégâts aux récifs coralliens	Perte d'habitats coralliens et diminution de la faune associée aux récifs	Dégâts causés par les ancres, échouements de navires	Dispositifs d'aide à la navigation médiocres, manque de points d'amarrage	Phénomène ponctuel, dans l'ensemble de la région	Faible à modérée
Dégâts aux récifs coralliens causés par les visiteurs	Bris des coraux et diminution de la faune associée aux récifs	Marche sur les coraux en eaux peu profondes, bris de coraux, ramassage de souvenirs, dégâts causés par les ancres	Gestion et application des règlements insuffisantes; manque de sensibilisation à l'environnement	Phénomènes localisés, concernant en particulier les récifs près du port de Djibouti et dans les zones de Musha et Maskali	Modérée à grave
Ressources marines biologiques :					
Risque de surpêche des espèces de tout-gros	Diminution de la taille moyenne	Activités de pêche dépassant le taux de capture optimal, usage de fusils-harpons	Surveillance et application des règlements en vigueur insuffisantes	Phénomène localisés, en particulier dans la région de la capitale et MPA	Grave
Pêche illicite du requin pour le marché étranger des ailerons de requin, par des vaisseaux étrangers	Réduction des stocks de requins. Prises accessoires de tortues, dauphins et poissons à nageoires; endommagement des récifs par les filets.	Activités de pêche accrues, utilisation de filets pour la capture de requins, bénéfices substantiels	Surveillance et application des règlements en vigueur insuffisantes	Ensemble de la région	Grave
Capture de tortues et ramassage de leurs oeufs	Diminution des populations nidificatrices	Besoin de source d'alimentation complémentaire, vente aux restaurants et vente des carapaces de tortues aux touristes	Manque de sensibilisation du public, manque de sources d'alimentation de substitution, application des règlements insuffisante	Ensemble de la région	Grave
Risques maritimes et pour la navigation :					
Risques pour la navigation	Risques de collisions et d'échouement de navires	Aides à la navigation rares et voies de trafic maritime mal délimitées	Dangers complexes pour la navigation, trafic maritime intense	Ensemble de la région, en particulier près du port	Modérée
Effluents de vaisseaux	Pollution localisée du milieu marin et des plages	Rejets des navires	Traitement à bord inadéquat, manque d'installations de réception portuaires	Ensemble de la région	Modérée

Problème	Symptômes / Impacts	Causes immédiates	Causes fondamentales	Portée	Gravité
Rejets de déchets solides des vaisseaux	Déchets solides sur les rivages, dans les mangroves et les récifs coralliens	Rejets de déchets solides des navires	Installation de mise au rebut inadéquates, surveillance et application des règlements inadéquates, manque d'installations de réception portuaires	Ensemble de la région	Modérée
Développement et transport des hydrocarbures :					
Petits déversements (< 20 tonnes)	Contamination des plages; atteintes aux biotes côtiers et marins	Rejets d'eaux usées, eaux de ballastage et eaux de cale, rejets d'huiles usées, déversement des soutes	Manque d'installations de réception portuaires; contrôles inadéquats; application des règlements insuffisante	Problème ponctuel; ensemble de la région	Modérée
Déverse-ment moyens (20-100 tonnes)	Contamination des plages; atteintes aux biotes côtiers et marins	Rejets des terminaux, petits déversements accidentels en mer	Contrôle et surveillance inadéquats des procédures, du matériel et du personnel; formation inadéquate	Problème ponctuel; ensemble de la région	Modérée à grave
Gros déversements et catastrophes potentielles	Destruction des habitations et des biotes côtiers et marins; dévastation des plages	Rupture de réservoirs de navires à la collision ou à l'échouement	Normes de sécurité des navires-citernes insuffisantes; dispositifs d'aide à la navigation insuffisants	Problème ponctuel; ensemble de la région	Grave
Développement urbain :					
Eaux de surface et souterraines	Extraction excessive d'eaux de surface et souterraines pour usages municipaux; intrusions d'eau salée dans les aquifères côtiers	Prélèvements excessifs d'eau souterraine	Allocation des ressources en eau sans préoccupation suffisante pour la conservation; entretien inadéquat des systèmes d'adduction d'eau	Phénomène localisé, région de la capitale	Modérée à grave
Décharges d'effluents non traités ou insuffisamment traités	Impacts sur les eaux souterraines, eutrophisation et altération du milieu marin; dangers pour la santé publique	Insuffisance des stations de traitement, entretien insuffisant des stations en place	Insuffisances des règlements de lutte contre la pollution, de la surveillance et de l'application des règlements	Phénomène localisé, région de la capitale	Grave
Mise au rebut de déchets solides	Dégâts aux organismes vivants des milieux côtiers et marins; détérioration esthétique	Mise au rebut des déchets défectueuse	Insuffisances des règlements sur la mise au rebut des déchets et de leur application; manque de système de gestion des déchets efficace; sensibilisation inadéquate du public	Phénomène localisé, région de la capitale	Faible à modérée
Utilisation des eaux de surface et souterraines	Extraction excessive d'eaux de surface et souterraines	Prélèvements excessifs, soucis insuffisants de conservation de l'eau	Mauvaise réglementation de l'exploitation des ressources en eau	Phénomène localisé dans les zones industrielles	Faible à modérée
Mise au rebut des huiles usées	Pollution des sols et des eaux souterraines	Mise au rebut inappropriée d'huile moteur	Manque d'autres options pour la mise au rebut et la récupération des huiles usées; manque de réglementation et d'application efficace des règlements	Phénomène localisé	Faible

DEGRADATION ET DESTRUCTION DES HABITATS

La destruction des habitats résultant de l'aménagement du littoral reste relativement localisée et concerne principalement les alentours de la capitale. L'aménagement et l'expansion des installations portuaires ont imposé de graves pressions aux récifs coralliens.

Les mangroves accusent une détérioration rapide le long d'importants segments du littoral de Djibouti, ce qui se traduit par une baisse de qualité de l'eau et une diminution des prises de poissons et de crevettes. En l'absence de sources d'énergie de remplacement d'un coût abordable, le bois des mangroves est utilisé comme bois de feu. Il est utilisé également comme fourrage par les éleveurs. Plusieurs années de sécheresse ont provoqué un influx de nomades en nombres croissants dans la zone littorale et en certains points, leurs chameaux paissent dans les mangroves. À l'ouest de la capitale, où s'étendait une vaste mangrove, certains peuplements ont été entièrement détruits et les autres sont gravement menacés. Dans cette région, la protection des mangroves doit être considérée comme une question de toute première priorité. Sur les huit aires de mangroves ayant fait l'objet d'une étude récente, deux ont été classées comme étant en bon état, deux autres en bon état mais exploitées par la population locale, une partiellement dégradée, deux dégradées et celle de Gaan Maan gravement dégradée (voir la figure 3 pour plus de détails).

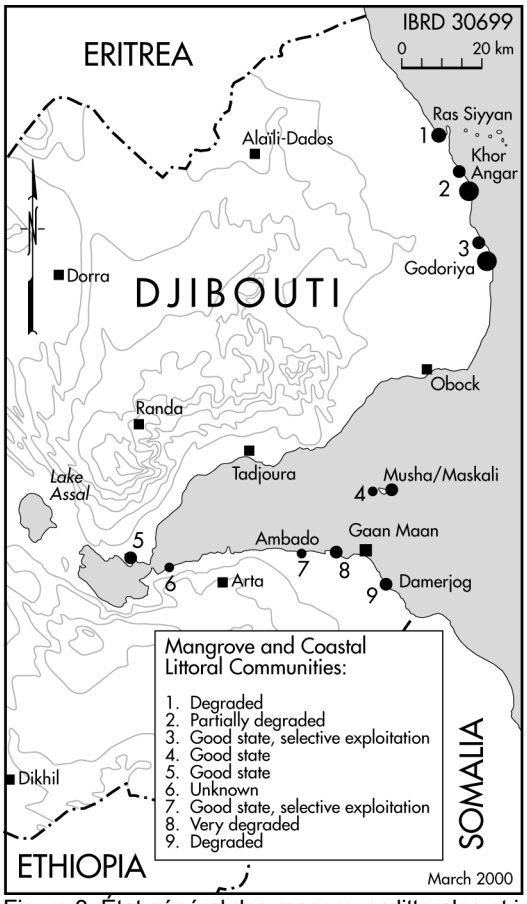

Figure 3. État général des mangroves littorales et insulaires *(Source : Rapport national Environnement, Djibouti 91).*

Les dégâts occasionnés aux récifs coralliens, causant une perte d'habitats et une diminution de la faune corallienne, sont très graves près de la capitale et dans les aires marines protégées de Musha et de Maskali. Les récifs sont moins gravement touchés dans les autres régions. À proximité du port de Djibouti, où ils se développaient autrefois en abondance, ils subissent une dégradation rapide du fait de la turbidité des eaux. Dans les zones de loisirs fréquentées, telles que les réserves de Musha et de Maskali et près de Khor Ambado, les coraux sont gravement endommagés par les visiteurs, essentiellement des expatriés. Les dégâts causés par les ancres de bateaux sont visibles. Le ramassage des coraux et des invertébrés des récifs, de même que la pêche sous-marine au pistolet-harpon, bien qu'illicites, se pratiquent toujours largement. On a fait état de signes de dégradation des récifs dans le détroit de Bab el-Mandeb, où le phénomène est peut-être attribuable à l'intensité de la navigation maritime (voir aussi les remarques de Sheppard & Wells 1988). Kinner (1987) arecensé 23 récifs coralliens dans tout le pays et a évalué leur état écologique; il en a classé neuf en état satisfaisant, tous dans l'ouest du pays, trois comme moyen, quatre comme mauvais et huit comme catastrophique (voir figure 4). Dans certaines formations coralliennes, on a relevé des signes de mort du corail sans raison apparente. Ce phénomène appelle une élucidation d'urgence. Mais il faut signaler qu'une légère pullulation de

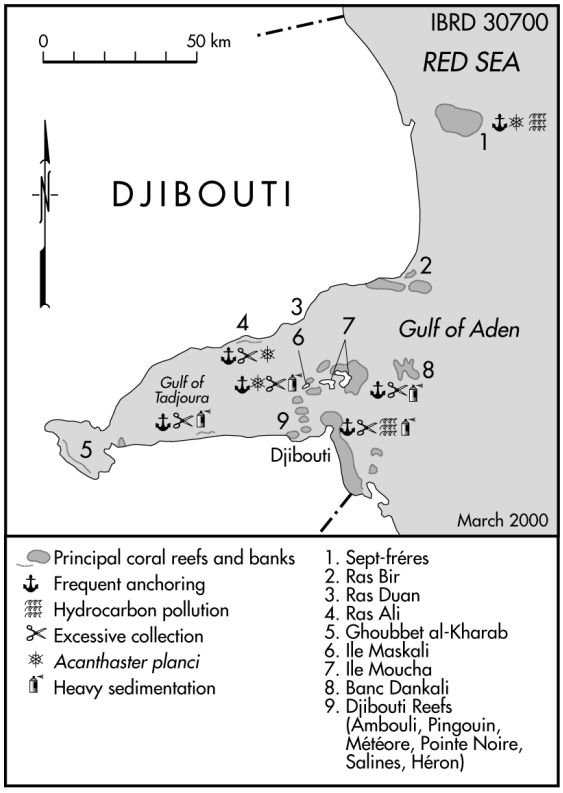

Figure 4. Les récifs coralliens de Djibouti : Situation générale et dégradations ponctuelles identifiées en 1989-90. *(Source : Rapport national Environnement, Djibouti 91).*

l'*Acanthaster planci* aurait été observée en 1992 dans certaines zones.

SUREXPLOITATION DES RESSOURCES BIOLOGIQUES MARINES

Comme il a été noté précédemment, les pêcheries jouent un rôle minime à Djibouti et les ressources biologiques marines sont largement sous-exploitées. Djibouti est le seul pays de la région qui possède des données fiables sur ses stocks ichtyologiques et sur les taux de capture optimaux, ce qui permet une gestion rationnelle des pêcheries. Il existe cependant un certain nombre de régions proches de la capitale dont les ressources sont surexploitées, à savoir notamment les localités de Doralé, Khor-Ambado, Arta Plage et the îles de Musha, Maskali et Waramous. Les pressions que subissent les ressources de ces régions sont le résultat d'importantes activités de pêche sportive et de pêche artisanale. C'est également dans ces régions que la destruction des récifs coralliens est la plus grave (voir ci-dessus).

Les stocks de requins s'épuisent du fait des activités de pêche illicites de pêcheurs étrangers pour le marché étranger des ailerons de requin. Cette pêche se pratique à la ligne ou au filet et endommage les récifs. Les ailerons des requins sont coupés, souvent quand le requin est encore vivant, et la carcasse est rejetée à la mer. Les prises accessoires, notamment de tortues, de dauphins et de divers poissons à nageoires, sont elles aussi rejetées, presque invariablement mortes. On ne connaît pas l'importance de activités de pêche illicite des requins dans les eaux djiboutiennes.

La capture de tortues marines et le ramassage de leurs oeufs, tous deux illicites, sont visiblement communs. La viande, l'huile et les oeufs de tortues sont une source d'aliments complémentaires importante pour les pêcheurs artisanaux de certaines régions et les coquillages sont vendus aux touristes. On note également la présence de cétacés et de dugongs dans les eaux djiboutiennes (Robineau & Rose 1982, 1984), qui sont capturés accidentellement dans les filets des pêcheurs.

RISQUES MARITIMES

Les importantes formations coralliennes situées à l'entrée du port posent des problèmes pour la navigation. Les dangers qu'elles présentent ajoutés à la densité du trafic maritime et au manque de dispositifs d'aide à la navigation ont pour effet d'accroître les risques de collisions et d'échouage de navires. Les rejets d'effluents et de déchets solides des navires représentent une menace supplémentaire. En raison de l'insuffisance des installations de réception des déchets au port, les navires se débarrassent de leurs déchets au large en les jetant à la mer.

IMPACTS DU SECTEUR PETROLIER ET DES TRANSPORTS MARITIMES

Tout le littoral de Djibouti est exposé à une menace constante de pollution d'importance variable par les hydrocarbures. Des fuites peuvent survenir aux terminaux pétroliers

ou aux navires-citernes, ce qui causerait une pollution chronique de la zone intertidale. Compte tenu des courants et des vents dominants, tous les points de la côte sont exposés à cette pollution, du moins à certains moments de l'année. Des agrégats de goudron provenant des navires de passage se déposent sur les plages. La zone du port est tout particulièrement exposée aux déversements: il s'y est produit un déversement de 20 à 25 tonnes en 1980 et deux déversements mineurs de 2 à 3 m^3 en 1981 et en 1985. Les Iles des Sept Frères sont également exposées au danger en raison de la proximité des grandes voies de navigation. On envisage actuellement la construction d'une raffinerie à Doralé/ Saline-Ouest. Si ce projet est mis à exécution, il fera peser une grave menace sur les riches habitats côtiers marins et les biotes de la région. Il y aurait également là un conflit d'intérêts avec le développement du secteur des pêcheries.

IMPACTS DES ACTIVITES INDUSTRIELLES

Les ressources limitées en eau douce et le peu d'attention accordée à la conservation de l'eau et l'entretien des systèmes de distribution affectent les réserves d'eaux de surface et souterraines. La nappe profonde alimentant la ville de Djibouti est en état de surexploitation et ceci engendre à des intrusions d'eau salée dans les aquifères côtiers. En zone aride où les pénuries d'eau douce sont constantes, de tels problèmes sont graves. Les quelques activités industrielles du pays sont centrées dans la région de la capitale et les rejets chroniques de leurs polluants dont la plupart arrivent à la mer sans être traités produisent une baisse de qualité de l'eau. Cet état de choses est attribuable principalement à la vétusté des équipements et des techniques et à la non application des règlements en vigueur. Ces problèmes sont, pour l'instant, localisés.

IMPACTS DU SECTEUR URBAIN (ASSAINISSEMENT ET ORDURES MENAGERES)

À l'heure actuelle, seule une station d'épuration des eaux usées est opérationnelle, les autres sont en arrêt. Les rejets d'effluents non traités ou insuffisamment traités provenant des ménages, du secteur industriel, des abattoirs et des établissements hospitaliers causent une pollution chronique. On relève également une pollution permanente provenant des déversements des collecteurs d'eaux pluviales, des effluents des installations de production d'électricité, de l'industrie pétrolière, et des décharges des camions de vidange des fosses septiques directement dans la mer. Ces activités ont des risques pour les ressources en eaux; elles altèrent le milieu marin et présentent de graves menaces pour la santé humaine. Les déchets solides qui sont déversés sur le littoral marin nuisent ainsi au biotope côtier et affectent également l'esthétique du rivage. La principale cause du problème est le manque d'installations et de systèmes efficaces de ramassage et de traitement des déchets. Le manque de sensibilisation du public vient aggraver la situation. De plus il n'existe aucun traitement de lexiviats de la décharge d'ordures ménagères de Douda. À Djibouti, ces problèmes sont essentiellement circonscrits dans la région de la capitale.

Initiatives environnementales récentes, en cours et planifiées

Le nombre d'initiatives environnementales mises en oeuvre à Djibouti est plutôt limité. On trouvera les principales d'entre elles résumées au tableau 9 :

- En 1990, un plan d'urgence sous-regional pour le golfe d'Aden a été formulé (Anon. 1990). Un centre d'intervention et d'aide mutuelle en cas de déversement d'hydrocarbures a été établi pour Djibouti, le Yémen et la Somalie.
- En 1992, l'Administration maritime a émis des règles concernant la gestion des aires marines protégées, comportant entre autres une stricte réglementation des espèces associées aux récifs.

Tableau 9: Initiatives, programmes et projets en cours ou planifiés dans le domaine de l'environnement

Programme / Projet	Période	Budget (en M de $EU)	Organisme d'exécution
Plan prévisionnel sous-régional pour le golfe d'Aden	1990		DAM
Établissement d'un centre sous-régional d'aide mutuelle pour l'intervention en cas de déversement d'hydrocarbures pour Djibouti, le Yémen et la Somalie	1990	702	DAM
Élaboration de règlements sur les aires marines protégées	1992	20	MAH, FAO et GTZ
Élaboration de règlements sur l'exploitation des espèces associées aux récifs coralliens	1992	20	MAH, FAO et GTZ
Élaboration de règlements des activités des pêcheries	1994		MAH
Adhésion à la Convention sur la diversité biologique	1996		MAH
Séminaire sur la gestion de l'environnement et le développement durable	1993-96	20	PNUD
Projet d'évaluation des ressources halieutiques et des quantités pêchables	1993-1996	200	MAH et GTZ
Plan d'Action National de l'Environnement	1997	442	DAE et PNUD
Éducation et sensibilisation à l'environnement	1997		MEN
Stratégie Nationale pour la Diversité Biologique	1997-1998	560	GFM

- De nouvelles dispositions réglementaires applicables aux pêcheries ont été adoptées en 1994 en vue d'assurer le développement durable des ressources ichtyologiques.
- En 1996, Djibouti est devenu signataire de la Convention sur la diversité biologique.
- De 1993 à 1996, le PNUD a organisé une série de séminaires sur la gestion de l'environnement et le développement durable.
- De 1993 à 1996, la DEP en collaboration avec la GTZ a réalisé un projet d'évaluation des ressources halieutiques et des quantités pêchables à Djibouti.
- En septembre 1996 la DATE a élaboré le Plan d'Action National de l'Environnement.
- En 1997-1998 une Stratégie Nationale de Biodiversité sera élaboré par le GFM.
- Le Ministère de l'Éducation Nationale projette d'intégrer une composante "Education et sensibilisation à l'environnement" dans les programmes scolaires primaire et secondaire. Un séminaire de sensibilisation sera organisé en septembre 1997, ainsi que l'élaboration d'un guide d'éducation à l'environnement.

Mesures prioritaires

Les mesures prioritaires identifiées à mettre en oeuvre à Djibouti sont résumées comme suit (voir tableau 10) :

- Il est urgent de formuler et d'adopter un Plan national de gestion intégrée du littoral. Les institutions ayant compétence en matière de gestion des ressources côtières et marines et les organismes

d'application des lois doivent être renforcés.

- Il est recommandé de lancer une initiative visant à la réhabilitation des récifs coralliens et des mangroves dégradés. Il conviendrait de formuler un programme de surveillance, de protection et de gestion de ces biotopes.
- Un programme de gestion des aires marines protégées existantes (Parc Territorial de Musha, Réserve Intégrale de Maskali-Sud) devrait être élaboré. Il conviendrait de procéder à une étude de faisabilité concernant la conservation et la gestion d'aires marines protégées supplémentaires, qui comprendraient entre autres les Iles des Sept Frères, la pointe de Ras Bir et la mangrove de Godoriya; et l'intégration de l'archipel des Sept Frères dans le Programme de l'Homme et la Biosphère de l'UNESCO.
- La gestion et la conservation des ressources biologiques marines entres autres les poissons des récifs, et les tortues marines sont d'une importance primordiale pour Djibouti. Les habitats marins de ces populations doivent être étudiés et faire l'objet d'une surveillance régulière. À cette fin, il est recommandé d'établir un département de biologie marine et d'assurer la formation des Djiboutiens dans ce domaine.
- Plan régional d'intervention contre la pollution des hydrocarbures dans le Golfe d'Aden: Réactivation du centre sous-régional anti-pollution (formation du personnel des parties contractantes au protocole, et programme d'entraînement).
- Il convient d'établir une base de données environnementales contenant des informations sur les ressources biologiques et d'effectuer une étude sur les principaux polluants menaçant les écosystèmes marins djiboutiens.
- Il est recommandé de réviser et renforcer les textes législatifs en vigueur et de renforcer les mécanismes d'application des règlements ayant trait à la gestion des zones et des ressources côtières et marines.
- Un cadre réglementaire et un programme pour les visiteurs des zones récifs coralliens doivent être formulés, y compris des directives et des mouillages pour les bateaux.
- Un plan général des pêcheries devrait être formulé. Ce plan devra également tenir compte des questions de commercialisation.
- Un programme de développement des communautés de pêcheurs devrait être mis en application, y inclus un programme d'élimination de la pauvreté. La surveillance des navires qui empruntent les eaux territoriales de Djibouti, les communications avec ces navires et le système de communication, notamment à Bab el-Mandeb.
- Il est urgent de renforcer les systèmes de recueil et de traitement des eaux usées.

Tableau 10 : Mesures prioritaires

Domaine de l'environnement	Mesure prioritaire	Échelon	Concentration	Urgence
Conservation des habitats	Préparation et application d'un Plan de gestion de la zone littorale	National	Cadre juridique Renforcement des capacités institutionnelles Cadre de planification	**
Conservation des habitats	Réhabilitation des mangroves pour réparer les dégâts causés par le remblayage et le pâturage des chameaux; élaboration et application d'un programme de conservation et de gestion des mangroves	National Local	Cadre juridique Information de gestion Programme de gestion	***
Conservation des habitats	Réhabilitation des récifs coralliens pour réparer les dégâts causés par les visiteurs; élaboration et application d'un programme de protection et de gestion des récifs coralliens	National Local	Cadre juridique Information de gestion Programme de gestion Sensibilisation du public	***
Conservation des habitats	Élaboration et application d'un plan de gestion pour les aires marines protégées existantes (Parc Territorial de Musha, Réserve intégrale de Maskali-Sud)	Local	Cadre juridique Information de gestion Programme de gestion	***
Conservation des habitats	Étude de faisabilité pour le conservation et la gestion d'aires marines protégées supplémentaires (notamment les Iles des Sept Frères, Ras Bir, Mangrove de Godoriya)	National Local	Cadre juridique Information de gestion Développement technique	**
Conservation des habitats	Cadre de développement et programme pour les visiteurs concernant les zones à récifs coralliens, y compris directives pour les embarcations et les mouillages	National Local	Cadre juridique Programme de gestion Développement technique Sensibilisation du public	***
Ressources marines biologiques	Évaluation des stocks ichtyologiques des récifs coralliens, élaboration et application d'un programme de prélèvement de poissons d'aquarium	Local	Information de gestion Programme de gestion	*
Ressources marines biologiques	Élaboration et application d'un programme de protection et de gestion des tortues	National Local	Étude de faisabilité Information de gestion	**
Ressources marines biologiques	Élaboration et application d'un plan de production et de commercialisation des pêcheries, compte tenu des résultats des récentes évaluations des stocks	National	Information de gestion Programme de production	**
Socio-économique	Élaboration et application d'un programme de développement communautaire et d'atténuation de la pauvreté dans les collectivités de pêcheurs	National Local	Études de faisabilité Développement communautaire	***
Risques pour la navigation	Amélioration des marques de navigation, en particulier sur les grandes voies de navigation maritime	National Local	Développement technique	*
Transport d'hydrocarbures	Révision et application du Plan régional d'intervention contre la pollution des hydrocarbures dans le cadre du Centre d'assistance mutuelle du golfe d'Aden	National Local	Renforcement des capacités institutionnelles Développement technique	**
Développement portuaire	Préparation d'une étude de faisabilité et construction d'installation de réception portuaires	Local	Étude de faisabilité Renforcement des capacités institutionnelles Développement technique.	**

Domaine de l'environnement	Mesure prioritaire	Échelon	Concentration	Urgence
Renforcement institutionnel	Établissement d'un département de biologie marine et formation de biologistes de la vie aquatique	National	Renforcement des capacités institutionnelles Développement technique	***
Recherche appliquée	Constitution d'une base de données sur la diversité biologique et l'environnement	National	Information de gestion	***
Législation	Révision des textes législatifs en existence et renforcement de l'application de la législation en matière de gestion des zones littorales et marines	National	Cadre législatif Renforcement des capacités institutionnelles Développement technique	***
Développement urbain	Renforcement des systèmes de recueil et de traitement des eaux usées dans les zones littorales, en particulier dans la ville de Djibouti	Local	Études de faisabilité Renforcement des capacités institutionnelles Développement technique	***
Développement urbain et rural	Renforcement des systèmes de gestion et de mise au rebut des déchets solides, en particulier à proximité de la ville de Djibouti	Local	Études de faisabilité Renforcement des capacités institutionnelles Développement technique	**

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