REGIONAL STATUS OF CORAL REEFS IN THE RED SEA AND THE GULF OF ADEN - MIDDLE EAST- 2000

Nicolas Pilcher[1] & Abdullah Alsuhaibany[2]

[1]Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia Email: nick@tualang.unimas.my
[2]PERSGA, P.O. Box 53662, Jeddah 21583, Saudi Arabia. Email: abdullah.alsuhaibany@persga.org

Executive Summary
The status of coral reefs in Egypt, Sudan, Djibouti, Somalia, Yemen, Saudi Arabia and Jordan are presented. These countries all belong to the Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), which commissioned this report. Corals in this region are primarily found on fringing reefs along the mainland and island coastlines, barrier reefs, pinnacles and atolls. A wide range of other habitats contain corals, including submerged patch reefs, coralline red algal beds, relic reef formation and volcanic rock flows.

In general reef health was considered good, with 30 % to 50 % live coral cover at most locations, and > 50 % total cover on average. Coral bleaching caused extensive die-offs in the Arabian Gulf and the northern - central Red Sea in 1998, and on the Sudanese coasts a red algal film was present over most shallow reefs. Coral diversity and reef-associated fauna was considered among the highest in the Indian Ocean region.

Major threats to coral reefs include landfilling and dredging for coastal expansion; destructive fishing methods; damage by the recreational SCUBA diving industry, shipping and maritime activities, sewage and other pollution discharges; lack of public awareness, and insufficient implementation of legal instruments that affect reef conservation.

A number of international, regional, bilateral and multilateral agreements and other legal instruments have been adopted by the States, and each possesses a relatively complete set of national Laws and Regulations. However, the implementation of these remains generally poor and in some cases there is no implementation and enforcement whatsoever.

For coral reef conservation to improve and be effective in the Region, there is a need for increased public awareness, increased enforcement and implementation of national and international legal instruments, and the implementation of coastal management plans that integrate coastal development, industrial effluents, and tourism with the maintenance of environmental quality in marine habitats.

Egypt

The Arab Republic of Egypt is home to over 1800 km of diverse coral reef habitats along the western Red Sea coast and in the Gulfs of Suez and Aqaba. Until recently the reefs were considered healthy and free of major anthropogenic stresses but recently sedimentation from land reclamation works, oil spills and physical damage from the recreational SCUBA diving industry have taken their toll, and coral cover at many places has dropped by up to 30 %.

Corals accounted for 55 % of reef cover in non-sheltered areas and 85 % of cover in sheltered areas. The percentage of live coral cover was highly variable along the coast, with the highest cover occurring on reef walls and the leading edges of the reefs. Southern reefs housed a greater diversity of fish species than northern reefs, while exposed reefs contained higher diversity of fishes than sheltered reefs. The reefs are under a number of anthropogenic impacts including recreational SCUBA diving practices, oil spills, land reclamation and sedimentation. Natural threats include flooding, disease and predator outbreaks. There are four Marine Protected Areas that include coral reefs, and seven additional areas that have been proposed or suggested to the Government for protected status. Egypt is a signatory to a number of international conventions under which the conservation of coral reef resources is stipulated or indirectly addressed. The country has also enacted a number of laws and presidential decrees through which coral reefs receive direct or indirect protection. To improve the current response to and mitigation of natural and anthropogenic threats, the development of an integrated coastal area management plan, the review and upgrade of existing regulations and more efficient monitoring and control of pollution sources and coastal development are required.

Sudan

The Sudanese Red Sea coast is approximately 750 km long inclusive of bays and inlets, and encompasses three primary coral habitats: barrier reefs, fringing reefs and Sanganeb, an oceanic atoll. The coral reefs are considered to be in moderate to good health, despite recent reports of extensive coverage of algae over a high proportion of the fringing reefs. The reefs are patchy at depths < 10 m, with average live coral cover ranging from 5 to 75 %. Below 10 m, the reefs contain healthy colonies of framework corals. Fish fauna health was considered good, and that overfishing not a severe problem at the coral reefs. Key indicator species were abundant and diversity appeared high relative to other Red Sea sites. The Crown of thorns *Acantaster planci* was not recorded in plague numbers at any of the Sudan reefs. In 1999, bleached corals were estimated to cover 14 % of the substrate. There is one established protected area: Sanganeb Marine National Park. Four other areas have been proposed as protectorates, and await government decisions and implementation. Fisheries play a minor role in the economy, but are important at a subsistence level. Neither commercial nor artisanal landings reach the estimated maximum sustainable yields, and fishery development at present is negligible. The most severe threats to reefs come from maritime shipping and dredging. The tourism sector contributes to damage of reefs by anchor and flipper damage. Sudan has much of the infrastructure needed for regular monitoring and effective management of coral reef resources, but many of the present problems with coral reef conservation are attributed to a lack of law enforcement, a lack of awareness, a weak legal framework, and the absence of surveillance. An integrated coastal management plan which takes into consideration shipping, coastal development, pollution and natural resources, along with effective and enforced implementation, would cater to most of the above.

Djibouti

Djibouti has a coastline of 372 km. The north coast generally shallow and sandy with occasional coral outcrops, and the Sawabi archipelago east of Ras Siyyan is fringed by coral reefs. The southern coast is shallow with poorly developed coral reefs, linked to the cold water upwelling from the Indian Ocean. Moucha and Maskali islands had moderate to good live coral cover (> 30 %). Live coral on the reefs to the north of Moucha and Maskali was moderate to good (25 to 40 % cover). The reefs of Khor Ambado had an average hard coral cover of 52 %. Species diversity of benthic and sessile organisms was low. Coral and other

fauna were relatively rare on the back reef and reef flat. Eastward from Khor Ambado the reef was in moderate to good condition with coral cover within samples of up to 80 %. The status of reefs at Sept Frères was good (cover averaged 34 %), and most parts of the archipelago had balanced and healthy reefs. No significant signs of recent bleaching were recorded on the reef face or reef flat. A total of 166 species of corals were recorded in the 1998. The reefs of Djibouti are under pressure from many anthropogenic sources of impact, primarily tourism and sewage discharges. The major economic sectors in the coastal zone are maritime transport and port-related activities. Man-induced pressure is particularly high in the vicinity of the capital. Fisheries play a limited role, although subsistence fisheries are locally important. Djibouti has two declared marine protected areas, and are two additional areas proposed for protected status, one of which is of regional importance. Several key actions at the national level in the form of legislation and implementation could lessen the risks of ship-based pollution and oil spills. A dedicated research and monitoring programme that fed back into coastal area management plans would contribute greatly to efficient conservation actions.

Somalia

The coastline is naturally divided into north and south sectors, totalling some 3300 km. The north coast is generally shallow with exposed, high energy sandy beaches. The central portion of this consists of shallow, sandy shorelines, and occasional outcrops and cliffs which may extend into the shallow water. There are limited coral reefs near Raas Khansir, Raas Cuuda Siyara, and off El Girdi and west of Berbera. Reefs were shallow (1 - 10 m) and occurred on fossilised rock. The coral communities on the reefs varied considerably in condition. All had been affected by bleaching to some degree. The shallow reefs to the east of Berbera had suffered nearly total mortality. Deeper reefs (2 - 5 m) were in better condition. At the Saardin islands, coral diversity, fish populations and individual fish sizes were large. A total of 69 species of scleractinian coral, 11 species of alcyonacean coral and two species of fire coral were recorded. In general the area is both productive and relatively pristine apart from the effects of coral bleaching and some COTS predation. Somali fishermen target a limited number of demersal stocks and a range of coral reef fish. Fishing is limited and nearly entirely artisanal in nature. On the north coast most commercial operations are carried out by foreign vessels. Three areas have been proposed for protection along the north coast, of which only the Aibat, Saad ad-Din and Saba Wanak area includes coral reefs. The effects of human activity on the environment appear to be minimal, the only exceptions being the relatively heavy, opportunistic exploitation of turtles and sharks. Fisheries and transport are only a small component of the national economy, and are not significant threats to coral reefs. Somalia is a nation caught in a period of political unrest, from which it is slowly emerging. Its ability to effectively implement the stipulations of international agreements are limited, and national legislation is virtually non-existent. The two key requirements for improved conservation of coral reefs are funding and personnel. Conservation of coral reefs is currently given a lower priority than the rebuilding of the nation and the eradication of poverty. There is a need to develop a system of marine protected areas, and for the adoption of oil spill response measures, broad-scale environmental education, and continued research and monitoring for early detection of reef deterioration.

Yemen

The Republic of Yemen lies in the south-western corner of the Arabian Peninsula, and includes the Socotra archipelago. The coastline is about 2200 km long, roughly one third of which is in the Red Sea and the remaining two thirds is in the Gulf of Aden. Several major

projects have recently assessed the distribution, composition and status of living marine resources around much of the Yemen coastline, focusing on the Red Sea coast, the Gulf of Aden and Socotra archipelago. In excess of 250 species of reef building corals and 600 species of reef-associated fishes have been identified on Yemen reefs and coral communities. In particular, coral and fish communities of the Socotra archipelago are extremely diverse. A total of ca. 176 species of stony corals are presently known for the Yemen Red Sea, with richness at individual sites ranging from 1 to 76 spp. At least 19 new records have been identified for the southern Red Sea and further coral specimens await identification. Diversity is lower along the mainland Gulf of Aden coast, which is thought to support some 100 coral species but remains relatively poorly studied. In contrast, the Socotra archipelago supports a diverse fauna of ca. 240 stony coral species, placing it among the richest sites in the western Indian Ocean. Cover of stony corals, dead corals, soft corals and algae were all highly variable among different sites within the Red Sea, Gulf of Aden and Socotra archipelago. Ratios of live : dead coral cover at individual sites were related largely to the differential effects of recent disturbance, notably coral bleaching in 1998. The northern Red Sea had low average live coral cover (17 %), high average dead coral cover (34 %) and high macroalgae cover (20 %). The northern and central Yemen coast and nearshore islands had very low live coral cover (3 %) and very high dead standing coral cover (averaging 34 %). Around the Socotra archipelago, cover of stony corals ranged from < 1 % to > 75 %, and in large patches (ca. 1,000 m^2) attained ca. 100 %. Overall, living stony coral cover averaged ca. 20 % , with highest cover (ca. 35 %) on the outer islands. Bleaching effects in 1998 were patchily distributed around the Socotra archipelago and NE Gulf of Aden. At worst affected sites more than half species were injured and about half of the live coral cover was killed. Only in recent years has the protection of coral reefs been addressed. Coastal development, the petroleum industry and maritime shipping pose a significant risk to reefs in the form of untreated sewage, land filling, and hydrocarbon pollution. Fishing is a traditional profession for thousands of Yemenis. Total annual catches vary between 90,000 and 95,000 mt and more than 90 % of the total fish production is landed by artisanal fishermen. Reef-based fisheries, for the most part, are underdeveloped and at a subsistence level. There is one protected area and six proposed protected areas. Establishment of marine protected areas is a relatively new process, with funding and technical input from IUCN, the Global Environment Facility and PERSGA.

Saudi Arabia

Saudi Arabia's Red Sea coastline extends approximately 1,840 km while the Gulf extends approximately 1072 km. The Gulf coast is much more developed (40 %) than the Red Sea coast, although in some areas along the Red Sea the impact on the marine environment is severe. The presence of most of Saudi Arabia's oilfields in the Gulf has been a significant factor in the development of the region Coral reefs are found fringing the entire length of the Saudi Arabian Red Sea coastline and the offshore islands, and are generally in good condition with the exception of those near Jeddah and Yanbu. There were 194 species of corals recorded in the early 1980s along the Saudi Arabian coast with the greatest diversity in the central portion. In the Arabian Gulf, the reefs mostly appear as small pinnacles or outcrops, and as patch reefs between Ras Al-Mishab Saffaniyah and Abu Ali, and between Abu Ali and Ras Tanura, and as fringing reefs around the offshore islands. Bleachng caused mass coral mortality in the central-northern Saudi Arabian Red Sea in late 1998. Bleaching was patchily distributed and highly variable in intensity. The most intense bleaching occurred near Rabigh, where > 65 % of total coral cover was bleached or recently dead. Significant levels of coral mortality were observed along the south Red Sea, where at some sites live coral cover

declined from 80 % in 1993 to about 10 % in 1999. In the Arabian Gulf, the average live coral cover was 33 %. On the reef slope live coral cover dropped from 23 % in 1994 to just 1 % in 1999. At one site more than 99 % of colonies were dead with only small pockets of surviving coral tissue. Threats to Saudi Arabia's coral reefs originate primarily through industrial development and maritime transport, including oil spills, landfilling, pollutant discharges, and effluents from desalination activities. Most acute damage to reefs is localised and restricted to offshore islands (in the Gulf) and around major urban areas (in the Red Sea). Many marine areas have been proposed for protected status, dating back to the mid- and late 1980s. However, with the exception of the Farasan islands, protected in 1996, and the Jubail Wildlife Sanctuary which was developed shortly after the Gulf war, there have been no other marine protected areas established. Saudi Arabia has carried out a number of programmes and adopted a number of legal measures to conserve coral reefs. These include laws on pollution discharges and the establishment of protected areas. However, a number of issues remain unresolved or poorly addressed. These include foremost enforcement of existing emission standards, industrial development which includes landfilling, and integration of the public and private sectors in reef conservation.

Jordan

The Jordanian coastline extends approximately 27 km along the north eastern-reaches of the Gulf of Aqaba. Approximately 30 % of the coast is used for port. Fringing reefs border up to 50 % the coast supporting a high diversity of coral and associated fauna (158 coral species in 51 genera and over 280 fish species). Jordan's coral reefs are in good condition, supporting up to 90 % cover of scleractinian corals. No bleaching events were recorded in the aftermath of the 1997/1998 global warming event, possibly as a result of the extreme northern latitudes. There are no existing marine protected areas, although the area within the Marine Station grounds is *de facto* a protected area. The Aqaba Coral Reef Protected Area is the only proposed protected. Jordan has revised its legal and regulatory framework for environmental protection at a national and international level. The country is party to eight international conventions or treaties which directly or indirectly have an impact on the conservation of coral reefs. The Gulf of Aqaba is highly susceptible to pollution. At present pollution is limited and localised. The main threats are oil spills and discharges, industrial discharges, municipal and ship-based sewage and solid waste. The development of the tourism sector might also further threaten the coral reefs. To improve the conservation status of coral reefs, there is a need to strengthen the overall institutional capabilities of government agencies through hiring and training of staff, the implementation of environmental protection laws and regulations, and improving regional cooperation to co-ordinate and enhance the efforts of individual Gulf-bordering nations. Several additional measures are also needed, including the development of an integrated coastal zone management strategy, capacity building at both the legislative and management and operation levels, the establishment of a Marine Protected Area and the harmonisation of existing regulations at a national and international level.

1. Introduction

This report summarises the status of coral reefs in the countries bordering the Red Sea and the Gulf of Aden that belong to the Arab League. These include, in anti-clockwise regional order: Egypt, Sudan, (Eritrea is not a member of the Arab League), Djibouti, Somalia, Yemen, Saudi Arabia (including its waters in the western Arabian Gulf), and Jordan (Fig. 1). The Red Sea and Gulf of Aden represent a complex and unique tropical marine ecosystem, with an extraordinary biological diversity and a remarkably high degree of endemism. This

narrow band of water 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.

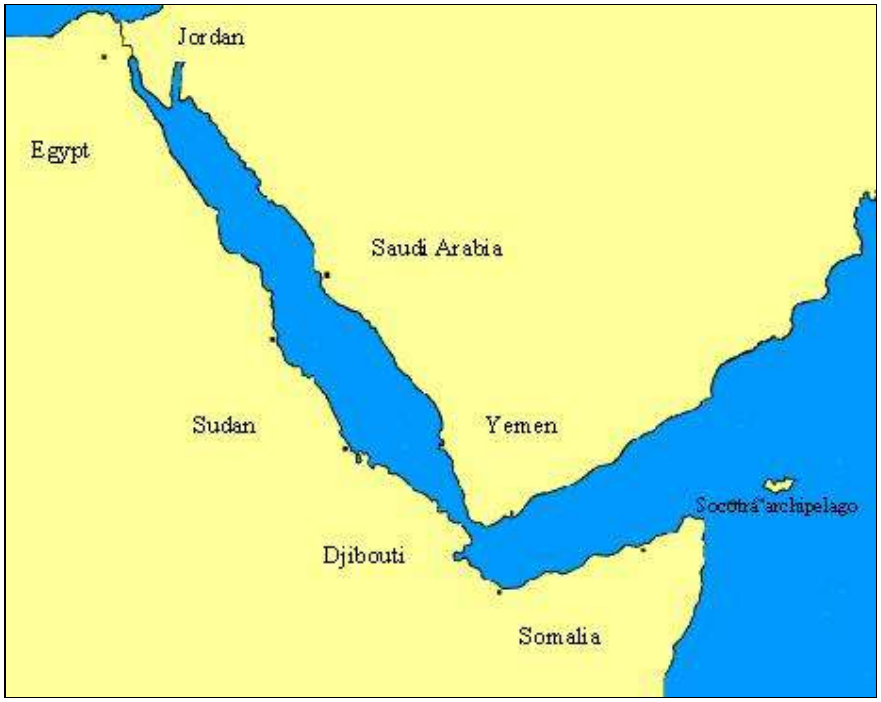

Fig. 1: Red Sea and gulf of Aden regional extent.

The Region contains some of the world's most unique and diverse marine and coastal habitats, encompassing the Arabian Gulf, the Gulf of Aden, the Red Sea and the Gulfs of Suez and Aqaba. The natural coastal resources have supported populations for thousands of years, and nourished the development of a maritime and trading culture linking Arabia and Africa with Europe and Asia. The Arabian Gulf is a shallow water body that experiences temperature extremes of 10 ºC and 40 ºC. The narrow straits of Hormuz restricts water exchange with the Arabian sea, which combined with high evaporation rates creates high-salinity water within the Gulf. Species of corals appear more tolerant than their counterparts in the Red Sea, and up to a critical point are able to withstand environmental extremes that would normally kill corals in most other reef areas outright. An almost continuous band of coral reefs fringes the shorelines of the Gulf of Aqaba. Coral assemblages in the shallow Gulf of Suez are less well developed. The Red Sea is one of the most important repositories of marine biodiversity in the world. It's relative isolation has given rise to an extraordinary range of ecosystems, biological diversity and endemism, particularly among reef fishes and reef-associated organisms. The Gulf of Aden is influenced by the seasonal upwelling of cool waters from the Indian Ocean, limiting coral reef development. Despite the seaonal upwelling, the Gulf of Aden houses diverse and complex reefs and non-reefal assemblages.

Some of the sandy beaches form major nesting sites for sea turtles, and the Socotra archipelago is being considered for World Biosphere Reserve status.

The coral reefs of the region are comprised of more than 250 species of scleractinian corals, representing the highest diversity in any section of the Indian Ocean. The warm water and absence of fresh water runoff provide suitable conditions for coral reef formation adjacent to the coastline. In the northern Red Sea the coast is fringed by an almost continuous band of coral reef, which physically protects the shoreline. Further south the shelf becomes much broader and shallower and the fringing reefs gradually disappear and are replaced with shallow, muddy shorelines. Coral reefs become more numerous in the offshore parts of this coast.

Two major institutions are in charge of co-ordinating the conservation and management of coral reefs in the region: The Regional Organisation for the Protection of the Marine Environment (ROPME) and the Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). The two institutions co-operate closely with each other in the framework of a Memorandum of Understanding.

Although many reef areas in the region are still in a pristine state, threats are increasing rapidly and reefs are being damaged by coastal development and other human activities. Major threats include: landfilling and dredging for coastal expansion; destructive fishing methods; damage by the recreational SCUBA diving industry, shipping and maritime activities, sewage and other pollution discharges; lack of public awareness, and insufficient implementation of legal instruments that affect reef conservation.

The present regional report provides background information and current status of coral reefs and coral reef fisheries. It is based on information from publications and reports, which are listed either at the and of this document or in the individual country reports.

2. Geographical Reef Coverage and Extent

Along the northern Red Sea the coast is fringed by an almost continuous band of coral reef, which physically protects the nearby shoreline. Further south the coastal shelf becomes much broader and shallower and the fringing reefs gradually disappear to be replaced by shallow sandy shorelines and mangroves. Here coral reefs become more numerous and extensive in the offshore regions. The Gulf of Aden mainland supports only patchy reef distribution, but the Socotra archipelago is fringed by extensive reefs.

The Egyptian Red Sea coast extends along the Gulfs of Suez and Aqaba and the Red Sea, and is bordered by fringing reefs for most of this length. There are also several submerged reefs and fringing reefs surrounding some 35 small islands. The most northerly reefs at near Suez, where patch reefs are small and shallow. On the western coast of the Gulf of Suez reefs are more developed, forming a fringing reef that extends form 50 km south of Suez to Ain-Sukhna. There are extensive reefs in the southern Gulf of Suez, on the Sinai peninsula at Ras Mohammed and surrounding the Ashrafi islands close to the western shores of the Gulf. In the Gulf of Aqaba there are narrow fringing reefs along the steep cliffs of both shores. In the Red Sea, fringing reefs extend from Gubal at the north nearly continuously to Halaib, at the border with Sudan.

The Sudanese coastline extends from the Egyptian border south to Eritrea. There are three primary coral habitats along the Sudanese coastline: barrier reefs, fringing reefs and Sanganeb, an oceanic atoll. Most of the coast is bordered by fringing reefs 1 - 3 km wide which are separated by deep channels from a barrier reef 1 - 14 km offshore. The outer barrier drops steeply to several hundred meters depth. One of the most unique reef structures in the Sudanese Red Sea is Sanganeb atoll, which rises from a sea-floor at more than 800 m depth.

Somalia's coastline is naturally divided into north and south sectors, separated by the Horn of Africa. There are coral reefs of limited near Raas Khansir, Raas Cuuda Siyara, and off El Girdi and west of Berbera.

The Djibouti coastline is fringed by extensive coral reefs in places. The north coast is generally shallow and sandy, with a few coral outcrops. The Sawabi archipelago is also fringed by coral reefs. The southern coast is shallow with poorly developed coral reefs, linked to the cold water upwelling from the Indian Ocean. The Gulf of Tadjoura contains low diversity coral reefs. At the mouth of the Gulf are Mousha and Maskali islands, which are surrounded by extensive coral reefs.

In Yemen, coral reefs are mainly found along the Red Sea coast, Socotra archipelago and some sites in the Gulf of Aden. Coral growth of the Red Sea coast is found both as coral reefs and coral communities on a variety of substrates. Coral reefs off the northern Gulf of Aden are limited by cold intense seasonal upwelling. Coral reefs are extensive surrounding the Socotra archipelago.

In Saudi Arabia, coral reefs are found fringing the entire length of the Red Sea coastline and the offshore islands. The Red Sea coast is divisible into several relatively homogeneous areas in terms of the variety and distribution of coastal and marine habitats and reefs: the Gulf of Aqaba in the north, the northern-central section from immediately south of the Gulf of Aqaba to Jeddah, and the central-southern region from south of Jeddah to the Yemen border and including the Farasan Bank and Islands. The central-northern area supports a near-continuous coral reef tract composed of a wide range of reef types, comprised of mainland and island fringing reefs, various forms of patch reef, coral pinnacles and ribbon barrier reefs. Mainland fringing reefs are distributed along much of the coastline, and are often developed in the entrances and sides of sharms. Circular / elongate patch reefs are also widespread in offshore waters (< 50 m depth). Pinnacles (individual corals and coral ‘bommies’ surrounded by sand) are present in shallow waters (< 10 m depth), particularly in the Al-Wajh Bank and Tiran areas. Barrier reefs composed of platform and ‘ribbon’ reef structures are developed further offshore on the edge of the ‘continental’ slope, where water depths increase from < 50 m to > 200 m. The central-northern Saudi Arabian Red Sea does not support atoll-like or ‘tower’ reefs, more characteristic of southern areas and the outer Farasan Bank. To the south, reefs are less well developed along the mainland coast. Further offshore however, complex reef structures are developed on the Farasan Bank and islands. In the Arabian Gulf, the reefs mostly appear as small pinnacles or outcrops, and as patch reefs between Ras Al-Mishab Saffaniyah and Abu Ali, and between Abu Ali and Ras Tanura, and as fringing reefs around the offshore islands.

Along Jordan's short coastline (27 km), fringing reefs border up to 50 % the coast supporting a high diversity of coral and associated fauna.

3. Survey Methods

The region was the focus of numerous studies between 1997 and 2000, of which several updated information collected during previous studies and provided comparisons and temporal studies at key locations. In some countries these studies have involved rapid assessments of coral reef habitats, while the most common methods involved belt transects for fish census, line intercept transects for substrate cover and composition, and timed swims for assessment of general reef condition and major disturbances. In Saudi Arabia and Yemen, satellite imagery was used to document large-scale extent of reef habitats.

In Egypt, surveys were carried out between 1997 and 1999 from Hurghada to Shakateen, covering 130 reef sites. In addition, more detailed studies were carried out at 11 sites close to Hurghada to assess the impact of recreational diving on reef habitats. Abou Zaid summarised data collected by the Egyptian Red Sea Coastal and Marine Resources Management Project, the Ecological Sustainable Tourism Project and the Coral Reef Biodiversity Project to provide an recent overview of reef status. Rapid Environmental Asssessments (REAs) were made at 48 frequently visited dive sites as part of the Environmentally Sustainable Tourism Project.

In Sudan, rapid assessment surveys were carried out in 1999 at three sites (Abu Hanish Jetty, Bashear Port and Arous). A more thorough survey was carried out in 1997 covering the coastal area from Port Sudan to Suakin. Reef check methods were followed to determine percent cover of corals and to obtain a general assessment of reef health in 1999, while 10 m quadrat analysis and 20-minute timed swims were used to assess the percentage cover of different life forms, along with counts for indicator species and several commercial fishes in 1997.

In Djibouti, two short but extensive reef assessments in 1998 and one comprehensive subtidal survey in 1999 have provided a wealth of information on the status of coral reefs. These were among the first and most detailed surveys of Djibouti coral reefs.

In Somalia, three short surveys between 1997 and 1999 along the north coast provide the bulk of the current knowledge on the status of the coral reefs. Each of these used simple, rapid assessment methods. There is a need for detailed surveys which also extend to the southern coast.

In Yemen, methods have ranged from remote sensing using satellite imagery (Socotra), rapid ecological and impact assessments (Red Sea, Gulf of Aden and Socotra), to more detailed biodiversity studies (Red Sea and Socotra). Most recently these studies have culminated in the initiation of long-term monitoring programs at selected sites in the Red Sea and Socotra archipelago. Several major projects have recently assessed the distribution, composition and status of living marine resources around much of the Yemen coastline, focusing on the Red Sea coast, the Gulf of Aden and the Socotra archipelago. Additional studies at key sites along the Gulf of Aden and Red Sea have been undertaken by members of the Arabian Seas Expedition and as part of smaller projects.

In Saudi Arabia, the distribution and composition of coastal and marine habitats of the central-northern Red Sea, from north of Jeddah to Haql in the Gulf of Aqaba were assessed between 1997 and 1999. This study produced detailed site inventories for corals, fish, other

benthos, algae, sea-grasses, coastal vegetation and birds, and assessed the distribution and abundance of marine mammals and turtles. Combined with socio-economic assessments of patterns of human use and detailed habitat mapping prepared from aerial photos and satellite images, the data were used to define key reefs and larger reef areas of high conservation significance for MPA planning. In the Farasan Islands Marine Protected Area (FIMPA), abundance of live coral, dead coral, and coral-feeding crown-of-thorns starfish *Acanthaster planci* and snails *Drupella* spp. were assessed in 1999. In the Arabian Gulf, effects of the Gulf War oil spills on coastal and marine habitats and species and on coral cover and community composition were assessed at sites along the mainland coast and offshore islands. More recently, the effects of mass coral bleaching in 1998 were examined, using the same sites as were established for the Gulf War assessment.

In Jordan, current research involves studies on the coral communities near the fertiliser industries and extend along the entire coastline, in particular the monitoring of biological and physical characteristics including currents, temperature, and nutrients levels. Studies also are aimed at identifying temporal and spatial changes in reef structure, coral coverage and fish population diversity and density, and address the impact of industry, diving and tourism.

4. Status of Coral Reefs – Benthos and Fish

i. Summary

ii. Coral Diversity

In Egypt, reefs in the north were more diverse than those in the south, with nearly double the number of coral species and genera. The distribution and development of reef-building corals was restricted by several physio-chemical parameters, including temperature, sediment load, salinity and light.

No recent updates on coral diversity are available for Sudan.

In Djibouti, a total of 166 to 167 species of corals were recorded, dominated by *Acropora hemprichi, Echinophora fruticulosa* and *Porites nodifera*. Only 10 % of the species were found at all sites, 40 % were present at several sites. Nearly 50 % of the coral species were restricted to a handful of sites. *Acropora* sp. suffered high mortality in Khor Ambado and off Maskali. The highest diversity was recoded at Arta Plage. Grande Isl. in the Sept Frères had the second highest diversity of corals, followed by Trois Plages in the Gulf of Tadjourah.

In Somalia, a total of 74 species of scleractinian coral, 11 species of alcyonacean (soft) coral and two species of fire coral were found in 1999. Other reef organisms encountered were sparse and included only five *Panulirus versicolor,* two specimens of two species of anemones, five specimens of *Tridacna* spp. and various sponges, ascidians, holothurians, echinoids, crinoids, molluscs and zoanthids.

In Yemen, a total of ca. 176 species of stony corals have been recorded. Richness at individual sites ranged from 1 to 76 spp. Along the Red Sea, almost 50 % of sites had more than 40 coral species and 12 % of sites had over 50 species, similar to counts at reefs in the central and northern Red Sea. At least 19 new distribution records for the southern Red Sea

have been identified, and further coral specimens await identification. Diversity is lower along the mainland Gulf of Aden coast, which is thought to support some 100 coral species, but remains relatively poorly studied. By contrast, the Socotra archipelago supports a diverse fauna of ca. 240 stony coral species, placing it among the richest sites in the western Indian Ocean. The high diversity is related to the co-occurrence of a composite coral fauna from different biogeographic provinces and sub-provinces, including the Indo Pacific, the Indian Ocean, E. Africa, Arabia and the Red Sea.

In Saudi Arabia, the coral communities were composed of at least 260 species of reef-building stony corals from 68 genera in 16 families of the Scleractinia in Red Sea waters. Of these, 26 species were previously undescribed and ca. 50 species were distribution range extensions into the Red Sea. The coral communities were composed predominantly, both in terms of composition and cover, by the families Acroporidae, Faviidae and Poritidae. A diverse mix of soft corals, hydrozoan fire corals, gorgonians, corallimorpharians and zoanthids were also present. Species diversity of scleractinian stony corals at individual sites in the central-northern Red Sea ranged from ca. 20 – 100 spp. There was only minor variability in species composition among the different coral reef assemblages, with the entire region exhibiting a high degree of homogeneity in terms of coral community composition, both latitudinally and longitudinally. Reefs with moderate to high species diversity and abundance and living coral cover were widely distributed, with no clear latitudinal or longitudinal trends. Such reefs have high significance for replenishment, because of their potential as sources of large numbers of propagules of coral and of other reef-associated taxa. The Arabian Gulf is relatively depauperate in coral species in comparison with the Red Sea, supporting considerably less than 100 scleractinian taxa. Notably the families Astrocoenidae, Oculinidae and Caryophylliidae were not represented, while the Fungiidae and Pectiniidae were represented by a single species (*Cycloseris cyclolites* and *Echinophyllia aspera* respectively). The depauperate nature of the Arabian Gulf coral fauna has been attributed to the harsh environmental conditions (temperature extremes, limited suitable antecedent topography for reef development and turbid waters), to a likely dispersal bottleneck through the Straits of Hormuz and to a partial dispersal barrier in the Arabian Sea.

There is no recent data on the status of coral diversity in Jordan.

iii. Coral Cover

In Egypt, corals accounted for 55 % of reef cover in non-sheltered areas and 85 % of cover in sheltered areas. The percentage of live coral cover generally ranged from 11 to 35 % in the reef flat areas, and the highest cover was found along the reef walls (12 to 85 %) and reef slopes (5 - 62 %). The percentage of live coral cover was highly variable along the coast, with the highest cover occurring on reef walls and the leading edges of the reefs. Overall there has been a 20 to 30 % decline in coral cover at most sites and the percentage of recently dead coral has increased by several factors.

In Sudan, over 80 % of the coastal fringing reef sites had a high percentage of thin algal film cover, averaging 28.8 %. Live coral cover ranged from 5 to 60 %. Dead coral coverage of > 1 % was only noted at five sites. The dominant substrate cover at depths < 10 m was algal film. The percentage of hard live coral at Abu Hashish Jetty ranged from 23.5 % at 10 m depth and 50 % at 5 m, while dead coral (DC) ranged from 2.5 % at 10 m depth and 0 % at 5 m depth. At Bashaer Oil Exporting Port HC covered 37.5 % while DC covered 21.25 % of the

substrate. At Arous, dead corals covered 51.25 % of the substrate and no bleaching was observed below 4 m. Bleached corals were observed at the top of the fringing reef at 2 m. Overall bleached corals were estimated to cover 14 % of the substrate.

In Djibouti, Percentage cover ranged from 5 % (offshore of the main tourism beach on Maskali) to 90 % (at Hamra Island, Sept Frères). At this latter site the dominant coral was Acropora, forming a coral garden. In 26 samples, percentage cover of live hard coral was equal to, or greater than, 50 %. In reef edge swims, percentage cover of living hard coral ranged from 5 % to 70 %, and exceeded 20 % in all but 3 samples.

In Somalia, living coral cover varied between 0 - 60 % on reefs affected by the bleaching and COTS phenomena, the average being between 2 - 5 %. Reefs not affected by bleaching had a coral cover ranging between 60 - 80 %. These constituted a fairly narrow fringing band on the outer perimeter of the reefs, and there was relatively little healthy coral.

In Yemen, cover of stony corals, dead corals, soft corals and algae were all highly variable among different sites within the Red Sea, Gulf of Aden and Socotra archipelago. In the northern area of the Yemen Red Sea, extensive coral mortality over the past decade resulted in major reductions in living coral cover on some reefs. Reefs of the southern Red Sea, and those fringing offshore islands, were less disturbed, supporting higher living coral cover. Semi-protected island reefs in the northern Red Sea had low average live coral cover (17 %), high average dead coral cover (34 %) and high macroalgae cover (20 %). The northern and central Yemen coast and nearshore islands had very low live coral cover (3 %) and very high dead standing coral cover (averaging 34 %). Macro algae cover was also high (avg. 34 %). Clear water communities facing the open sea had the highest live coral cover (29 %) and lowest dead coral cover (14 %) in the Yemeni Red Sea. Macroalgae cover was also among the lowest, while coral species diversity was high (46 sp.) with some of the largest colonies encountered in the surveys. Deep water pinnacles and submerged patch reefs had high overall coral cover (avg. 52 %), with similar levels of live (24 %) and dead coral (28 %). Most exposed reefs with algal crests and monospecific stands of coral also had high cover of dead coral, often in the form of mounds or ridges of branching coral rubble but also dead massive and tabular *Acropora* colonies. Reefs in this group had a very high percentage of total coral cover (averaging over 50 %), although it was mostly dead standing coral (avg. 44 %). Southern fringing reefs also had higher average cover of dead corals (23 %) than live corals (15 %) and substantial cover of macroalgae (avg. 14 %). The lack of major biogenic reef accretion in the Gulf of Aden and Socotra archipelago notwithstanding, some sites support high live coral cover (> 50 %, and large sizes of individual coral colonies). Around the Socotra archipelago, cover of stony corals ranged from < 1 % to > 75 %, and in large patches (ca. 1,000 m^2) attained ca. 100 %. Overall, living stony coral cover averaged ca. 20 % , with highest cover (ca. 35 %) on the Brothers (Samha, Darsa and including Sabunyah Rocks). Stony coral cover was much higher on the north coasts (ca. 25 %) than on the south coasts (ca. 5 %).

In Saudi Arabia, living cover of reef-building corals ranged from < 10 % to > 75 % while soft corals ranged up to 50 % cover. High cover of dead coral (> 20 %) occurred on some reefs following coral bleaching or predation. High cover of living corals was associated with reefs of relatively high exposure to wave energy and high water clarity. High coral cover was usually present on the shallow reef slopes of exposed fringing, patch and barrier reefs. With some important exceptions, deeper reef slopes (> 10 m), reefs in low wave energy

environments and reefs with low water clarity usually had lower living coral cover than their shallow, more exposed counterparts.

There is no recent data on the status of coral cover in Jordan.

iv. Fish Communities

In Egypt, there were a total of 261 fish species representing 89 genera in 46 families, and southern reefs housed a greater diversity of fish species than northern reefs. Exposed reefs contained higher diversity of fishes than sheltered reefs, which was attributed to the lower incidence of divers and fishermen in these areas. The most abundant family was the Pomacentridae (damselfishes), represented by 16 to 26 species across all sites, followed by the Labridae (wrasses), represented by 20 species. The most common damselfish was *Chromis dimidiata*, and the most common wrasse was *Labricus quadrilineatus*. The least abundant family was the Scaridae (parrotfishes), represented by only nine species, of which *Hipposcarus harid* and *Scarus ferrugineus* were the most common.

In Sudan, fish communities were considered healthy and abundant. The Humphead Wrasse *Cheilinius undulatus*, was found in three of the 25 timed swims. Angelfish were observed at all but one site, with 15 sites recording more than 10 angelfish; Butterflyfish were recorded at all sites, of which 19 contained more than 50 individuals; Triggerfish were only recorded at seven sites, with a maximum of two at any site; Groupers were recorded at all sites, and 13 sites contained > 20 individuals; Similarly, snappers were recorded at 24 of the 25 sites, with a maximum count of 212 and at four sites > 100; Surgeonfish, in particular the endemic *Acanthurus sohal* and *Ctenochaetus striatus*, were noted at all sites; and a number of indicator wrasses were found at all sites. Sharks were reported at three sites.

In Djibouti, fish fauna was relatively well distributed. Four sharks were sighted at Hamra Island, and single individuals were observed in three other samples. Angelfish were observed at all sites (counts ranged from 6 to 31). Twenty-eight samples contained 10 or more angelfish. Total butterflyfish counts ranged from 8 to 110. Fifty or more butterflyfish were observed in 15 of 34 samples. The most frequently observed butterflyfish were *Gonochaetodon larvatus.* The total number of groupers observed ranged from 0 to 56. Twenty-eight samples contained 10 or more groupers, while 17 samples contained 20 or more. No species was ubiquitous to all samples. The most frequently observed species, both in number of samples it occurred in and total number of individuals was *C. hemistiktos.*

In Somalia, reef fish were diverse and the presence of large schools of fish as well as an abundance of large fishes indicated a relatively un-exploited resource and pristine environment. The reef fish community differed considerably from that of the eastern Arabian Peninsula to the north and the fish communities of eastern Africa to the south and the Red Sea to the west, particularly the Chaetodontidae, Acanthuridae and Balistidae.

No recent updates on coral reef fish fauna are available for Yemen.

In Saudi Arabia, no recent updates on coral reef fish fauna are available for the Red Sea. Past records vary greatly, from 325 species in 1988, 508 species in 1987, 776 species in 1971, and 1,000 species in 1984. Differences among these various estimates are in part due to distinctions in the definition of 'reef fish', with the more conservative estimates being based

on a stricter interpretation of the definition. In the Arabian Gulf, over 600 fish species are now reported, even though the area of coral reefs is highly limited and naturally stressful conditions for tropical marine fishes prevail. Species compositions and population densities were within the range of previous years.

There is no recent data on the status of fish diversity in Jordan.

5. Status of Coral Reef Fisheries

In Egypt, the Red Sea fisheries contribute approximately 11 to 14 % of the total annual Egyptian fish production, including aquaculture, and nearly 16 % or marine fisheries. Of these, 44 % of fish landings are coral reef-based, with the highest landings in Suez. Large fishing boats generally fish in southern Red Sea waters, but land their catch in Suez. Total catch increased in 1993, but declined from 1994 to 1998. Fishery activities are regulated by the General Authority for Fish Resources Development of the Ministry of Agriculture, which aims to increase fish catches to 70 thousand tonnes by 2017, but there is currently no active management of the Egyptian Red Sea fisheries. Over seven percent of the national workforce are involved in fisheries of one kind or another. Highest landings are reported for the port of Suez (78 % of the total), but most of the fishing boats landing their catch in Suez actually fish further south, in central and southern the Red Sea. The total number of commercial coral reef fishes species is 27, of which five make up over 48 % of the total landings, amounting to slightly over 22 thousand tonnes per annum. The balance of the catch is made up of crustaceans, offshore pelagic fishes and demersal fishes (in equal proportions). Fishery landings have decreased steadily since 1994, after a peak in 1993 which consisted of record landings of Indian and other mackerel, and sardines.

In Sudan, fisheries play a minor role in the economy at the national level, but are important at a subsistence level along the coast. Neither commercial nor artisanal landings reach the estimated maximum sustainable yields, and further fishery development at present is negligible. Fisheries are believed to have great potential in Sudan, but face logistical problems such as refrigeration and transport. There are about 65 species of economically important bony fishes, in addition to sharks, rays, shrimps, lobsters, crabs, molluscs and sea cucumber. Other reef-based fisheries include that for Trochus (*Trochus dentatus*) and sea cucumber (*Holothuria* sp.). All the shallow water areas (mersas) along the Sudanese coast are potential spawning grounds. Over 80% of fish are caught with hook and line. There are and estimated 400 small fishing boats in Sudan and about 300 slightly larger boats of 9 - 10 m (4 - 5 crew). The Fisheries Administration of Sudan suggests that the maximum sustainable yield from artisanal fisheries is around 10,000 mt. Present annual production is 1,200 mt. Peak landings occurred in 1984 and have gradually decreased by 30 % since that time.

In Djibouti, fisheries play a limited role, although subsistence fisheries are locally important. There are about 90 artisanal fishing boats, of which 75 are small, open boats (6 - 8 m) powered by outboard engines. Each boat operates with an average of three fishermen over one day trips. Some 15 of the boats are longer (10-14 m) and equipped with inboard engines. These carry an average of five fishermen each and go out for four days. Most of the fisheries are at the subsistence level and fishing effort is generally low. The majority of the catch is landed by hook and line. There is no processing of any relevance. About 75 % of the catch is landed at Boulaos. Other small landing places are Escale, Tadjourah and Obock. Catches are composed of grouper (23 %), Spanish mackerel (14 %), red snappers (13 %), antak (12 %),

blackspot snapper (10 %), bonito (5 %) and jacks (4 %). All other species are of minor importance. Fisheries production increased from 200 tonnes in 1980 to 400 tonnes in 1984 and 700 tonnes in 1988. From 1991 to 1994 the production decreased dramatically, due to political unrest in the north of the country. Fishery production is highest in May, June and September.

In Somalia, finfish fishing is limited and nearly entirely artisanal in nature. 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. There is an established lobster fishery based on nearshore reefs along the south east coast. Most commercial operations are carried out by foreign vessels (mainly from Yemen), that provide no catch or effort statistics. Somali fishermen target a limited number of demersal stocks, bound by fishing gear limitations, and a range of coral reef fish. The northern Somali fishery industry is located at Berbera, Siyara and Karin on a small scale. Fishing is done using small canoes, and set a limited number of 7, 15 and 30 cm stretch mesh size gill nets, and occasionally handline fishing. Turtles are harvested opportunistically, both by jigging and harpooning at sea and through the capture of nesting turtles. Gill nets are permanently set around the coral reefs at Siyara targeting sharks. Sharks are landed at Zeila and on Aibat island. Much of the commercial catch is made up of shark for the sharkfin industry. For the entire Somali coast the MSY of small pelagics has been estimated at 70,000 to 100,000 mt.

In Yemen, fishing is a traditional profession. 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 mt and more than 90 % of the total fish production is landed by artisanal fishermen. Most of the landings come from trawling in the Red Sea and the pelagics fishery in the Gulf of Aden. Reef-based fisheries, for the most part, are underdeveloped and at a subsistence level. Coral reef fisheries are based primarily in the Red Sea and around the Socotra archipelago. Coral reef-based fisheries are mostly artisanal in nature and are distributed along the entire coast. There are five main landing centres along the Red Sea coast: Midi, Khoba, Hodaida and Khaukha, and Mokha. Reef-based fisheries in the gulf of Aden are minor, with the majority of the fishing industry targeting pelagics. On Socotra, reef-based fishing activities take place along the entire coastline, but only one processing plant exists to market catches on a commercial scale. Catch statistics are generally unreliable because catches are auctioned and sold as individual fishes for large species, or in bundles for small size fish, without being weighed. Furthermore, there are no accurate figures on the fishing effort. In the Gulf of Aden there is information on demersal and pelagic stocks but little on artisanal fisheries. Large pelagics include tunas, Spanish mackerels, sharks, jacks and marlins. There has been a slow but gradual decline in catches of pelagic species following a peak in 1989, and demersal fish stocks have been declining sharply since 1987. Sharks (mostly Carcharinidae and Sphyrnidae) are also fished, using trolling and surface longlining. During the 1980s annual catches were in the order of 7,000 mt. There is an artisanal fishery for spiny lobsters (*Panulirus* spp.) in Hadhramut and Mahra and around the Socotra archipelago.

In Saudi Arabia, the fishery was exploited almost exclusively by artisanal fishermen from small boats and larger Sambouks until 1981. Coral-reef based fisheries are distributed along the length of the Red Sea, with the highest proportion of fishing boats being based in the south. That the greater number of boats in the south does not represent an increase in fishing

pressure on coral reefs, rather it represents the greater number of trawlers that make up the prawn and non-coral reef-based fisheries. Fishery statistics have been analysed for different sectors, but differences between the various sources do not allow standardisation or comparisons. A significant problem is that fishery statistics are normally aggregated for both the Red Sea and Arabian Gulf fisheries. A reliable long term series of catch and effort data, required for specific management suggestions, is not presently available.

In Jordan, the fishing industry is based in Aqaba and is small and artisanal, consisting of approximately 85 fishermen and about 40 boats. Total catch in 1995 was 15 mt, down from the 103 mt recorded for 1993 and the maximum of 194 mt in 1966. There are no cold storage facilities and catches are sold upon landing.

6. Threats to Coral Reef Biodiversity

The following threats are prevalent throughout the region. In some cases they are more applicable or important to one country or another, but are shared by all countries due to the enclosed nature of many of the region's waters. At times these are potential threats rather than existing ones. For example, coastal development in Somalia is not as extensive as that in Saudi Arabia, but continued growth and political stability will increase coastal settlement and use, and sewage, landfilling and pollution problems will become more acute.

Habitat Destruction

Extensive coastal development, which includes dredging and filling, destroys large tracts of coral reefs. Urban, industrial and port development coupled with inadequate environmental planning, and little or no environmental assessment near developed areas is severe. Siltation is invariably the result of poorly planned and implemented construction. Dredging and land reclamation (landfilling) activities have resulted in the loss of numerous reef habitats. Landfilling is one of the most disruptive activities to coastal and marine resources. Landfilling has caused severe and permanent destruction of coastal habitats and has changed sedimentation patterns that have damaged adjacent resources. Changes in water circulation caused by landfilling has then altered the distribution of plant and animal communities. Dredging causes destruction of the resources in the dredged area and often has indirect impacts from increased sedimentation. The lack of management and awareness, and lack of enforcement of regulations results in physical damage to coral reefs, a loss of coral habitat and a decline in reef-associated fauna.

Industrial Activities

The chronic release of industrial pollutants results in a decline in water quality. Among these are the oily discharges from refineries which are discharged without treatment or analysis. Sewage and phosphate ore washing are principal nutrient enrichment forces along the Egyptian coastline. Sewage, high in coliform bacteria and suspended solids, is normally untreated and discharged into the intertidal zones. Additional wastes in the form of plastics are discharged to the sea from urban areas and shipping. Major sources of pollution in Sudan are the power station in the innermost part of Port Sudan harbour and carbon residue from a tyre manufacturing company.

Oil and other Hydrocarbons

The danger from oil pollution comes not only from exploration activities but also from transport, in which millions of tonnes per annum pass through the region. More than 20 oil spills occurred along the Egyptian Red Sea since 1982. The spills involve a number of

pollutants, which smother corals and poison them through hydrocarbon absorption. Oil exploration through seismic blasts is also a threat to coral reefs. In Sudan, oil leaks occur on a regular base from the oil terminal and tankers in Port Sudan harbour, and the Port is already heavily polluted by oil. Small oil spills cause beach contamination and damage to the coastal and marine biota. These occur through the discharge of ballast and bilge water, discharge of waste oil, bunker oil spill. The lack of reception facilities at the port; inadequate control, and lack of enforcement compound the problem. Medium oil spills also cause beach contamination and damage coastal and marine biota. These occur through discharges from terminals and small accidents at sea. There are inadequate control and monitoring of procedures, equipment and personnel and training. Potential large oil spills and disasters could cause large-scale destruction of coastal and marine habitats and biota and devastation of beach habitats. These would occur through rupture of oil tanks through collision or wreckage. Most ports in the region have no reception facilities for oil-contaminated bilge or ballast water.

Maritime Transport

The regional waters are major shipping routes, and about 16,000 ships pass through the Strait of Bab al-Mandab each year and an estimated 25,000 to30,000 ships transit the Red Sea annually. The Arabian Gulf is also a major oil tanker and commercial shipping area. Apart from ship-related pollution risks (e.g. discharges of garbage and oily wastes; bunkering activities), accidents involving tankers together with discharges from unloading operations constitute a serious pollution risk. Physical damage to coral reefs is caused by anchors. The coral reef systems also pose several problems to navigation. Combined with heavy maritime traffic and limited navigational devices, there is a constant risks of ship collisions and groundings. This is particularly severe near the ports of Port Sudan and Suakin, both of which have to be approached through channels among large reef complexes. Vessel sewage and ship discharges of solid waste pose additional threats. Poor navigational control systems, and a lack of moorings throughout the region compound these problems.

Fisheries

At present shark resources are depleting and catches by local fishermen are declining rapidly due to large-scale shark fisheries by foreign vessels from the Region for the East-Asian shark fin market. A portion of these fishermen operate with licences, but many fish illegally. Sharks are caught by hook and line and nets, damaging coral reefs. Large amounts of bycatch, including turtles, dolphins and fin-fish are discarded, invariably dead. There is potential overfishing of game fish resulting in a decrease in average catch size, as the level of fishing efforts exceeds the Maximum Sustainable Yield. The lack of surveillance and enforcement of existing regulations, such as that regulating the use of spearguns in certain areas and MPAs is widespread. There is also a large by-catch of turtles, dolphins and finfish, and damage to reefs from nets. In addition, overfishing of reef-associated species has the potential to produce cascading secondary effects in the ecosystem. For example, outbreaks of crown-of-thorns starfish are hypothesized to be caused by overfishing of reef-associated fish predators in the families Lethrinidae, Balistidae and Tetrodontidae.

Sewage Treatment

The discharge of untreated or insufficiently treated sewage in coastal areas alters the marine environment, and is a threat to public health. The widespread lack of sewage treatment plants, lack of maintenance of existing plants and inadequate pollution control regulations,

monitoring and enforcement result in severe damage to coastal and marine life. Sewage discharges also cause algal booms throughout the coral reefs ecosystems.

Natural Predators
Major outbreaks include infestations of the crown of thorns starfish (*Acanthaster planci*), sea urchins (*Diadema* sp.) and gastropod snails (*Coralliphyllia* sp. and *Durpa* sp.). Coralliphyllia *violacea* was found to feed intensely on *Porites* sp. at several sites along the Red Sea. In Egypt in 1998 the greatest outbreak of *A. planci* (10,000 individuals) occurred around Gordon reef, near Tiran island. A large number of *A. planci* were also found at Khor Ambado in Djibouti. In Yemen, recent extensive coral mortality on offshore Red Sea reefs was similar in appearance to that following crown-of-thorns starfish outbreaks. The coral-feeding snails *Drupella* was present at most Red Sea and Socotra sites with a varying degree of abundance, most commonly on compact branching forms of *Acropora.* Generally damage was at a sub-lethal level, with most infected corals showing partial mortality ranging from 10 % to 70 % of the colony. The urchins *Echinometra* and *Diadema* spp. occur in moderate to high abundance (> 10 m^2) at some sites, and with the grazing parrot fishes (Scaridae) and boring sponges, are major contributors to bio-erosion of the reef substrate. Bio-erosion was particularly noticeable in Yemen at sites badly affected by the 1998 bleaching event.

Bleaching
Bleaching has caused extensive recent coral mortality on many reefs, including those in the northern nearshore area of the Red Sea, in the southern Red Sea, the Socotra archipelago and north east Gulf of Aden. A number of Red Sea sites with near total mortality had been reported as having healthy coral growth in the 1980s. Bleaching effects in 1998 were patchily distributed around the Socotra archipelago and NE Gulf of Aden. At the worst affected sites > ½ species were injured and about half of the live coral cover was killed. The bleaching followed a period of elevated sea surface temperatures of > 1 ^oC above mean monthly averages.

Coral Disease
A number of coral diseases are prevalent in the Red Sea, including black band and white band disease, believed to be the result of cumulative stresses from anthropogenic impacts such as high nutrient (chemical) and sediment (physical) loads.

Destructive Fisheries
Unsustainable fishery practices include spear fishing, the use of closed mesh nets, and dynamite (blast) fishing, which have been reported to occur along the Egyptian coastline. These practices remove many reef herbivores, resulting in changes to natural reef ecological processes such as algal blooms.

Recreational SCUBA Diving Practices
Major effects of the recreational SCUBA industry include anchor, trampling and flipper damage. Vast amounts of corals, molluscs and fish are also collected for the curio and aquarium trades.

Desalination
There is extensive use of desalinated water to meet demands of the population and industry. As of 1992 there were eighteen desalination plants operating along Saudi Arabia's Red Sea coast. Discharges into the marine environment from the desalination plants include chorine

and anti-scalant chemicals and warm brine. In Yemen, power stations at Mokha, Ras Katheeb and Hiswa (Aden) discharge saline high-temperature water directly into the sea causing temperature increase in surrounding waters.

Floods

In Egypt and to an extent in Yemen and northern Saudi Arabia, heavy rainfall causes floods from *wadis* increasing sediment loads and reducing salinity levels. These effects may extend several km offshore depending on the substrate type and severity of the flood.

7. Marine Protected Areas (MPAs) and Level of Management

Tourism has largely spurred the development and implementation of Marine protected Areas in the region, and these are mostly based in the northern Red Sea (e.g. Ras Mohammed and Hurghada) and Djibouti. More recent understanding of the ecological importance of several regions has resulted in the establishment of protectorates based on environmental qualities (such as Sanganeb atoll in Sudan, the Socotra archipelago in Yemen and the Jubail Wildlife Sanctuary in Saudi Arabia). Appendix III lists current established and proposed protected areas in the Red Sea and Gulf of Aden region.

In Egypt, there are four Marine Protected Areas that include coral reefs, and another two in which coral reefs are not present. These protectorates have mostly been established around the Sinai peninsula at sites where recreational SCUBA diving is common, and the threat from anchor and flipper damage is considered high. There are seven additional areas that have been proposed or suggested to the Government for protected status.

In Sudan, the only marine protected area is the Sanganeb Marine National Park, established in 1990. This is an 12 km^2 atoll with highly diverse and complex coral reefs, diverse reef-associated fauna.

There are two declared marine protected areas in Djibouti, which have been established for more than ten years. There are two additional areas proposed for protected status, one of which is of regional importance.

In Somalia, three areas have been proposed for protection along the Gulf of Aden coast. However, onlly one of these (the Aibat, Saad ad-Din and Saba Wanak area) encompasses significant coral growth.

There is one protected area and six proposed protected areas in Yemen. Establishment of marine protected areas is a relatively new process in Yemen, with funding and technical input from IUCN, the Global Environment Facility and PERSGA.

The Kingdom of Saudi Arabia has established a number of extensive terrestrial protected areas, but lags behind in the development and implementation of marine protected areas. Many areas have been proposed and suggested, dating back to the mid- and late 1980s, and remain that way to date. With the exception of the Farasan islands, protected in 1996, and the Jubail Wildlife Sanctuary which was developed shortly after the Gulf war, there have been no other recent marine protected areas established. With the resurgence of PERSGA and its Strategic Action Plan this is expected to change, with up to 32 proposals for protected areas being put forward for the Red Sea alone.

In Jordan there are no existing marine protected Areas, and the Aqaba Coral Reef Protected Area is the only proposed protected area.

8. Government Legislation, Strategies and Policy Pertinent to Reef Conservation

i. Summary

Egypt is a signatory to a number of international conventions under which the conservation of coral reef resources is stipulated or indirectly addressed. At the same time, since the early 1980s the country has enacted a number of laws and presidential decrees through which coral reefs receive direct or indirect protection.

Sudan is a signatory to a number of international conventions and agreements that promote the protection of coral reefs. National legislation in Sudan does not address coral reefs *per se*, but indirectly supports pollution control measures that affect coral reefs. It is suggested that the demarcation and enforcement of marine protected areas will strengthen national legislation.

Given of the importance to protect the marine environment and to fight all kinds of pollution, the Republic of Djibouti is a signatory to a number of international conventions and has enacted several national instruments through which conservation and management of coral reefs are directly or indirectly addresses.

Although signatory to a host of international agreements and protocols, Somalia is a nation caught in a period of political unrest, from which it is slowly emerging. Its ability to effectively implement the stipulations of international agreements are limited, and national legislation is virtually non-existent.

The Republic of Yemen is a party to international conventions, agreements and treaties which have implications on the marine environment. Similarly, a number of national instruments exist at various government levels which directly of indirectly concern coral reefs.

Saudi Arabia is signatory to regional and international agreements which place obligations upon it for prevention of pollution and protection of resources, including coral reefs. Among these are a number of international agreements and memoranda of understanding, and a series of national laws and royal decrees that are pertinent to coral reef conservation.

In recent years Jordan has improved the legal and regulatory framework for environmental protection at a national and international level. The country is party to eight international conventions or treaties which directly or indirectly have an impact on the conservation of coral reefs.

ii. International Agreements

Although not every regional State is a Signatory to every Agreement, Protocol or Declaration, and certain States are the only Signatories to some, the following are the primary international agreements in force in the region:

- The Regional Organisation for the Protection of the Marine Environment of the Red Sea and Gulf of Aden (PERSGA);
- The Protocol for Regional Cooperation for Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1982);
- The Convention for the Prevention of Pollution of the Sea by Oil (MARPOL);
- The Convention on Wetlands of International Importance (RAMSAR);
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- The African Agreement for the Conservation of nature and natural Resources (Algiers 1988);
- 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);
- The Convention Concerning the Protection of the World Cultural and Natural Heritage (1974);
- The Protocol Concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in Cases of Emergency (1984);
- The United Nations Convention on the Law of the Sea (1985);
- The Convention of the Prevention of Marine Pollution by Dumping Wastes and other Matter (London Convention) and its four annexes;
- The Brussels Convention (1969) on the intervention at high sea;
- The Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment (Jeddah Convention);
- The Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (1988);
- The Convention on the Conservation of Migratory Species of Wild Animals (1986);
- The Protocol Concerning Co-operation in Combating Marine Pollution in Cases of Emergency in the Eastern African Region (1988);
- The Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region (1988);
- The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1996);
- The Montreal Protocol on Substances that Deplete the Ozone Layer (1996);
- The United Nations Framework Convention on Climate Change (1996);
- The Vienna Convention for the Protection of the Ozone Layer (1996).
- The Kuwait Regional Convention on the Protection and Development of the Marine Environment from Pollution (1978);
- The Protocol on Marine Pollution Resulting from Oil Exploration Activities in the Arabian Gulf Region (1989);
- The ROPME protocol for Protection of Pollution of the Sea from Land-based Sources (1990); and
- The Convention on Biological Diversity (CBD).

At the regional level, an agreement was signed by Yemen, Djibouti and Somalia on the establishment of a sub-regional centre to combat oil pollution in the Gulf of Aden. Oil spill response facilities are stored at Djibouti. Yemen and Djibouti are currently negotiating a

bilateral agreement regarding the use of this equipment. On 20 January 1986 Djibouti and Somalia signed a bilateral fishing agreement.

iii. National Legislation

Regionally, a number of Presidential decrees, Public laws, Acts, Ordinances, Strategies and Regulations have been formulated and implemented that concern coral reef conservation. These are too numerous to list country by country, but a degree of overlap exists dealing with oil and other forms of pollution, coastal development and tourism, including landfiiling and dredging, sewage disposal and coral mining, through which coral reefs receive direct and indirect protection. More detailed listings of these instruments are provided in the individual country reports (Pilcher & Alsuhaibany, 2000).

9. Recommendations to Improve the Conservation of Coral Reef Resources

Predominant threats in the region are associated with shipping, pollution from the petrochemical industries and its handling, industrial development, and coastal development that results in degradation of marine habitats through dredging and landfilling, and sewage discharge. The region comprises two highly-used shipping routes: the Arabian Gulf and the Gulf of Aden / Red Sea / Gulf of Suez complex. Thousands of ships utilise these waters each year, and contribute to pollution of marine habitats through oil spills, bilge discharges, solid waste and sewage disposal, in addition to direct damage through groundings and collisions with reefs. Improvement of navigation conditions and waste handling facilities will solve many of these issues. Industrial development, which includes heavy industries, the petrochemical sector, fertilisers and desalination plants all are contributing sources of pollution. Be it in the form of organic matter, hypersaline and hot brine, or residues from secondary petrochemical processes, all find their way to nearby coral reefs. Coastal development is localised but affects large tracts of coastal habitats. Pollution in the form of sewage disposal, landfilling and dredging directly affect coral reefs. There is a need to streamline development activities within coastal management programmes, and to develop and implement legislation that curbs these environmentally degrading concerns. Table I lists the regional action priorities for combating the major threats to coral reefs.

Table I: priority actions for conservation of coral reef resources (adapted from World Bank 1998).

Environmental Issue	*Priority Action*	*Scale*	*Emphasis*
Long-term commitment	High-level commitment by governments to achieve long-term goal of conservation and sustainable use of the Red Sea and Gulf of Aden	Regional National Local	Commitment Public awareness
Public awareness	Development and implementation of a regional programme for environmental awareness, including educational materials, media information, training	Regional National Local	Capacity building Public awareness
International agreements	Ratification of MARPOL Convention, Civil Liability Convention (1969 and 1992) and the Fund Convention (1971 and 1992)	International Regional National	International framework Preventive action
Maritime transport	Adoption of Port State Control by countries in the region	Regional National	National framework for maritime supervision Preventive action
Environmental management	Strengthened capacity of governments to regularly use environmental assessments in development decisions and project	Regional National Local	Preventive action Capacity building Planning studies

	implementation		
Environmental management	Strengthened regional capacity for development and implementation of coastal zone management programmes	Regional National Local	Preventive action Capacity building Planning studies
Habitat conservation	Development of a regional programme for the conservation of key habitats	Regional National	Management programme Capacity building Enforcement
Habitat conservation	Development of institutional capacity and framework for a regional network of Marine Protected Areas	Regional National Local	Management programme Capacity building
Habitat conservation	Rehabilitation of coral reefs from damage by visitors	National Local	Legal framework Management information Management programme Public awareness
Living marine resources	Development and implementation of management programme for shark fisheries	Regional National	Management information Management programme
Living marine resources	Development and implementation of management programme for reef fisheries	Regional National Local	Management information Management programme
Living marine resources	Development of a regional research programme on coral reef management, including coral die-off, fisheries dynamics and environmental monitoring	Regional	Management information Capacity building
Living marine resources	Development of regulations and control mechanisms for the collection of corals and shells for souvenir trade	National	Enforcement Public awareness
Living marine resources	Development of regulations and control mechanisms for the collection of and trade in ornamental fish	Regional National	Legislative framework Enforcement Public awareness
Living marine resources	Measures to control intensive collection of fish and invertebrates on reef flats and spearfishing	National Local	Enforcement Public awareness
Navigation risk	Development of improved Traffic Separation Schemes in coordination with IMO	Regional Sub-regional National	Preventive action Capacity building Management information
Navigation risk	Development and implementation of sub-regional vessel traffic systems for Gulf of Suez, Gulf of Aqaba and Straits of Bab al-Mandab	Sub-regional National	Preventive action Capacity building Technical development
Navigation risk	Review of navigational charts, conduct hydrographic surveys and prepare updated charts for key areas along shipping routes and in vicinity of major ports	Regional Sub-regional National Local	Capacity building Technical development Management information
Petroleum development and transport	Development and implementation of a regional oil spill contingency plan	Regional Sub-regional National Local	Capacity building Technical development
Petroleum development and transport	Expand system of sub-regional marine Emergency mutual Aid Centers by establishing the planned center in hughada, strengthening the existing MEMAC and upgrading national capacities in emergency response	Regional Sub-regional National	Capacity building Technical development Management information
Urban and industrial development	Increased priority for management of solid waste, through technical and non-technical interventions, including public awareness	Regional National Local	Capacity building Technical development Public awareness
Applied research	Preparation and dissemination of species identification guides to coastal and marine resources of the Region in a variety of languages	Regional National	Basic scientific information Capacity building Management information Public awareness

Applied research	Strengthening of environmental laboratory and monitoring capacity, including standardisation of sample collection, testing and reporting procedures on a regional basis	Regional National	Management information Capacity building 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

Appendix I – Selected References

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Appendix II - Acknowledgements

This report was compiled from country reports prepared under the auspices of the Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). We would like to thank the collaborators on each of those reports and all of the researchers who contributed to them. We would also like to thank Prof. Abdulaziz Abuzinada and Dr. Hany Tatwany at the National Commission for Wildlife Conservation and Development for giving us access to material presented at the Regional Workshop on the Extent of Bleaching in the Arabian Region, held in February 2000. Finally we would like to thank Fareed Krupp and Rod Fleming for critical reading of the manuscript. All assistance is gratefully acknowledged.

Appendix III: Table of Existing and Proposed Marine Protected Areas

Country	Protected area	Size	Year of declaration	Major habitats and regional significance	Impacts and conflicts	Management/ Projects	Priority
Djibouti	Maskali Sud Integral Reserve	ca 3 km²	1972	Coral reef and rich reef-associated fish and invertebrate fauna	High recreation pressure, trampling of reefs, collecting of corals, spearfishing,	Low	National
Djibouti	Musha Territorial Park	ca 10 km²	1980	Coral reef and rich reef associated fish and invertebrate fauna, mangroves	High recreation pressure, trampling of reefs, collecting of corals, spearfishing	Low	National
Djibouti	Godoriya	Undefined	Suggested	Extensive mangrove area, Rhizophora and Avicennia, rich mangrove associated fauna	Grazing and wood collecting	None	National
Djibouti	Iles des Sept Frères and Ras Siyan	Undefined	Suggested	Group of high aspect, rocky islands and adjacent coastal stretch with mangrove-fringed bay, diverse coral reef and rich reef associated fish and invertebrate fauna at the junction between the Red Sea and the Gulf of Aden, nesting seabirds	Recreation pressure, fishing, siltation caused by passing vessels	None	Regional *
Egypt	Abu Gallum Multiple Use Management Area	120 km²	1992	Rocky coast, coral reef, seagrass beds, important for fish, birds and terrestrial mammals, mountainous areas near the coast	Recreation pressure	Medium, supported by EU project	National
Egypt	Ashtom El-Gamil	1200 km²	1988	Sandy shore, wetlands, birds, fish and small mammals		Medium	Local
Egypt	Ras Mohammed National Park	480 km²	1992	Coral reef, mangrove, sandy areas, fish, turtles, important for environmental education	High recreation pressure	High, supported by EU project	Regional *
Egypt	Nabq	500 km²	1992	Northernmost mangrove area in the Red Sea, coastal wetlands, seagrass beds, coral reef	Recreation pressure, shrimp farm	Medium, supported by EU project	National/ Regional
Egypt	El-Zaranik	700 km²	1985	Sandy, wetland, migratory birds, reptiles and mammals		Medium	National

Egypt	Giftun Islands and Straits of Gubal	Undefined	Proposed	Group of islands off the western coast with well-developed and diverse coral reefs and rich reef-associated fauna, turtle and bird nesting	Recreation pressure, anchor damage, fishing	GEF-Egypt and EU projects	National/ Regional *
Egypt	Safaga Island	Undefined	Suggested	Small nearshore island off Safaga, mangroves, coral patches, birds	Safaga port shipping, possibly fishing	GEF-Egypt and USAID projects	National
Egypt	Wadi Gamal	Undefined	Proposed	Large terrestrial area, coastal wetland, mangroves, islands, migratory birds	Hunting, plant collection, seasonal flooding	GEF-Egypt and USAID projects	National
Egypt	Sharm al-Lulu	Undefined	Suggested	Small bay with corals on both sides	Unknown, possibly tourism	GEF-Egypt project	Local
Egypt	Ras Banas	Undefined	Suggested	Lagoon with mangroves in inner area and corals at tip	Fisheries	GEF-Egypt and USAID projects	Local
Egypt	Dedalus Island	Undefined	Suggested	Small island 40 km offshore, diverse coral reef	Potential damage from diving	GEF-Egypt and USAID projects	Local
Egypt	Zabareged Island	Undefined	Suggested	Small island, coral reefs, turtle nesting site	Potential damage from divers	GEF-Egypt and USAID projects	Local/ National
Egypt	Brother Islands	Undefined	Proposed	Coral islands with rich coral reefs	Extensive diving	GEF-Egypt and USAID project	Local/ National
Egypt	Offshore reefs near al-Qusair	Undefined	Suggested	Extensive and complex submerged offshore reefs, diverse reef-associated fauna	Anchor damage, coral collection, possibly damage from diving	GEF-Egypt and USAID projects	National
Egypt/ Sudan	Gabal Elba Conservation Area	30000	1986	Terrestrial part with mountains and gently sloping plains, 22 offshore islands of the Siyal and Rawabel groups; extensive fringing reefs, mangrove, seagrass, , fish and mammals	Fishing	GEF-Egypt and USAID project	Regional/ Global
Eritrea	Dahlak Islands	Undefined	Proposed	Low-lying islands, mangroves, coral reefs, seagrass beds, turtle nesting, important bird area, dugongs	Fishing, egg collecting	GEF-Eritrea project	Global*
Eritrea	Dur Gaam & Dur Gella Islands	Undefined	Suggested	Representative land flora and fauna, known turtle nesting beaches, interesting diving & snorkelling locations, minimum conflict with human users	Fishing, diving tourism	GEF-Eritrea project	Regional
Eritrea	Fatuma Island group	Undefined	Suggested	First recipient of Gulf of Aden & Indian Ocean effects, thus a good monitoring point; mangrove, Suaeda saltbush, important nursery area for sharks & other resources, potential turtle nesting beaches	Turtle hunting, fishing	GEF-Eritrea project	Regional

Eritrea	Museri Island group	Undefined	Suggested	Three species of mangrove, Suaeda saltbush, extensive patch coral areas, diver fish communities, significant bird breeding areas including large Crab Plover colony and others.	Limited human use	GEF-Eritrea project	Regional
Jordan	Aqaba coral reefs	Undefined	Proposed	Complex and diverse fringing reefs with a rich and diverse reef-associated fauna at the northern tip of the Gulf of Aqaba	Reef fisheries, recreation pressure, development pressure	GEF-Jordan project	Regional/ Global *
Saudi Arabia/ Egypt	Strait of Tiran	Undefined	Proposed	Islands and extensive coral reefs with diverse reef associated fauna in transition area between Gulf of Aqaba and Red Sea, turtle nesting, dugong	Small part of the area used by tourists from Egypt	None	Regional *
Saudi Arabia	Ras Suwayhil	267 km²	Proposed	Pristine and diverse coral reefs and reef associated fauna, prime example of Gulf of Aqaba reefs, high cliffs, and scenic features, seabirds, dugong	Unknown	None	Regional
Saudi Arabia	Sharm Zubayr coast	80 km²	Proposed	Coastline and sharm with fossil reef cliff, narrow reef flats and fringing reef, northernmost mangroves in Saudi Arabia	Construction of causeway	None	National
Saudi Arabia	Ghubbat Bal'aksh	33 km²	Proposed	Sharm and coastline with reefs, particularly high coral diversity, seagrass beds, osprey, low hills inland	Unregulated recreation	None	National
Saudi Arabia	Sharm Dumagyh, Sharm Antar	70 km²	Proposed	Scenic lagoons with fringing reefs, seagrass beds, mangrove areas, green and hawksbill turtles, osprey, area backed by hills	Fishing and recreation	None	National
Saudi Arabia	Wajj Bank, Sharm Habban and Sharm Munaybirah	2840 km²	Proposed	Extensive shallow water area with mainland coast and offshore islands, most extensive coral reef system of entire Red Sea, diverse reef associated fauna, seagrass beds, mangroves (Avicennia and Rhizophora), turtles, bird nesting sites, key area for dugongs	Collection of turtle and bird eggs, fishing	None	Global *
Saudi Arabia	Qalib Island chain	included in Wajj Bank	Proposed	Series of low lying, sandy islands, seagrass beds and coral reefs, lagoons, important nesting site for turtles and seabirds	Collection of turtle and bird eggs	None	National

Saudi Arabia	al-Hasani, Libanah Islands	Undefined	Proposed	High aspect islands with shallow and deep fringing reefs, high quality coral reefs, important nesting site for turtles and sea birds	Egg collection	None	National
Saudi Arabia	Ras Abu Madd, Sharm Hasi	Will be combined with previous area	Proposed	Scenic sharms and high quality fringing reefs, fossil reef terraces, osprey	Fishing activities	None	National
Saudi Arabia	Ras Baridi, Sharm al-Khawr	30 km²	Proposed	Sand beaches, small islands, high quality coral reefs, seagrass beds, most important mainland nesting beach for marine turtles (green and hawksbill), bird nesting area, dugong	Pollution from industrial source	None	Regional
Saudi Arabia	Sharm Yanbu	50 km²	Proposed	Deep, sheltered, bi-lobed lagoon, mangrove and seagrass beds, fringing reefs, osprey, dugong	Recreation activities	None	National
Saudi Arabia	Yanbu Royal Commission protection area	ca 5 km²	Estab-lished	Mangroves and good quality fringing reef, osprey	Unknown	Medium	Local
Saudi Arabia	Shi'b al-Qirin Reef	15 km²	Proposed	High quality inshore and offshore reef complexes, osprey	Unknown	None	National
Saudi Arabia	Marsa al-Usalla, Marsa Tawil	30 km²	Proposed	Shallow lagoons surrounded by dense stands of halophytes, mangrove, seagrass beds, algal beds, osprey, migratory birds	Livestock grazing on inland halophytes	None	National
Saudi Arabia	Mastura beach	30 km²	Proposed	Low lying shoreline with stands of reed (Phragmites) and palms, rare freshwater dependent vegetation site	Recreation pressure	None	National
Saudi Arabia	Marsa as-Sarraj	200 km²	Proposed	Largest land-locked lagoon on Saudi Arabian Red Sea coast, seasonally inundated, stands of mangroves, halophytes, seagrass beds, high quality reef, osprey, important coastal wetland	Agricultural development, fishing	None	National
Saudi Arabia	Marsa Umm Misk	67 km²	Proposed	Shallow bay with extensive seagrass beds, small stands of mangrove, osprey, dugong	Unknown	None	National

Saudi Arabia	Haramil Island	included in previous area	Proposed	Small elongated island, densely vegetated by halophytes, dugong, osprey, nesting bridled terns and brown noddies	Island used by fishermen	None	National

Saudi Arabia	Ras Hatiba	ca 450 km²	Proposed	Large shallow lagoon, sand and coraline spits, small mangrove stands, offshore reefs, high diversity of habitats, prime site for education and extension	Recreation pressure, unregulated development	None	Local
Saudi Arabia	Jeddah salt marsh	100 km²	Proposed	Marshland and coral reef, key site for birds: large concentration of waders, osprey, spoonbill, flamingos	Oil pollution and other waste disposal, possibly development	None	National
Saudi Arabia	ash-Shu'aybah, Mastabah	ca 100 km²	Proposed	Large lagoon with extensive mangroves, fossil reef terrace and good quality offshore reefs, bird breeding area, osprey	Cutting of mangrove, unregulated development of recreational amenities	None	Local
Saudi Arabia	Qishran	Undefined	Proposed	Complex of reefs, coral spits, seagrass beds and extensive mangroves, important seabird site, osprey, dugong	Development for recreation, possible corniche development	None	National
Saudi Arabia	Inner Farasan Bank	Undefined	Proposed	Low lying, seasonally inundated mainland coastline, fringing mangroves, islands, birds nesting and dugong area	Unknown	None	National
Saudi Arabia	Outer Farasan Bank	Undefined	Proposed	Major reef and island system with diverse habitats, mangrove, seagrass beds, coral reefs, bird and turtle nesting area, representative of central Red Sea	Unknown at present	None	National
Saudi Arabia	Umm al-Qamari	2 km²	1977	Two small islands off the Red Sea coast, with thousands of resident birds such as collared doves, herons, pelicans, gulls and sooty falcon	None	Low	National
Saudi Arabia	Marka Island	Undefined	Proposed	Low, sandy island with dense halophyte vegetation, good quality reefs, bird breeding site	Island used by fishermen, possible egg collection	None	National
Saudi Arabia	Ras Tarfa	230 km²	Proposed	Coastal and terrestrial reserve, large spit with associated mangrove and seagrass beds, key site for numerous marine and terrestrial habitats, important bird area	Possibly hunting	None	National
Saudi Arabia	Farasan Islands	3310 km²	1996	Terrestrial and coastal reserve, archipelago of coral islands, mangroves, coral reefs, seagrass beds, marine mammals, nesting seabirds, two species of mangroves, endemic gazelle	Fishing, development, recreational pressure expected to increase	Terr: high Mar: low	Global *

Saudi Arabia	Khawr Amiq, Khawr Raqa	Undefined	Suggested	Lagoons, osprey	Unknown	None	Local
Saudi Arabia	Khawr Nahoud	ca 33 km²	Proposed	Lagoon with fringing corals, seagrass beds, mangroves, dugong, important bird site, osprey	Presently unknown	None	National
Saudi Arabia	Khawr Itwad	ca 70 km²	Suggested	Lagoon, abundant seagrass, extensive mangrove stands, fringing corals	Unknown	None	Local
Saudi Arabia	Shi'b Abu al-Liqa, Shi'b al-Kabir	140 km²	Suggested	Small lagoonal areas with abundant mangroves, coral reefs	Unknown	None	Local/ national
Saudi Arabia	Khawr Wahlan	27 km²	Proposed	Representative saltmarsh with halophytes, significant coastal wetland area	Grazing	None	National
Saudi Arabia	Duwayyimah	160 km²	Proposed	Productive shallow lagoon, seagrass, mangroves, osprey, dugong	Unknown	None	National
Somalia	Daloh Forest Reserve	2510 km²	Proposed	Rocky evergreen Juniperus forest with Afroalpine vegetation, sandy coastal plain with grasses, gazelles, Somali wild ass, (terrestrial part very important)	Grazing and collection of wood	None	National, (local for marine section)
Somalia	Maidh Island	ca 1 km²	Proposed	Rocky island with an estimated up to 100,000 breeding birds, very large breeding colony of noddy (Anous stolidus)	Guano collection outside breeding season	None	National/ Regional
Somalia	Aibat & Saad ad-Din Islands, Saba Wanak	ca 300 km²	Suggested	Low-lying mangrove islands with probably largest coral reef area in Gulf of Aden, coastal area with 27 water courses, largest salt-marsh, swamp and mangrove area in Gulf of Aden, Rhizophora and Avicennia, very important nesting site for seabirds and probably turtles	Fishing, egg collection, collection of corals	None	Global*
Sudan	Sanganeb Marine National Park	12 km²	1990	Atoll with highly diverse and complex coral reefs, diverse reef associated fauna, sharks, marine mammals, manta rays, only typical atoll in Red Sea	Recreation pressure, anchor damage from tourist boats	Low	Global *
Sudan	Shuab Rumi	ca 4 km²	Proposed	Highly diverse offshore reef with unique reef-associated fauna, sharks, marine mammals	Low recreation pressure, shark fishing	None	National/ Regional

Sudan	Mukkawar Island and Dungonab Bay	300 km²	Proposed	Coral reefs, whale sharks, largest schools of manta rays in entire Red Sea, bird nesting sites, oyster beds	Shark fisheries, oyster culture	None	Regional *
Sudan	Suakin Archipelago	Undefined	Proposed	Coral reefs, diverse fish fauna, important turtle and bird nesting area	Shark fisheries, turtle and bird egg collecting	None	National/ regional
Sudan	Khor Kilab Bird Sanctuary	2 km²	Proposed	Estuary (khor) area with mangrove and salt marsh, important for migratory birds	Unknown	None	National
Sudan	Abu Hashish Recreational Park	ca 5 km²	Proposed	Coral reefs, fishes	Pollution, recreation pressure, fishing	None	Local
Yemen	Socotra Islands	3625 km²	1996	Island group with outstanding terrestrial plant and animal endemism; diverse and largely pristine marine environments and biota	Fishing	GEF-Socotra biodiversity project	Global *
Yemen	Ras Sharma	Undefined	Proposed	Beach and steep rocky headlands, important nesting site for green turtles	turtle egg collecting, possibly slaughtering of turtles	None	National/ Regional
Yemen	Dhobbah (Shihr)	Undefined	Proposed	Shady beaches, important turtle nesting site	turtle egg collecting, possibly slaughtering of turtles	None	National
Yemen	Belhaf and Bir Ali area	Undefined	Proposed	Coastal stretch and 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	Regional *
Yemen	Ras Isa/ Kamaran Island	Undefined	Proposed	Coral reefs with diverse reef associated fauna, mangroves	Oil terminal and chronic oil pollution, threat of major oil spill, reef fisheries for the aquarium trade	None	National
Yemen	Khor Umaira	Undefined	Suggested	Mixed seagrass and coral habitat; semi-enclosed lagoon with turtle nesting beaches	Fisheries	None	National
Yemen	Bab al-Mandab and Perim Islands	Undefined	Suggested	Extensive mangrove stands, dense seagrass beds,	Major shipping lane, pollution, siltation, cutting of mangrove	None	National

Yemen	Ras Isa/ Kamaran Island	Undefined	Proposed	Coral reefs with diverse reef associated fauna, mangroves	Oil terminal and chronic oil pollution, threat of major oil spill, reef fisheries for the aquarium trade	None	National