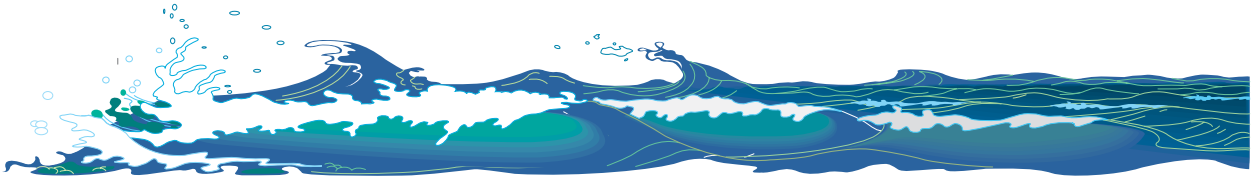
MARINE REGION 11
Arabian Seas

Anthony W. Chiffings



BIOGEOGRAPHY AND BIODIVERSITY

The Arabian Seas Marine Region includes marine areas from Djibouti to Pakistan, including the northern part of Somalia, the Red Sea, the Gulf, and parts of the Arabian Sea.[1]

Coastal and marine environments throughout the Arabian Seas Region are subject to increasing human pressures, many of which appear to have resulted in harmful environmental effects. Oil, phosphate mining (Hanna 1982, 1983a), and domestic, urban and industrial pollutants are a problem in several areas in the Gulf and the Gulf of Aqaba and have resulted in local habitat degradation, eutrophication and algal blooms. Throughout much of the Arabian Seas the coastal zone is becoming a repository for solid wastes. In the Red Sea, the ecological effects from oil exploitation, phosphate mining (Hanna 1982, 1983a,b), and industrial inputs (such as from mining) are of increasing concern, and will become more so if deep-sea metalliferous mud begin to be mined (Hanna 1983a; Nawabi 1983).

Ecological problems also result from the loss and degradation of productive coastal habitats caused by coastal landfill, dredging, and sedimentation. In some Gulf States (for example, Saudi Arabia), 40 percent of the coastline has now been developed, and a significant proportion of the shoreline of countries such as Kuwait and Bahrain is artificial. Loss of habitat extends to other parts of the region and to the wider Indian Ocean where approximately 50 percent of mangrove forests may have been lost over the last 20 years (IUCN/UNEP 1985c). Overfishing is a major concern in all areas of the region.

Degradation of coral reefs from heavy collecting and other recreational and tourism uses is becoming widespread, particularly in the Red Sea (Hanna and Ormond 1982; Ormond 1981; Hanna 1991). Fishing and hunting of adult turtles and birds (and their eggs) is extensive in some areas (Hanna 1994). The effects of land-based activities such as nutrient and sediment runoff from

phosphate mining (Hanna 1982; Hanna and Ormond 1982), agriculture and grazing, and reductions in freshwater seepage due to groundwater extraction are also contributing to degradation of coastal environments.

Oceanography

The Arabian Seas Marine Region is a natural unit created by the geological history that formed the Arabian peninsula and its associated regional seas and the maritime climate that is dictated primarily by the seasonal monsoons associated with the Asian continent.

Map 11 shows ideal summer and winter wind distribution and surface circulation patterns for the Indian Ocean. Wyrtki (1973) and Shepherd, Price, and Roberts (1992) provide concise descriptions of the physical oceanography of the Indian Ocean, including the monsoon gyre.

The Red Sea, a product of deep-ocean rifting, extends for 2,100 kilometers from Suez to the Strait of Bab el-Mandeb, which connects it with the Gulf of Aden and the Indian Ocean. The Sea has an average depth of 500 meters, with a maximum of over 2,000 meters, and is noted for some of the hottest and most saline seawater in the world. In the south, surface water temperatures exceed 30°C in summer, while salinity is $40^{o/oo}$ in the north in winter and up to $46^{o/oo}$ in the middle of the Suez Canal.

The Red Sea has a number of unique features. It is the warmest and most saline of the world's seas. It has no permanent inflowing coastal rivers or streams, only sudden brief torrents, and mostly northwesterly prevailing winds, which contribute material to the sea floor. The nature and distribution of sediments are unlike those in other seas. The Red Sea is partially isolated from the open ocean (Hanna, personal communication). It is located in an arid, tropical zone. Rainfall in general is sparse and varies widely, with particular areas receiving no rainfall for months or years. Over the sea, rainfall may amount to as little as 10–15 millimeters per year, whereas along the coastline its estimated range is from a few millimeters per year along the northern part of the western shore, gradually increasing to 180 millimeters at Suakin (19°N) (Edwards 1987). These unique features have contributed to making the Red Sea vulnerable to the impacts of human activities.

The Gulf, in marked contrast, is a shallow sedimentary basin with an average depth of 31 meters. Freshwater is supplied by the Shatt el Arab and some Iranian rivers. Surface water temperatures range from 32–33°C in summer to 22–24°C in winter in the south but only 16°C in the north. Salinities generally range from about $38–40^{o/oo}$, increasing to more than $60^{o/oo}$ in areas such as the Gulf of Salwa, but falling to around $37^{o/oo}$ in the Gulf of Oman. Tides in the Kuwait region range up to 3.5–4.0 meters, whereas south of Al Kobar, on the Saudi coast, they are is less than 1 meter. Even so, strong tidal flows occur throughout the Gulf.

The Gulf of Oman is deep and largely open to the influence of the northern Indian Ocean (Arabian Sea). The oceanic coasts of Yemen and Oman are completely open to the influence of the northern Indian Ocean and are, in parts, subject to large oceanic upwellings that bring nutrientrich water to the surface, causing high productivity.

The coast of Pakistan constitutes the northern boundary of the Arabian Sea, with oceanic influences dominating over those of the continent, which is essentially a subtropical dessert. River flows are monsoonal, with the only major freshwater input coming from the Indus, at the eastern extremity that discharges some 200,000 gallons of water and 450 million tons of suspended sediment annually and forms the Indus cone, a subaqueous delta 1,500–2,000 kilometers long (Pernetta 1993).

Currents in the Gulf and the Red Sea largely result from density gradients in the

water column. Evaporation in the Gulf causes movement of water inward through the Strait of Hormuz. Surface salinity is highest in the two large southern Gulf embayments where greatest evaporation occurs. Denser water formed in these regions sinks toward the Strait of Hormuz while less-dense water enters along the surface and northern edge of the Strait, moving in a counterclockwise surface current and leaving the Gulf in the deeper and southern part of the Strait (Sheppard, Price, and Roberts 1992).

Currents in the Arabian Sea result from the removal of surface water during the summer monsoon and its replacement by cooler upwelling water (Sheppard, Price, and Roberts 1992).

Surface water density in the Red Sea rises with a fall in water temperature to the north and evaporation causing increased salinity. Decreasing temperatures and evaporation in the Gulf of Suez result in the formation of dense water that turns under and is returned southward in the deep Red Sea (Sheppard, Price, and Roberts 1992).

Circulation and exchange in the Red Sea is not well understood, but is thought to be quite complex as a product of the low-energy regimes involved. In simple terms though, in winter (September–June) surface water is driven into the Red Sea by prevailing winds from the southeast, beneath which there is a deep outward flow of more dense, saline water. During summer, prevailing winds change to the northwest, driving the upper water layer out of the Red Sea over a deeper inward flow from the Gulf of Aden. Net outflows are 10 percent higher in salinity, and balance the effects of evaporation in the Red Sea.

Tides in the two regional seas are in the range of 0.5–1.5 meters. In both the Red Sea and the Gulf, tidal movement provides nutrients necessary for the vigorous growth of benthic biota. The central Red Sea is almost tideless and has wind-driven seasonal changes in water level that are more significant.

The Arabian Sea coastline of the Arabian peninsula has a tidal range of 1.5–2.5 meters over most of its length, but these tides are thought to be subordinate to the persistent impact of high-energy waves (Sheppard, Price, and Roberts 1992). The Pakistani coast has tides of up to a 3.5-meter range (Pernetta 1993).

Coastal Geography and Geology

The main body of the Red Sea lies in a rift valley separating the African and Arabian plates (Drake and Girdler 1964; Quennel 1958). Plateaus and mountains rise steeply to more than 1,000 meters above sea level north of Jeddah and 3,660 meters in Yemen. The coastal plain is from 2–50 kilometers wide and slopes up gently to the east until it meets the mountains. The mountains are deeply cut by valleys but streams flowing in the uplands fail to cross the coastal plain to reach the sea (Schwartz 1982).

The Gulf of Aqaba is 170 kilometers long and 14–26 kilometers wide and forms part of the Afro-Syrian Rift System with steep walls dropping to great depths (2,000 meters in places). It is separated from the Red Sea by the 6-kilometer wide Straits of Tiran. Fringing reefs lie along most of the Sinai Peninsula shoreline (Hanna, personal communication).

The Gulf of Suez is a wide, shallow basin with an average depth of 20–30 meters, greater depths in the central trough, and a depth of 90 meters at the entrance to the Red Sea. The fringing reefs in the Gulf of Suez are not as well developed as those in the Gulf of Aqaba.

The Red Sea Barrier Reef is located 10–40 kilometers off the coast of Saudi Arabia and is about 400 kilometers long and several kilometers wide. The platform surface is 30–60 meters deep, on which sit many steep-sided patch reefs. Almost continuous

marginal coral reefs occur along much of the coast from the Gulf of Aqaba to the Strait of Bab al-Mandeb. A similar description of the reef morphology also applies to the African side of the Red Sea. The mainland coast along the southern Red Sea has experienced less uplift than other areas, with some subsidence in recent times. The Farasan and Dahlak Archipelagos are relicts of an ancient carbonate platform a few hundred meters thick that grew on ancient evaporitic salt deposits.

The Gulf lies between the Arabian and Iranian plates, and there is a strong contrast between the sheer eastern coast and the flat, low western coast. The Arabian western coast is generally low, flat and sandy. Beach sands may be cemented into beach rock. Often a sandbar overtopped by dunes isolates large lagoons flooded in winter but dry and covered by salt or gypsum for the rest of the year. Extensive algal and intertidal flats occur south of the Bahrain archipelago. The coast of the United Arab Emirates is characterized by a number of broad, sandy flats and lagoons and edged with barrier and fringing reefs.

At the northern end of the Gulf is the vast deltaic plain of the Euphrates, Tigris and Karun rivers that is formed of swamps, sandbars, spits and islands with fluctuating boundaries. The eastern coast is a region of extensive continental sedimentation. It is flat and low as far as Bushehr, then rocky and cliffed. In front of Ras Musandam the coast forms a large recess at the Strait of Hormuz, with two main islands—Queshm and Hormuz. Along the north shore, cliffs and deltaic plains alternate.

The open, oceanic coast of Oman and Yemen includes sandy and rocky stretches with ragged cliffs. The southern coast of the Arabian peninsular is composed of rocky headlands with cliffs alternating with shores of fine sands buffeted by oceanic swells.

The Baluchistan coast (700 kilometers, 75 percent of which is in Pakistan) is steep with rugged outcrops and is dominated by short, sandy beaches backing on to high, near-vertical cliffs or sometimes sandy plains or dunes. Much of the area is volcanically active. Eastward, greater variation occurs, from steep cliffs, up to 145 meters high, to tidal lagoons, including tidal deltas, and mud volcanoes. The Indus Delta, with its extensive mudflats, tidal channels and mangroves, has already been described (see Pernetta 1993).

Ecosystem Diversity

The following discussion is adapted from Sheppard, Price, and Roberts (1992) and Hanna (1991 and 1994).

Sabkha

Sabkha is a widespread inter- and supratidal habitat, measuring many kilometers across in places. It forms flat plains, with crusts of sodium chloride and gypsum, with important “algal mats” a few centimeters thick, beneath which is a black reducing layer. The mats are complex associations of cyanophytes, bacteria and diatoms. Pools are a special feature of sabkha. Those with subterranean connection with the sea have a relatively high benthic diversity. With increasing isolation from the sea, diversity falls and the persistent microbial biota then forms a typical mat. These are highly productive and fix nitrogen. When desiccated in summer, mats become dry and crisp, breaking into characteristic polygons.

Large areas of Sabkha are found in the United Arab Emirates, the Bar al Hiskmann peninsula in Oman, along the shores of the Gulf of Suez, and much of the Saudi Red Sea coast.

Marshes and Wetlands

Salt marshes have been greatly reduced or eliminated throughout much of Arabia, although marshes of the Shatt al Arab still

cover approximately 18,500 square kilometers. Eleven halophytic community types have been described, largely on the basis of elevation and periodicity of immersion. In places, reed vegetation is strongly enhanced by sewage enrichment, when it may reach heights of up to 5 meters. In the Gulf and parts of the Red Sea (not the northern Red Sea), many new marsh communities are appearing as a result of sewage outfalls along the coast of Saudi Arabia and near Port Sudan. Enrichment not only stimulates marsh development, but in the case of the Red Sea, also adds significant nutrient loads. These areas act as a focus for numerous species of birds, especially migrants.

About 3 percent of the Egyptian coast is comprised of saltmarsh (Hanna 1994). Saltmarshes in the northwestern Red Sea are located around Ras-Mohammed, Abu-Monqar, Wadi El-Gemal islands and Gebel Elba.

Numerous deltas and estuaries with extensive intertidal mudflats and their associated wetlands occur along the Pakistani coast. The Indus Delta has an estimated 3,000 square kilometers of delta marshes.

Sandy Shores

Most sandy shores in the northern Red Sea are narrow beaches adjoining coral reef flats, which themselves are usually narrow. Broader beaches occur where the reef edge swings further out from shore, leaving a lagoon. Sand beaches are most important and extensive in the Arabian Sea. A study by McCain (1984) found that in the Gulf every square meter could contain 400,000 animals, each over 0.5 millimeters in size, with faunal abundance significantly correlated to slope. The total number of species found in this study was 147, much less than on the rocky shores. Sandy beaches are also a feature of parts of the Gulf of Oman and the Pakistani coastline.

Rocky Shores

The diversity of rocky shores is significantly higher than that of sandy beaches or mud, although biomass may be less. Hanna (1994) found that about 20 percent of the Egyptian Red Sea coast is formed by rocky, erosional, wave-cut cliffs. Basson and others (1977) note that the rocky intertidal in the Gulf is much less productive than sandy intertidal areas, attributing this to intense heating at low tides in summer. The rocky shores of Oman show a general increase in diversity southward, although little taxonomic work has been done in this area (Jones 1986; Campbell 1988).

Detailed descriptions of the Red Sea are provided by Jones, Ghamrawy, and Wahbeh (1987). Much of the available rocky intertidal zone of the north occurs in erosion notches of fossil cliffs. These provide a more moist and sheltered habitat than do the horizontal expanses of intertidal rock that are common in the south and support a greater range of the fauna.

Rocky shores are a major feature of the Gulf of Oman and the Pakistani coastline, as well as the Arabian Sea shore of Oman and Yemen.

Mangroves

The mangroves of Arabia include communities that grow on soft-bottom and hard-bottomed substrates, the latter being more prevalent in the northern Red Sea. Compared with other Indian Ocean mangroves, the number of mangrove and associated species in the Arabian Seas Marine Region is low, although most of the characteristic faunal zones are still present. Low diversity is attributed to the generally severe climatic and environmental conditions (such as high salinity), in conjunction with the more limited range of suitable habitats and niches.

Avicennia marina grows in both types of substrates and is the dominant mangrove species, tolerating the high salinities (40–

50$^{o/oo}$) and extremes of water temperature (12–35°C) associated with the Arabian Seas region. In the Red Sea, three other species are known but are uncommon. The northern latitudinal limit (27–28°N) of naturally occurring mangal ecosystems in both the Red Sea and Gulf is attributed largely to cold winter temperatures.

Mangroves are tallest (5–7 meters) in the southern Red Sea, where the continental shelf is wider and the intertidal slopes more gradual, allowing development of better sedimentary conditions. In parts of Oman, *Avicennia* reaches 6 meters, whereas in the Gulf it is poorly developed and often stunted (1–2 meters), at least along western shores. Productivity of mangroves in the region is considered to be generally low, with the exception of the Indus delta (see below), although few quantitative studies have been undertaken.

Interactions between mangroves and adjacent ecosystems are probably greatest in the southern Red Sea and undoubtedly make a significant contribution to coastal productivity. Important mechanisms include transfer of nutrients and energy, aided by movements of fauna. Stabilization of shoreline sediments is also enhanced by mangroves, particularly in the southern Red Sea.

The Indus Delta has an estimated 44 percent of its intertidal area (260,000 hectares) covered in mangroves of four species, *Avicennia officinalis, Rhizophora conjugata, Ceriops tagal,* and *Salsola foetida,* that reach heights of 12–15 meters. These species line the tidal channels that extend inland for considerable distances. Tidal influence reaches 97 kilometers upstream as far as Tatta. These mangrove systems are extensively studied (Pernetta 1993). Mangrove areas are also found at other sites along the Pakistani coast.

Coral Reefs

The diverse and spectacular coral reefs for which the Red Sea is renowned are found only in its central and northern half. North of 20°N reefs are typically well developed and drop steeply into deepwater; south of 20°N, reefs occur in a shallow, turbid environment and are less developed. Greatest development occurs in offshore barrier reefs and in reefs fringing 1–7 kilometers wide alluvial plains on the mainland. Thinner reefs cover the Gulf of Aqaba and other northern shores. The continental shelf widens to the south and mainland shores are dominated by mangrove and sand beaches. Well-developed reefs occur around the Farasan and Dahlak Islands, which also support extensive mangroves.

The Gulf of Aden has very poor reefs because of upwelling water and sandy shorelines, and this condition continues down the coast of Somalia for 500 kilometers and north to the Muscat area of Oman. Further north, Musandam has the most diverse reefs, while Iran probably has the most developed. The coast of the United Arab Emirates is low lying and mostly swampy. Offshore the water is very shallow and rich in seagrasses, and while it is generally muddy and unsuitable for most corals, there are numerous patch reefs.

Algal reefs occur in the southern Red Sea in low-energy conditions. They support dense brown algal cover and provide important hard substrate in otherwise sandy areas.

A longitudinal series of coral reefs lie along the axis of the Red Sea on ridges resulting from normal faulting and upward movement of underlying salt deposits. These are widespread in the Red Sea. Atolls are also numerous and are found mostly on the ridges. Diverse reefs are found between Ras Shukhei and Quseir along the Egyptian coast and in the area of Ras Mohammad and the Straits of Tiran (Hanna, personal communication).

There is a fairly distinct Arabian coral species grouping. Within it, there is a single, principal division into a Red Sea group, and a Gulf of Oman/Arabian Sea group, which then fuses with the Gulf. In the Red Sea there are 13 principal coral communities, some of which can be subdivided further into a total of 22 recognizable units. Most show considerable localization, correlated with latitude but linked with gross changes in coastal bathymetry and morphology. On any one reef in the Red Sea, the general pattern of coral diversity with depth follows that of most Indo-Pacific reefs, rising to a maximum at 5–20 meters deep before declining. About two-thirds of species have a depth distribution that is not significantly skewed to deep or shallow water. Coral cover is usually less than 50 percent, but in sheltered areas one or two species, especially *Porites,* may cover 80 percent of the substrate.

In the Gulf, fewer coral communities exist: only five are recorded from Bahrain. Kuwait, Qatar, Bahrain and the United Arab Emirates have 30 species or less. Despite this, coral cover is high. The richest reefs known surround Saudi Arabian coral cays. At the entrance to the Gulf, Musandam contains reefs dominated by *Porites* and *Acropora.* In the Capital Area of Oman, substantial monospecific reefs of *Pocillopora damicornis* occur. Coral-dominated communities become rare further south.

Seagrasses

Eleven seagrass species are known for the Arabian Seas Marine Region, of which *Halodule uninervis* and *Halophila ovalis* are the most prevalent. Diversity is greatest in the Red Sea proper (10 species) and lowest in southeast Arabia (4 species) and the Gulf (4 species). Seagrass beds also attain greatest development in the Red Sea, particularly toward the south, despite the reverse trend shown by certain species. The seagrass distribution and diversity of the Pakistani coast is not well described at this time.

Studies on seagrass standing crop have been undertaken mostly in the northern Red Sea. Highest biomass is associated with *Thalassodendron ciliatum, Thalassia hemprichii* and *Syringodium isoetifolium*. Biomass of *Halodule uninervis*–dominated communities in the Gulf are comparable to figures for similar species in the Red Sea and elsewhere.

Seagrasses provide a mostly indirect food source and habitat for both resident fauna and temporary visitors, including commercially important fish and crustaceans (for example, *Penaeus semisulcatus).* Despite regional variation, available data suggest that both species richness and abundance of fauna are greater in the Gulf than in the Red Sea, at least in its northern parts. Benthic fauna (within seagrasses and sand or silt) in the Gulf are principally suspension feeders, that utilize more abundant organic particulates than occur in the clearer waters of the northern Red Sea.

Upwellings

In summer, prevailing winds flow down the Red Sea for its entire length, reinforcing the clockwise airflow in the Arabian Sea. This generates strong southwesterly winds, leading to cool, nutrient-rich upwelling. Upwellings result in higher nutrients and the development of Ecklonia kelp beds in places, inhibiting the development of coral reefs.

Species Diversity

The following discussion is adapted from Sheppard, Price, and Roberts (1992).

Plants

Seaweeds
There are extensive areas dominated by macroalgae on both reefs and other sub-

strates. Brown algae are mostly of small species, although large forms occur on reef crests and in the Arabian Sea where upwelling is important. Green and red types are ubiquitous, the latter including some species that grow deeper in the Red Sea than anywhere else due to their utilization of blue light and energy-conserving growth patterns. Calcareous red algae are mainly restricted to very shallow areas. For many species, vigorous water movement is essential, although dense algal growth also occurs on unconsolidated substrate, helping to stabilize it. In a list derived from numerous earlier collections, Papenfuss (1968) recorded nearly 500 species of algae from the Red Sea. Basson and others (1977) and Basson (1979) recorded only about one-tenth of this number of fleshy algae in the Gulf, and there has been little systematic collecting subsequently to indicate what the true numbers are.

In the Gulf there is usually a gradation from coral to algal domination on limestone platforms as stress increases, causing a demise of both corals and reef growth. In these conditions, usually termed "marginal," algal dominance arises from shading, greater tolerance of temperatures below 18°C, and high levels of dissolved nutrients.

Phytoplankton

Many species of plankton found in the Indian Ocean are absent from the Gulf and the Red Sea. Of 452 known Indian Ocean dinoflagellates, 130 have been recorded in the Arabian Sea, 88 in the Red Sea, and fewer still in the Gulf. The decline westward in the Red Sea is partly compensated by the presence of several endemics and by blooms of *Oscillatoria erythraeum.* Cell densities similarly decline westward. While the trend is similar in winter and summer, winter cell counts are one to two orders of magnitude greater. There is a large input of mesoplankton from the Gulf of Aden at peak times of influx, though most do not survive beyond the central Red Sea. In the Gulf, plankton densities are much greater than in the Red Sea, most being diatoms. Phytoplankton in the Arabian Sea is also dominated by diatoms as is typical of tropical upwelling areas. This area is the most fertile part of the Arabian Seas Marine Region

Pelagic primary productivity of the Red Sea is highest in the south. In the very clear Gulf of Aqaba, significant production continues to depth of about 200 meters (compared to 40 meters in the Arabian Sea). Summer values are approximately half those of winter.

Zooplankton

Zooplankton diversity declines westward. Peak numbers throughout the Red Sea lag a few weeks behind those of phytoplankton. Calanoid copepods are the most important group with 300 species in the Arabian Sea, 60 in the southern Red Sea, and 46 in the north. Euphausiids are important in terms of biomass, although of 22 Indian Ocean species, only 10 occur in the Red Sea. In the Gulf, zooplankton shows marked temporal and geographic variation; diversity is less than in the Arabian Sea but is similar to that in the Red Sea with 33–45 species per cubic meter near offshore islands. Densities are high and as many as 3,000 individuals per cubic meter have been recorded.

There is marked vertical stratification of zooplankton in the Red Sea. Peak diversity and abundance remain within the photic zone, but a secondary maximum is found near the oxygen minimum layer at 400-meters. Close to shore, demersal zooplankton and larvae of reproducing invertebrates tend to dominate measurements of numbers and productivity.

Fish

There are marked differences throughout the Arabian Seas Region in the structure and composition of fish assemblages, re-

flecting the heterogeneous nature of the environment.

The most diverse assemblages occur within the Red Sea with a total of approximately 1,000 species present (including nonreef species). The Gulf supports only about 200 species in total, of which at least 125 are found on reefs. Within the Red Sea there are major differences in assemblage composition between areas north and south of latitude 20°N. This may be due to the differences in reef habitat between these areas or differences in water quality, particularly the limit of penetration by nutrient-rich water from the Gulf of Aden (which occurs at around 20°N), and north–south gradients in temperature, salinity and turbidity.

The Gulfs of Aqaba and Suez support distinctive fish assemblages. Those of the Gulf of Suez share greater affinities with southern Red Sea assemblages than with the Gulf of Aqaba, probably due to its shallow, turbid nature. The Gulf of Aden marks a division between a fauna dominated by Red Sea species to one dominated by Indian Ocean species in the Gulf of Oman and the Gulf. Upwelling of cold water in the Arabian Sea appears to provide this major biogeographic barrier. Compared with the Red Sea, reefs of the Gulf and Gulf of Oman support low-diversity fish assemblages. This probably reflects the scarcity of reef habitat and the extreme environmental conditions.

Although the region is relatively rich in terms of commercial finfish and shellfish species, the fisheries sector plays only a minor role in most national economies. In most countries the contribution of the fisheries sector to the gross domestic product is less than 1 percent. However, in the Sultanate of Oman revenue from fish was equivalent to 36.5 percent of the total oil export revenue for 1984, and fish currently are the most important export product after petroleum. In general, fisheries of the region seem to be suffering from overexploitation. This is particularly true in the case of the shrimp fisheries. Aside from overexploitation resulting from inadequate fisheries management, degradation of the environment is probably a major cause of the decline in fish and shrimp catches. This degradation includes the elimination of important nursery areas (especially for shrimp) by land reclamation and dredging in the coastal areas, destruction of feeding and breeding habitats by bottom trawling, and increased marine pollution by discharge of liquid and solid wastes into the marine environment. In addition, selective fishing for species of predator fish may have upset the balance between the different species.

Table 11.1 Breeding Turtle Records and Counts around Arabia

Location	*Green*	*Hawksbill*	*Loggerhead*	*Olive Ridley*
Gulf islands	750–1,000	100–300		
Daymaniyat Islands	+			
Capital Area, Oman	+	+		
Rass al Hadd	6,000			
Masirah Island	+	80	30,000	230
Gulf of Kutch				+
Gulf of Aden	—			
Red Sea	+	+		

— Data not available.

Marine Reptiles

Sea Snakes

A recent review of snakes of Arabia (Gasperetti 1988) records that of the 55 species of sea snakes, 9 or 10 occur in some coastal waters of Arabia. All but one species of sea snake are found in shallow coastal waters, which may be turbid and where there is organically rich substrate. Notably, sea snakes do not occur in the Red Sea.

Turtles

Table 11.1 gives details of breeding turtle records and counts around Arabia (Miller, personal communication; Symens, personal communication; Sheppard, Price, and Roberts 1992).

The region is now very important for several species of turtles. A significant reduction in numbers of turtles from overexploitation has taken place (Miller 1989; Frazier, Bertram, and Evans 1987). The most important part of the region for turtles is the Arabian Sea both in terms of numbers of breeding species and abundance of nesting individuals. Present levels of turtle populations are clearly reduced, providing a focus for conservation efforts in the region (Clarke and others 1986).

Marine Mammals

Dugong

The dugong occurs in both the Gulf and Red Seas. It has not been recorded along the Arabian shores of the Arabian Sea where very few sites of suitable habit occur. In Oman, there have been no confirmed sightings of dugong. The estimated Gulf population is 7,310 (about 1,300) individuals, making this the most important area for the species in the western part of its range, and second in global importance only to Australia. In the Red Sea dugong are estimated to number about 4,000. Dugong are actively hunted and are also caught accidentally (Preen 1989).

Whales and Dolphins

There has been no systematic survey of whales or dolphins in any of the coastal waters of the Arabian Seas. The greatest number of records come from the Arabian Sea, where both dolphins (and toothed whales) and several baleen whales have been reported. At least a dozen species of dolphin, and finless porpoise, have been recorded for the Arabian Sea and coastal waters. Fourteen species of cetacean, including three species of great whale (blue, Bryde's and sperm), have been recorded in the Gulf of Aden (Smith and Smith 1991).

Gallagher (1991) lists 14 species of toothed whale and dolphin from Oman, based on a collection of stranded carcasses. Humpback whales are believed to breed off Oman, and the highly productive upwellings that occur along this coast are thought to be an important feeding area for this endangered species (Reeves, Leatherwood, and Papastravrou 1991). Papastavrou and Salm (1991) describe a small-scale marine mammal fishery in Oman.

Basson and others (1977) reported that several species of dolphin occur in the Gulf, some in schools of hundreds. Four small-cetacean species are known to occur in the Gulf, including the finless porpoise (*Neophocaena phocanoides*). Three to four species of great whales have also been recorded, although it is probable that these animals are not resident but strand after becoming trapped (Preen, personal communication).

Concern about the long-term survival of marine mammals in the Gulf has arisen as a result of a series of die-offs. In 1983 at least 38 dugong and 33 dolphins stranded along the Saudi Gulf and Bahrain. This die-off was coincidental with the Nowruz oil spill, but there was no direct evidence to link the two events (Preen 1989). In 1986 over 500 dolphins died in Saudi Arabia,

Bahrain and Qatar (Preen 1991). In 1991 at least 79 dolphins and 14 dugongs stranded along the Saudi coast of the Gulf of Salwa. This die-off coincided with the Gulf War oil spill, but occurred several hundred kilometers south of the most heavily polluted area (Preen 1991).

Frazier, Bertram, and Evans (1987) reported that eight species of dolphins and toothed whales occur in the Red Sea and claimed that the Spotted dolphin (*Stenalla attenuata*) was the most common. IUCN/MEPA (1987) reported from their coastal surveys along the Saudi coast that more than 90 percent of dolphin sightings were of the common dolphin (*Delphinus delphis*), whereas in the southern Red Sea, at least around the Farasan islands, the spinner dolphin (*Stenella longirostris*) is the most abundant species (Preen, personal communication). These differences in reporting may reflect either an area difference, or misidentification. While baleen whales were not reported by Frazier, Bertram, and Evans (1987) or IUCN/MEPA (1984, 1987) more recent evidence suggests that some whales are relatively common in at least the southern Red Sea. Four whales, thought to be Bryde's whales, were observed during an aerial survey of the Farasans in August 1987 (Preen 1989), and in another survey in September 1993, three animals were seen (probably *Balaenoptera edeni*) and four skeletons located. Local fishermen maintain that whales occur in the area all year-round (Preen, personal communication). Four whale skeletons, possibly *B. edeni, B. physalus, B. borealis*, and *B. musculus*, were recorded in Yemen in 1988 (Preen, personal communication) and whales, possibly Bryde's have been seen blowing off Kamaran Island (Porter, personal communication).

It should be noted that the whole of the region is part of the Indian Ocean Whale Sanctuary established in 1979 to provide protection to the great whales from commercial whaling (Holt 1983).

Biogeographic Classification

The following provisional biogeographic classification of the Arabian Seas Region was prepared by Tony Chiffings and is based on the approach of Hayden, Ray, and Dolan (1984) and other sources as noted (see Map 11).

Realms and Regions

Hayden, Ray, and Dolan (1984) defined an equatorial boundary separating the northern Indian Ocean from the greater part of the Indian Ocean at between 5–10°S latitude. They consider it to be a single ocean realm. This classification is well supported by the physical evidence. Regional circulation is strongly influenced by monsoons down to a latitude of 10°S, resulting in a semiannual reversal of the surface circulation. Regional water movement is also influenced by the outpouring of cold, high-salinity water from the Arabian Gulf, and to some extent the Red Sea, leading to an independent rudimentary meridian circulation (Dietrich 1973). It should be noted that in no other ocean does such a reversing, monsoon gyre form (Wyrtki 1973).

The boundary between the northern Indian Ocean monsoon system of circulation and the subtropical gyre is well defined by a subsurface front that separates the low-oxygen, high-nutrient waters in the north from the high-oxygen, low-nutrient waters in the south (Wyrtki 1973). Nutrients, chlorophyll "a" concentrations, and primary production data presented by Krey (1973) also support this division.

Wyrtki (1973) provides a concise description of the physical oceanography of the Indian Ocean, including the monsoon gyre. Sen Gupta and Naqvi (1984) review the chemical oceanography of the northern Indian Ocean.

Hayden, Ray, and Dolan (1984) considered the coastal area from Pakistan to Somalia to be the Coastal-margin realm

"Eastern monsoon (J)," a realm that also appears on the eastern side of India. Both share common wind distribution and surface current patterns. The important distinction between the two is the high volume of river runoff in the Bay of Bengal and a large excess of evaporation over precipitation and runoff in the Arabian Sea, Arabian Gulf and Red Sea (Sen Gupta and Naqvi 1984).

The Red Sea and Arabian Gulf are both considered by Hayden, Ray, and Dolan (1984) as marginal seas. Again, this distinction is well supported by the physical oceanographic evidence (for example, Detrich 1973; Wyrtki 1973; Morcos 1970 and Hunter 1982 and 1983).

Comparison of surface distributions of temperature, salinity, oxygen, phosphate-phosphorus, nitrate-nitrogen, relative transparency, and silicates all suggest that Socotra Island and its associated islands should be considered a barrier between the eastern Somalia coast and the Gulf of Aden and that the Gulf of Aden should be considered a region separate to both the Red Sea and the upwelling area along the Oman coast. Based on these data the latter should also be considered a region in its own right (Swallow 1984; Currie, Fisher, and Hargreaves 1973; Wyrtki 1973; McGill 1973; El-Sayed and Jitts 1973). Distribution data for total pigment concentrations during both monsoon periods for the Red Sea and western Arabian Sea presented by Halim (1973) also support this conclusion.

Tertiary production data for the Indian Ocean presented by Cushing (1973) support both the classification of the northern Indian Ocean into a distinct realm, and the identification of the areas adjacent to the Omani and northern Somali coasts as distinct regions. Limited total net biomass distribution data presented by Rao (1973) also support the latter conclusion.

Based on temperature and salinity data and inferred circulation (Morcos 1970; Edwards 1987), five distinct regions are recognized within the Red Sea. The southern (RS1), central (RS2) and northern (RS3) Red Sea form distinct regions based largely on salinity discontinuities and inferred mixing.

Weikert (1987) describes a sharp nutrient decline in surface waters at 19°N consistent with the maximum extension of Gulf of Aden water, which is presumably reflected also in the rate of salinity change shown in Edwards (1987). Weikert (1987) also divides the body of the Red Sea into three regions in tabulated data for daily primary production, phytoplankton and zooplankton biomass, and abundance of the oceanic waters. The northern segment extends down to 24°N, the central segment from there on down to 18°N, and the southern segment from there on. These divisions fit well with the physical parameters.

The Gulf of Aqaba (RS4) and the Gulf of Suez (RS5) form two additional distinct regions, with the Gulf of Suez being relatively shallow (50 meters), vertically well mixed due to wind, and having well-developed latitudinal salinity and temperature gradients. This is in contrast to the Gulf of Aqaba that, as a deep (800–1,800 meters) continuation of the Red Sea, has seasonally related vertical mixing and less evident salinity and temperature gradients (Morcos 1970).

The Arabian Gulf has been regionalized on the basis of temperature, salinity, and circulation patterns presented by Hunter (1982) into five biogeographic regions. As with the Red Sea, discontinuities in salinity have been used as the principal demarcation element. The Arabian Gulf is a shallow sea (mean depth 35 meters) where evaporation exceeds runoff and precipitation gives rise to dense, saline waters, particularly in the shallow areas (less than 10 meters) of the southern and southwestern coasts (Hunter 1982). These areas form three of the regions determined here in this report—the Kuwait-Saudi coastal region (AG3), the Gulf of Salwa (AG4), and the Qatar-UAE region (AG5). The strongly influenced freshwater region of the Shatt-al-

Arab (AG2) and the body of the Gulf from a 10-meter depth across to the Iranian coastline (AG1) form the forth and fifth regions, respectively.

Faunal Provinces

The Somalia, southern Arabian peninsula, and Arabian Gulf coasts are classified as a single faunal province (Western Indian ocean) by Hayden, Ray, and Dolan (1984). The Pakistani coast is considered the westernmost extent of a province (Indo-Polynesian) that extends right through to southern China, along the northeastern coast of Australia, and around the New Hebrides and New Caledonia. The Red Sea is classified as a separate province.

The identification of the Red Sea by Briggs (1974) as a separate province is well supported by the information in more recent reviews of the fauna and flora of the Red Sea (in Edwards and Head 1987). Crossland and others (1987), in reviewing all of the available data for the eastern side of the Red Sea, classified it into four different regions based on a review of existing biological data. This is a classification that could be extended across to the western coast given the consistency with relevant isoclines (see above), and commonality of physiography and such biological features as coral reefs (Bemert and Ormond 1981). Such a conclusion is consistent with that of Moore (1987) when considering the nutrient and phytoplankton status.

The five regions recognized above for the Red Sea appear to be largely consistent with the floral and faunal subprovinces recognized by Crossland and others (1987), although they placed the southern boundary for the central segment at 22°N, not 24°N. This is coincidental with the start of the southward-extending continental shelf, suggesting that the shallow bathymetry is an important controlling fact for these southern, inshore communities. This is an observation that Moore (1987) also strongly supports. It is important to note that in Edwards and Head (1987) the discussion of subdivisions does not always make the distinction between nearshore coastal distributions and those offshore or oceanic .

The inclusion of the Arabian Gulf by Briggs (1974) in the Western Indian Ocean province may no longer be appropriate. Price (1982) reported that 12 percent of echinoderms are endemic and that the levels of endemism for Arabian Gulf fish is higher than originally thought, and may approach those of the Red Sea. As a result, the Arabian Gulf has been recognized as a separate faunal province here.

Within the Arabian Gulf itself the division into subprovinces is difficult in that the biotopes of the Gulf have not been specifically considered in this way before. In addition, while the coastal areas of Kuwait, Saudi Arabia and Bahrain have been extensively studied (for example, Basson 1977; Jones 1986; MEPA 1987b,c; Price, Vousden, and Ormond 1983; Price and others 1987) studies elsewhere in the Gulf are limited. Based on this work, it seems reasonable to identify the Gulf of Salwa and the Kuwait-Saudi coasts as separate and distinct biogeographic entities. The status of the Iraq-Iran and the Qatar-UAE coastal regions remains unqualified.

Until more evidence is forthcoming, the northern region of the Gulf of Oman and the Pakistani region can appropriately be considered as part of the Indo-Polynesian province, as identified by Briggs (1974).

It should be noted that Sheppard, Price, and Roberts (1992) have most recently provided a detailed analysis and discussion of the biogeography of the Arabian region. They concluded that it was appropriate to designate the whole region as a biogeographic subregion, and not at the level of its component seas and gulfs. Even so, they recognized important ecological gradients or controls in species distribution and abundance that have been a prime consideration here for the boundaries identified in

establishing the individual provinces, as this is considered most meaningful to the process of identifying areas for which MPAs are needed.

ASSESSMENT OF EXISTING MPAS

Description of National Systems

The following information is provided by Chiffings (1992) and is based on data from the World Conservation Monitoring Center (WCMC) and other sources as indicated.

Nineteen marine protected areas have been identified as having been declared under relevant national legislation (Map 11). Numerous other areas have been proposed as MPAs in scientific surveys and evaluations conducted over the last 10–15 years. There are also a number of coastal protected areas, many of which include intertidal terrain but have not been included as MPAs in this report because available information suggests that the marine component is relatively minor or incidental. A list of these areas is included in the Appendix.

The present level of management and active protection against human degradation for most existing marine protected areas is not known. Some countries are making progress toward the establishment and management of MPAs, these include Oman, Saudi Arabia and Egypt. These initiatives should be recognized and encouraged. However, in most parts of the region the present level of protection for conservation of biodiversity is low.

Bahrain

Bahrain has no identified marine conservation areas except for Ras Tubli (Tabuli Bay) as a Nature Reserve, although the distribution of principal habitats is well understood. Damage from oil spills as result of the 1991 Gulf War was considerably less than on the Saudi coast. The Gulf of Sulwa region, including Bahraini and Qatari waters, contains the world's second largest population of dugong (Preen 1989) and therefore constitutes an area of vital conservation significance for this species.

Djibouti

Coral reefs occur to the west of the port of Djibouti and in the archipelago of the Sept Fréres, at the entrance to the Red Sea. An area of coral reef extending from the lighthouse at Musha to the Ile du Large is protected (IUCN 1992).

The following MPAs have been identified:

- Musha Territorial Park (Iles Moucha)
- South Maskali Islands Integral Reserve (occurs within Musha TP)

Egypt

Egypt has proposed a number of MPAs for the northern Red Sea and along the Sinai peninsula in both the Gulf of Suez and Gulf of Aqaba. The Government of Egypt has recognized the need for sustainable development in coastal regions and has requested assistance from the GEF to develop a coastal zone management program. This initiative would provide an important opportunity to establish a system of MPAs to conserve marine biodiversity and manage the use of marine resources in a sustainable manner. To date, six MPAs have been declared (one of which is an extension to an existing area).

The following MPAs have been identified:

- Abu Gallum Multiple Use Management Area
- Gebel Elba Conservation Area
- Nabq Multiple Use Management Area
- Ras Mohammed National Park

Ras Mohammed Sector, additional marine areas:

- Tiran-Sanafir Islands Protected Area

Ethiopia

The state of knowledge for much of the Gulf of Aden and the western Red Sea is extremely poor, with the exception of specific areas in Sudan and the Egyptian coast. The Ethiopian coastline is one of the least populated coastlines in the world and is owned by some of the poorest people in the world. Until recently the country has been torn by civil war for extended periods of time. One MPA has been declared but its present biological and management status is unknown. At present an IUCN adviser is working with the new Eritrean government on marine conservation issues.

The following MPAs have been identified:

\ Dahalac Marine National Park

Islamic Republic of Iran

There is a number of protected areas along the Iranian coast. These include two of the three biogeographic zones covered by this country's coastline, the exception being the Indo-Pacific. However, the majority of these seem to be coastal terrestrial areas with others being proposed marine areas (for example, Hara Marine Park). Only one established MPA could be confirmed. Its present legal status is not clear because it was declared prior to the Revolution in 1979. Likewise its level of management, the extent of degradation following eight years of war with Iraq, and possible impacts from the more recent Gulf War are not known.

The following MPA has been identified:

\ Shidvar Wildlife Refuge

Iraq

There are no declared MPAs along the relatively short Iraqi Arabian Gulf coastline, which is restricted to an area next to the town of Faw by the mouth of the Shatt al Arab (mouth of the Euphrates and Tigris rivers). Areas that have not been developed and that are recommended for protection include the mudflats near Khore Zubair and Khor abd Allah (WCMC 1991). Prior to the Gulf War clear evidence of mangrove die-off in these areas was available in satellite imagery, and aerial surveillance immediately after the war showed strong indications of impact from oil spills, as well as other war damage. Drainage of the marsh areas of the Tigris-Euphrates Delta, and the damming of these two rivers may have a very large impact on the northern Gulf marine ecosystems.

Saudi Arabia

Saudi Arabia, through its Meteorological and Environmental Protection Administration (MEPA), has had detailed coastal surveys undertaken by IUCN for both its Arabian Gulf and Red Sea coasts (MEPA 1987a,b,c). A National Coastal Zone Management Plan has been proposed, which includes the identification of environmentally sensitive areas that need to be evaluated in detail prior to establishing a system of protected areas. An initial evaluation of these areas has been undertaken for the National Commission for Wildlife Conservation and Development (NCWCD) to identify areas for inclusion in the National Protected Areas System Plan (Chiffings 1989; Child and Grainger 1990). With the adoption of the System Plan, a review of each of the recommended areas and preparation of detailed management proposals is planned.

The northern Saudi Arabian Gulf coastal area was severely impacted by oil spills as a result of the Gulf War. Environmental consequences of the oil spills and burning oil wells have been determined from a number of studies (see Al-Rabah 1993; Price and Robinson 1993; CEC/NCWCD 1992, 1994; Sadiq and McCain 1993). A large-scale re-evaluation of proposed MPAs has been made, based on detailed surveys and studies on damage and recovery, by an interdis-

ciplinary team of more than 50 scientists from six European countries, Saudi Arabia, Kuwait and Bahrain (CEC/NCWCD 1992, 1994). As a result, a new MPA is being established comprising the two large embayments north of Jubail and the offshore coral islands. Other identified areas on the Saudi Gulf coast (for example, Tarut Bay) are suffering from severe degradation due to development.

The following MPAs have been identified:
\ Farasan Islands Protected Area
\ Um Al-Qamari Island Protected Area

Kuwait

Kuwait has no designated marine protected areas, although based on a major study by the Kuwait Institute for Scientific Research in 1988, the government had identified a series of nature conservation areas that were proposed in its Master Action Plans (WCMC 1991). While the coral islands of Qaru, Kubbar and Umm al-Muradum are only small areas on a regional scale, they are important to the protection of rare, high-latitude coral reefs and green turtle–nesting beaches. The shallow waters of Kuwait Bay are a critical nursery habitat for commercial species of shrimp and fish and contain a unique species of mudskipper. The Bay, unfortunately, is rapidly succumbing to intense urban development pressure, including infilling.

Oman

Oman has a strong commitment to a coastal zone management program, which has been developed with IUCN, that includes the identification, declaration and management of MPAs. Oman is a particularly successful example of coastal zone management planning in the Arabian Seas. The government's commitment to coastal zone management has resulted in significant contributions to conservation of coastal and marine environments.

There are five coastal protected areas, three of which are MPAs and cover a range of environments, species, objectives and management issues. These vary from the remote Daymaniyat Islands where there are minimal resource use conflicts and globally significant habitats for hawksbill turtles and seabirds to the Qurum mangroves that lie in the heart of a major residential area (Price and Humphrey 1993). Other factors also contributing to marine conservation include traditional fishing controls, fisheries legislation and strict controls over land developments.

The following MPAs have been identified:
\ Daymaniyat Islands National Nature Reserve
\ Khawr Salalah BS Managed Nature Reserve
\ Quru Managed Nature Reserve
\ Ra's al Hadd (Turtle Reserve) Managed Nature Reserve
\ Ra's al Jumayz National Nature Reserve

Pakistan

At present the status of MPAs in Pakistan is not clear. While Preen (1993) reports four, Niaz Rizvi, and Abdul Majid (personal communication) report no MPAs in Pakistan. Those proposed are intended to protect turtle nesting beaches. The exception is the recognition of the Indus Delta as a region of major conservation significance. Pernetta (1993) provides greater detail.

Qatar

Qatar has recently completed a detailed coastal inventory using fine scale, airborne image analysis, but has not declared MPAs as yet.

Republic of Yemen

The Republic of Yemen has identified four areas as proposed MPAs, including the Island of Socotra. The state of knowledge of the Republic's coastline is reasonably well known, particularly with respect to exploited fish resources. Available information is summarized in Sanders and Morgan (1989).

Sudan

The Sudan Marine Conservation Committee—an interdepartmental committee established in 1978—is responsible for marine conservation in Sudan. At present the Committee is concentrating on conservation activities in the Port Sudan area and a Marine National Park at Sanganeb (Nasr 1985). In 1984, Sudan agreed to cooperate with Egypt and established a protected area that includes the offshore islands and coastal mangrove stands in the Abraq, El Deib and Gebel Elba areas (Hanna, personal communication)

The following MPAs have been identified:

- Sanganeb Atoll Marine National Park
- Abraq, El Deib and Gebel Elba area Conservation Area

United Arab Emirates

Information on coastal marine areas in the United Arab Emirates (UAE) is very sparse. Except for some areas that have been identified as proposed MPAs and Khor Dubai that has been declared a Nature Reserve, no areas have been declared. The central western area of the UAE (bounded by Abu al Abyad Island, Bu Tinah shoal and Ruwais) contains a large proportion of the Gulf dugong population and is of international significance for the conservation of this species (Preen 1989).

Other National Initiatives

In the Red Sea, protected areas have also been established in other countries (for example, Israel and Jordan), often in conjunction with zoning and other resource use policies. Further information on marine conservation in the regions is available in IUCN/UNEP (1985b), Ormond (1987), and Sheppard and Wells (1988).

International and Regional Initiatives Relating to MPAs

The following information is provided by Sheppard, Price, and Roberts (1992).

UNEP Regional Seas Programme

Included in the Regional Seas Programme are the Red Sea and Gulf of Aden region, and the Kuwait Action Plan (KAP) region (also known as the Gulf or the Regional Organization for Protection of the Marine Environment sea area or region).

The Kuwait Action Plan forms part of the broader Kuwait Regional Convention for the Protection of the Marine Environment from Pollution. All Gulf countries are signatories to the convention, the aims of which include the prevention and control of pollution from ships and other causes, the establishment of national standards, and the development of national research and monitoring programs relating to all types of pollution. The KAP operates through close cooperation with international organizations, regional organizations (for example, ROPME) and also with many national organizations, institutions and focal points. Many of the major conservation and research initiatives in both the Gulf and Red Sea have been part of UNEP's Regional Seas Program. After the 1991 Gulf War, ROPME was revitalized and moved back into its secretariat in Kuwait.

The Red Sea and Gulf of Aden Action Plan is based on the Regional Convention

for the Conservation of the Red Sea and Gulf of Aden. Actively involved have been regional organizations such as ALECSO (Arab League Educational, Cultural and Scientific Organization), PERSGA (Environmental Program for the Red Sea and Gulf of Aden) and others, with ALECSO coordinating all activities and providing the interim secretariat for PERSGA, based at MEPA in Jeddah, Saudi Arabia. At present a revised plan is being drawn up following a recent meeting in January 1994 at Arab League headquarters in Cairo.

Other Regional and International Agreements

In addition to the UNEP Regional Seas Programme, there are other important regional agreements (Johnston 1981; Couper 1983; IUCN/UNEP 1985a,b; IUCN 1987). Included are the African Convention on Conservation of Natural Resources, the Saudi-Sudanese Red Sea Commission (deep-sea mining), the Arab Declaration on Environment and Development, the Gulf Cooperative Council (GCC), Marine Emergency Mutual Aid Centre (MEMAC), Gulf Area Oil Companies Mutual Aid Organization (GAOCMAO). These and other agreements relate to environmental management and pollution control.

Important international agreements include parts of the United Nations Convention on the Law of the Sea (UNCLOS), the Convention on International Trade in Endangered Species (CITES), the Ramsar Convention, the Bonn Convention on Migratory Species, the Indian Ocean Alliance, International Biological Program (IBP), Man and the Biosphere Programme (MAB), the World Heritage Convention and others (Johnston 1981, Couper 1983) (Table 11.2).

Upholding regional and international agreements is particularly important in seas like the Red Sea and Gulf whose transboundary resources constitute global commons shared by many countries.

Table 11.2 Countries in the Arabian Seas Region that Are Party to the Major Conventions

Country	*World Heritage*	*Ramsar*	*UNESCO MAB*
Egypt	✓	✓	✓
Iran	✓	✓	✓
Jordan	✓	✓	
Kuwait			
Oman	✓		
Pakistan	✓	✓	
Saudi Arabia	✓		
United Arab Emirates			
Yemen	✓		

World Heritage

There are no World Heritage Sites in the region with a marine component.

Ramsar

The following Ramsar sites include marine habitat components:

- Shadegan Marshes and mudflats of Khor-al Anaya and Khor Musa (Iran)

UNESCO Man and the Biosphere Programme

As yet there are no marine Biosphere Reserves in the region.

MARPOL

The Red Sea, Gulf, Gulf of Oman and Gulf of Aden have been declared Special Areas under Annex I and V of the MARPOL treaty.

Assessment of Representation of Biogeographic Zones within MPAs

The following assessment is based on Chiffings (1992).

Gulf of Aden (GA)

There is only one site protected (Iles Moucha and South Maskali Islands) and three more identified. The biogeographic region is poorly represented, but even more poorly described. The coastlines of Somalia, Djibouti and the Republic of Yemen all need surveying before it will be possible to make recommendations on the location of suitable MPAs. The one exception to this is the Socotra Island archipelago that forms a boundary between the major Somali upwelling and the Gulf of Aden. This complete area should have very high priority for establishment as a Biosphere Reserve. This may require a cooperative effort between Somalia and the Republic of Yemen. Prior to the present civil war a proposal to establish Socotra Island (only) as a Biosphere Reserve was being prepared by the Environmental Protection Council of Yemen, together with UNESCO. A GEF funded coastal zone management program, focused on the Red Sea, was also to begin at the time that civil war broke out.

Southern Red Sea (RSl)

With two existing MPAs and numerous proposals for additional areas, the eastern Red Sea coast of the southern Red Sea zone is well covered in terms of MPAs that will ensure adequate conservation of biodiversity when the proposed areas are proclaimed and actively managed. At present, the risk of severe human degradation is relatively low but ever increasing as development proceeds in both southern Saudi Arabia and Yemen. It is worth noting that commercial oil fields have been found offshore of the Yemen coast.

The western side of the southern Red Sea area is very poorly represented and just as poorly documented. There is one existing MPA in the Dahlac Islands. The area, however, does not seem to threatened by major development proposals. The Ethiopian and Eritrean people were until recently in the grip of one of the worst famines in modern African history and suffering the ravages of a civil war. This coast will need surveying before it will be possible to make recommendations on the location of suitable MPAs.

Central Red Sea (RS2)

Although there are as yet no established MPAs, the eastern side will be well covered by the Saudi system of proposed MPAs. However the western side is in need of strengthening. There are three existing MPAs along this coast but few other sites have been identified. Before a decision is taken as to where major biodiversity MPAs should be established in Sudan and southern Egypt, coastal and marine inventories need to be completed and compiled. In the case of the Sudan this could be arranged through the Sudan Marine Conservation Committee. The Egyptian coast has been assessed in the past (Hanna, personal communication) and these data need to be brought together for analysis and identification of priority sites and information gaps.

Northern Red Sea (RS3)

There are three existing MPAs in this zone and numerous proposals for additional areas. This is the one section of the Red Sea that has a good coverage of proposed MPAs on both coasts. It is now necessary to develop detailed management plans for these areas, particularly on the Egyptian coast as tourism is a fast-growing industry that may threaten the natural marine resources it depends on. The impact of oil pollution on the Egyptian Gulf of Suez and northern Red Sea are a major cause of reef and fisheries deterioration (Hanna, personal communication).

Gulf of Aqaba (RS4)

There are two existing MPAs in the Gulf of Aqaba and proposals for a number of additional areas. The eastern side has been well surveyed by Saudi Arabia and Jordan, and the Sinai side by Fishelson (1980). As it is an area of low population and represents an important international security corridor, extensive impacts from development are relatively unlikely in the immediate future.

Gulf of Suez (RS5)

There are no existing MPAs and those proposed are clumped at the Red Sea end of the Gulf. The same comments apply here as for the western, central Red Sea. Existing data need to be brought together to allow an initial assessment before proceeding in the selection representative areas.

Southern Oman (OM)

There is one existing MPA and numerous sites have been identified for MPA status. This area is part of the Omani CZM program and as such has a good representation of MPAs intended to conserve biodiversity.

Indo-Pacific (IP1)

There are four existing MPAs. On the Omani side of the Gulf of Oman the same comments apply as above for the southern Omani coast.

The Iranian and Pakistani coasts are very poorly represented with no existing MPAs and few additional areas proposed. Again, the present state of knowledge about this coast is poor and therefore requires systematic documentation before appropriate recommendation on the location of suitable MPAs. Because of the importance of parts of this coastline to individual species (for example, turtles and migratory waders), detailed knowledge about specific areas already exists. The next step is to review this information to identify what additional information is necessary in order to proceed further. Preen (1993) has done this for Pakistan and proposes a list of protected areas.

Arabian Gulf Basin (AGl)

There is one existing MPA. There are several other coastal areas that appear to provide a good geographic cover, but the existence of a marine component, its actual extent, and the present biological and management status of each of the sites needs to be established.

Shatt al Arab (AG2)

There are no existing MPAs. The Shadegan marshes (included in a protected area that includes intertidal elements) is a site of major international significance for a wide range of both resident and migratory birds, hence their status as a Ramsar Treaty site. As with the rest of the Gulf their present biological status needs to be assessed so that a remediation plan can be prepared for the Gulf region as a whole (see below).

Southern Coastal Arabian Gulf (AG3)

There are no existing MPAs and although the extent of proposed MPAs represents the biodiversity needs of this region, the present biological status of these areas needs to be assessed following the impacts of the Gulf War. The ever-increasing impacts of development are also a major threat, with some areas already suffering major habitat loss and associated environmental degradation.

Gulf of Salwa (AG4)

There are no existing MPAs. Two areas proposed by Saudi Arabia are representative

of the western part of the Gulf of Salwa. Given the relatively pristine nature of the area and its global importance to the conservation of Dugong (Preen 1989), there is the urgent need though, to see these and comparable areas in Bahrain and Qatar waters committed as a major Biosphere Reserve.

Qatar-UAE Coastal (AG5)

There are no existing MPAs, and while the United Arab Emirates have proposed a good representative sample of areas on the eastern side of the region these may not fully meet biodiversity conservation needs. Although it represents a diverse and important set of habitats there is no known systematic, nor overall, survey of the region. This region is also an area of particular conservation significance to dugong (Preen 1989). Again, surveying at a regional scale to identify nature and extent of major biotopes is the most important priority at this time.

PRIORITY AREAS AND RECOMMENDATIONS

The following recommendations and priority areas are a product of the review process carried out to develop this report. Due to the limited feedback from some parts of the region they do not necessarily represent the views of the relevant authorities within each of the listed countries. Priorities for Kuwait and Oman were submitted by relevant government authorities.

National Priority Areas for Marine Biodiversity Conservation

Further contact with many of the countries in the region will be required to identify areas of national conservation significance. Based on the submissions received, the following areas can be highlighted.

Egypt

- El-Ghardaqa
- Abu Monqar and El-Gaftun Islands
- Shadwan and Gubal Islands
- Tiran/Sanifar Islands and Ras Mohammed
- Gabel Elba together with Siyal and Rawabel Islands

Kingdom of Saudi Arabia

- Farasan-Gizan area

Kuwait

- Coral Islands of Qaru, Kubbar and Umm al-Muradam
- Kuwait Bay

Oman

- Daymaniat Islands

Regional Priority Areas

The areas listed below have been identified as being of highest priority at the regional level after consideration of the criteria listed in the introduction to this report. Most areas are proposals for the establishment of new MPAs rather than direct support to the management of existing areas, although in some instances the priority areas are large and include one or more smaller MPAs. Improved management of such MPAs should be a priority. In some cases only limited information has been available to describe particular areas.

Proposed New MPAs

\ The Arabian Gulf-Gulf of Salwa (Saudi Arabia, Bahrain, Qatar (26°0′N, 50°5′E)): As a complete biogeographic province this area is of global importance. It is also has global status as a major conservation area

for the dugong and other rare and endangered species. It is therefore recommended that, over and above the specific areas identified in Saudi Arabia, the Gulf of Salwa, shared between Saudi Arabia, Bahrain and Qatar, be considered a priority area for the establishment of a regional MPA (such as a Biosphere Reserve) so as to ensure the protection of a major part of the Gulf dugong population—the largest known outside of Australia (Preen 1989). Protection should also be afforded to the seagrass beds, reefs and island of the central western area of the UAE (approximately bounded by Abu al Anyad Island, Bu Tinah shoal and Ruwais), as this area supports most of the remainder of the Gulf dugong population and is suspected of being an important turtle feeding area.

- Farasan-Gizan Area-Red Sea (Saudi Arabia (16°8′N, 42°5′E)): This area includes the Farasan archipelago of over 100 islands (largest, 381 square kilometers) with its extensive series of fringing and patch reefs. Inshore waters include large areas of mangroves, mudflats and seagrass beds that support one of the three important dugong populations known from the Red Sea and a large shrimp fishery. Preliminary evidence suggests that the area is an important site for cetaceans, with herds of up to 600 spinner dolphins seen in the area and large baleen whales occurring among the Farasan Islands throughout the year. Most of the area is largely undisturbed and has been the subject of a number of recommendations for protection (UNEP/IUCN 1988). There is an MPA established in the immediate vicinity of Farasan Islands. It is recommended that protection be extended to cover a wider area of the archipelago.
- Tiran Islands Area (Egypt, Saudi Arabia (28°0′N, 34°8′E)): These islands occur at the mouth of the Gulf of Aqaba and include Tiran, Sinafir and Burqan Islands. There are well developed and diverse reefs and abundant fish life, and dugong have been recorded. Green turtles nest on Tiran and Sinafir Islands. The straits between the islands are an important shipping lane. The islands have been proposed for protection by a number of studies (UNEP/IUCN 1985a,b,c) and are included in the Saudi coastal planning process. The Egyptian government also has a coast guard station on one island and has appointed park rangers to the area. Parts of the area fall within three Egyptian MPAs: Ras Mohammed National Park, Nabq Multiple Use Management Area, and Tiran-Sanafir Islands Protected Area.
- Straits of Gubal (Egypt (27°5′N, 34°0′E)): This area lies at the entrance to the Gulf of Suez and includes the islands of Gubal, Giftun, Shadwan, El-Ghardaqa, Abu-Ramada, Magawish, Abu-Monquar, El-Fanidir, Abu-Galawa and Abu Sadaf. The Straits are a major shipping lane for ships passing through the Suez Canal. The area includes well-developed and diverse coral reefs and nesting grounds for hawksbill turtles and has been the subject of a number of recommendations for protection (UNEP/IUCN 1988).
- Southern Egypt (proposed) Marine Park: Mersa Alam—Sudanese Border (Egypt (23–27°N, 33–35°5′E)): This section of the Egyptian Red Sea coast includes the Gebel Elba and Ras Banas areas, both of which exhibit high biodiversity, and typical marine areas of the western Red Sea coast. The area is described by UNEP/IUCN (1988) and has been proposed for a

large MPA that would incorporate a range of levels of protection (see also Ormond 1980, 1981). There is an existing MPA at Gebel Elba.

- Socotra Island (Yemen (26°0′N, 51°0′E)): The Socotra Island archipelago forms the boundary between the major Somali upwelling and the Gulf of Aden and is of high priority for protection.
- Wejh Bank (Saudi Arabia (25°6′N, 36°8′E)): The Wejh Bank is a very large complex of reefs surrounding a central lagoon containing many small patch reefs and mangroves. Patch reefs have high coral cover and dugong may be present. The area lies in an isolated region with little effects from development (UNEP/IUCN 1985a,b,c). The Wejh Bank area is one of the three very important areas for dugong along the eastern Red Sea coast.
- Qishran Islands-Ras al Askar (Saudi Arabia (20°3′N, 39°8′N)): On the central Red Sea Coast near the town of Al-Lith, this area straddles biogeographic areas RS1 and RS2. The third of the three most important dugong areas on the east coast, it includes numerous islands, mangrove areas, coral reefs and seagrass beds. Quishran and other islands in the area are known turtle-breeding sites (Miller 1989).
- Marshes of the Tigris and Euphrates (Iraq (30°5′N, 40°0′E)): The draining of these marshlands and the damming of the two rivers has the potential of dramatically altering the ecology of the marine systems in the northern Gulf, as well as the critical transmigratory feeding, and breeding habitats for waders.
- Ras Suwahil (Saudi Arabia (28°7′N, 34°8′E)): The area has been identified as a proposed MPA.
- Outer Indus Delta (Pakistan (24°0′N, 67°5′E)): The area extends southeast from Karachi to the Indian border. Management plans are being proposed.

This report has not concentrated on the important marine and coastal bird areas in the region. These have been identified over the past two years in a project that culminated in the publication, *Important Bird Areas (IBAs) in the Middle East*, by Birdlife International. Over 100 of the 400 sites identified are coastal and marine and have been selected because of the occurrence of globally or regionally threatened species, concentrations of seabirds or waterfowl, or the presence of species wholly or largely restricted to the Middle East (Porter, personal communication).

Existing MPAs that Require Management Support

No existing MPAs have been recommended as individual priority sites for management support. However, a number of existing MPAs fall within some of the areas proposed above, and these MPAs should be candidates for management support. These include the Farasan Islands (Saudi Arabia), Nabq Multiple Use Management Area, Ras Mohammed National Park and Tiran-Sanafir Islands Protected Area (Egypt), and Gebel Elba Conservation Area (Egypt).

Other Recommendations

The following are recommendations for action at the regional or national levels of activity. To date, there is not enough detailed knowledge of specific areas or incountry programs to make sensible recommendations as to where more specific efforts should be placed. A general note, however, is that action at the local level may frequently have

a training and awareness role well beyond the return to the immediate region.

This region is one where the coastal resources are either extremely well documented and a major coastal zone management undertaking has already been initiated, or where there is little or no systematic understanding and conservation efforts are the domain of a very small number of concerned government officials.

At this time the major knowledge gaps are the lack of systematic surveys of species and community composition for large parts of the region—the Gulf of Aden, the western side of the Red Sea, particularly the southern and central region, the Qatar-UAE region of the Arabian Gulf, and the northern side of the Arabian Gulf and Gulf of Oman. Considering the extensive nature of these areas, it is proposed that in the first instance there should be an emphasis on systematic survey using a systems approach that identifies the nature and extent of key biotopes at regional scales. This can be done relatively quickly and cheaply by a small team using modern mapping techniques including satellite imagery, oblique aerial photography, and limited ground survey (for example, Price and others 1987, MEPA 1987b). This is a particularly powerful approach when coupled with local knowledge and expertise. This kind of approach is likely to prove to be the most efficient method of gathering the data necessary to carry out an assessment of priority areas for MPAs.

Appendix Unconfirmed/Proposed MPAs in the Arabian Seas Marine Region

Country/ Territory	*Protected Area Name*	*Zone*	*IUCN Category*	*Area (hectares)*
Egypt	Giftun Islands MP	RS5	PRO	
	Gubal Islands MR	RS5	REC	
	Hamata Marine Zone NA	RS3	PRO	
	Hurghada NR	RS5	PRO	
	Qulan Islands MR	RS3	PRO	
	Ras Burkha	RS4	REC	
	Ras Garra	RS5	REC	
	Shadwan (Shaker) Island MR	RS5	PRO	
	Southern Egypt MP	RS3	REC	
	Straits of Tiran MP	RS3	REC	
Iran	Chah Bahar and Pizom Bays	IP1	PRO	
	Halileh Rud Mud Flats (Hale-Rud Marshes)	AG1	PRO	20,000
	Hormoz Island Biosphere Reserve	AG1	I	
	Khouran Straits Biosphere Reserve	AG1	PRO	
	Qeshm Islands and Bandar Marine Park	AG1	PRO	
	Rude-e-Gaz (Rud-e-Hara) Mangroves	AG1	PRO	
	Shadvar BR (Sheedvar)	AG1	PRO	
Jordan	Aqaba MaNR	RS4	PRO	
	Aqaba MP	RS4	PRO	
Kuwait	Bobiyan MP	AG2	REC	
	Failaka Island (North) NR	A3	REC	
	Failaka Island (South) NP	AG3	REC	
	Failaka Island (South) NRA	AG3	REC	
	Jal al Zhor NP	AG3	PRO	30,000
	Jal al Zhor NRA	AG3	PRO	
	Khawr Mu Fattah PA	AG3	PRO	
	Kubbar (Jazirat Kubbar) PA	AG3	REC	600
	Qaruh MP	AG3	REC	
Oman	Al Hallaniyah NScR	OM	PRO	2,500
	Al Salamah NNR	I P1	PRO	60
	Arkad NRR		PRO	264,000
	Bandar Jissah NScR	IP1	V	700
	Bandar Khayran NNR	IP1	VIII	1,400
	Barr al Hikman NNR	OM	PRO	288,000
	Bu Rashid NNR	IP1	PRO	50
	Dalkut-Kharfot NNR	OM	IV	
	East Masirah NNR	OM	PRO	4,500
	East Sharbithat	OM	IV	
	Fanaku NNR	IP1	PRO	20
	Hamar an Nafun NNR	OM	PRO	120
	Jabal Abu Daud NScR	IP1	PRO	35,000
	Jabal Bani Jabir NScR	IP1	PRO	138,000
	Jabal Hammar NSR + Sidah NNR	OM	IV & V	

Country/ Territory	*Protected Area Name*	*Zone*	*IUCN Category*	*Area (hectares)*
	Jabal Letub NNR	IP1	PRO	8,900
	Jabal Qamar NScR	OM	V	58,000
	Jabal Qatar NNR	IP1	PRo	44,000
	Jabal Samhan NNR	OM	IV & V	346,000
	Janabah Coast NScR	OM	PRO	69,000
	Jazirat Abu Sir NNR	IP1	PRO	150
	Jazirat Habalayn NNR	IP1	PRO	10
	Jazirat Hamra NNR	IP1	PRO	30
Oman *(continued)*	Jazirat l Khayl NNR	IP1	PRO	300
	Jazirat Musandam NNR	IP1	PRO	500
	Jazirat Umm al Fayyar in NNR	IP1	PRO	50
	Jazirat Umm al Ghanam NScR	IP1	PRO	500
	Kachalu NNR	IP1	PRO	10
	Khatmat Malahah NNR		PRO	50
	Khawr Balid NNR	OM	PRO	200
	Khawr Bat'ha NRR		PRO	30
	Khawr Dahariz NNR	OM	IV	150
	Khawr Hawasinah NRR		PRO	10
	Khawr Juraym NNR		PRO	20
	Khawr Kashmir NRR		PRO	50
	Khawr Mughsayl NScR	OM	VIII	10
	Khawr Nabr NNR		PRO	2,300
	Khawr Qurm NSCR	OM	VIII	70
	Khawr Rawri NNR	OM	IV & V	1,100
	Khawr Saham NNR		PRO	80
	Khawr Sallan NNR		PRO	100
	Khawr Sawli NNR	OM	IV	300
	Khawr Shinas NNR		PRO	2,100
	Khawr Taqah NNR		PRO	300
	Kuria Muria NNR	OM	IV	250,000
	Marbat NScR + Raaha NNR	OM	IV &V	26,000
	Masirah Straits NNR	OM	PRO	86,000
	Musandam NRR		PRO	132,000
	Musandam Peninsula	IP1	PRO	15,800
	North Jazir NNR	OM	PRO	15,000
	Ra's Suawadi NScR	IP1	V	1,500
	Ras Abu Daud	OM	VI	
	Razat NNR	OM	IV	1,000
	Sadh NScR	OM	V	3,500
	Salalal NNR	OM	VIII	6,800
	Shinas NScR	IP1	PRO	300
	South Jazir NScR + Khur Ghauri NNR	OM	IV & V	18,000
	South Masirah NNR	OM	PRO	19,000
	Wadi ash Shuwaymiyah NRR + Shuway. NScR	OM	IV & V	12,500
	Wadi Hawir NNR	IP1	PRO	3,300

Country/ Territory	*Protected Area Name*	*Zone*	*IUCN Category*	*Area (hectares)*
	Wadi Nhart NNR	OM	IV	5,500
	Wahibah NRR	OM	PRO	
	Wardi Hinna NSR	OM	V	
Pakistan	Astola Island (Haft Talar)	IP1	REC	0
	Hawkes Bay/Sandspit Beaches	IP1	REC	0
	Jiwani turtle beaches	IP1	REC	0
	Ormara turtle beaches	IP1	REC	0
	Pasni Coast	IP1	REC	0
Saudi Arabia	Abu Ali/Dawhat Dafi & Musallamiyah	AG3	IV	0
	Abu Duda	RS2	I	0
	Al Hasani & Libana Islands	RS3	IV	0
	Al Uqayr Bay & Coastal Region	AG4	IV	0
	Arabiyah Island	AG3	IV	0
	Coastline South of Sharm Zubeir	RS3	IV	0
	Ghubbet Bal'aksh	RS3	IV	0
	Harimal Island	RS2	I	
	Harqus Island	AG3	IV	0
Saudi Arabia	Inner Farasan Bank Reefs & Islands	RS1	IV	0
(continued)	Jana Islands	AG3	I	0
	Jeddah Salt Marshes	RS2	IV	0
	Jurayd Island	AG3	IV	0
	Karan Island	AG3	I	0
	Khawr al Ja'afirah & Islands., Ras al Tarfa	RS1	IV	0
	Khor Al Wahla	RS1	I	0
	Khor Amiq & Raqa	RS1	IV	0
	Khor Itwad	RS1	IV	0
	Khor Nahud	RS1	IV	0
	Kurayn Islands	AG3	IV	0
	Marqa Islands	RS1	I	0
	Marsa al Usalla & Mersa Tawil	RS2	I	0
	Marsa Umm Misk	RS2	IV	0
	Mastura Beach	RS2	I	0
	Mersa al Sarraj	RS2	IV	0
	Oreste Point	RS1	IV	0
	Outer Farasan Bank Reefs & Islands	RS1	IX	0
	Qalib Islands Chain	RS3	I	
	Qishran	RS1-2	I	0
	Qurayyah region	AG3	IV	
	Ras Abu Madd to Sharm Hasi	RS2	II	0
	Ras Baridi-Sharm al Kwawr	RS2	IV	
	Ras Hatiba	RS2	II	0
	Ras Suwahil & Maqna N. Beach	RS4	IX	0
	Safaniya/Manifa Bay complex	AG3	IV	0
	Sharm Dumagha & Sharm Antar	RS3	IV	0

Country/ Territory	*Protected Area Name*	*Zone*	*IUCN Category*	*Area (hectares)*
	Sharm Yanbu	RS2	I	0
	Sharm Zubeur	RS3	I	0
	Shi'Abu Al Liqa	RS1	IV	0
	Shib Al Kabir	RS1	IV	0
	Shu'aybah	RS2	II	0
	South Gulf of Salwah	AG4	IX	0
	Tarut Bay Complex	AG3	VIII	0
	Tiran Islands area	RS3	IX	0
	Wejh Bank	RS2	IX	0
Sudan	Mukawwar MNR	RS2	PRO	1,200
	Port Sudan MNP	RS2	PRO	0
	Sanganeb Atoll MNP	RS2	PRO	100
	Suakin Archipelago NP	RS1	PRO	0
United Arab Emirates	Abu al Abyadh Islands PriR	AG5	UA	0
	Abu Dhabi mangrove & coastal wetlands	AG5	REC	1,500
	Arzaneh Islands BS	AG5	REC	0
	Ganadah (Ras Ganadah) Lagoon & mangrove	AG5	REC	22,000
	Hammanya Lagoon	AG5	REC	200
	Jebel Ali turtle beaches R	AG5	REC	1,500
	Kalba mangroves	AG5	REC	0
	Khor Dubai marshes	AG5	REC	0
	Merawwah Islands	AG5	REC	0
	Qarnein Islands	AG5	REC	0
	Ramms Lagoon R	AG5	REC	0
	Umm al-Qaiwain Lagoon & island PriR	AG5	UA	1,000
	Zirkuh Islands BS	AG5	REC	0
Yemen, Republic of	Al Khawkhah	RS1	REC	0
	Al Mukha	RS1	REC	0
	Dhubab	RS1	REC	0
	Hidran marshes	RS1	REC	0
	Humar Island	RS1	REC	0
	Jabal Sabir-Wadi Thabad wadis	RS1	REC	0
	Kumran islands R	RS1	PRO	0
	Ra's Katanib Island	RS1	REC	0
	Ras Isa MP	RS1	REC	0
	Uqban (Ukban) Islands	RS1	REC	0
	Wadi Rima estuary	RS1	REC	0
	Wadi Siham	RS1	REC	0
	Zubayr Islands	RS1	REC	0
	Zuqur Islands MNP	RS1	REC	0
Yemen	Nishtun	GA	REC	0
	Perim Isles	GA	REC	0
	Ra's Abu Quizara	GA	REC	0
	Socotra Island PA	GA	PRO	362,500

The following recommendations are made for actions that are considered to be of regional priority:

- The Arabian Gulf as a complete biogeographic province is of global importance in its own right. It has global status as a major conservation area for dugong (classified as vulnerable) and other rare or endangered species.
- A regional survey of the Gulf of Aden is a basic first step to identifying areas for inclusion in a system of MPAs. Particular attention should be given to the Socotra archipelago. The Royal Geographic Society of the U.K. planning for a expedition to study biogeographic features of the Gulf of Adenand adjacent areas has been disrupted due to recent political events in Yemen, as has a GEF-funded coastal zone management program for Yemen.
- Where some information already exists, for example, in Pakistan, Iran, Egypt and the Sudan, support should be given to enable reviews, such as that recently completed for Pakistan, to be undertaken to identify major gaps in knowledge (Pernetta 1993).
- A preliminary appraisal should be obtained of the vulnerability of the coast of Ethiopia and the Sudan to development pressures in order to establish a priority on the need for further action. After identifying areas of present or high potential impact, a program should be supported to enable resource use planning and management so that exploitation can be undertaken in a sustainable manner.

NOTE

1. The region, originally referred to as the North West Indian Ocean Region, includes the Red Sea and its two Gulfs, the Gulf of Aden, the Arabian/Persian/Iranian Gulf, the Gulf of Oman, and that part of the northern Indian Ocean generally referred to as the Arabian Sea. The descriptor "Arabian Seas" has now been adopted as a clearer description of the region biogeographically, without compromising local naming conventions. In keeping with the convention adopted by Sheppard, Price, and Roberts (1992), the Arabian/Persian/Iranian Gulf shall be referred to throughout the text as the "Gulf" (see also the discussions on naming conventions and biogeographic considerations in the same reference).

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