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

The Red Sea and Gulf of Aden Regional Network of Marine Protected Areas

Regional Master Plan

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PERSGA - 'The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden' is an intergovernmental organisation dedicated to the conservation of the coastal and marine environments in the region.

The Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (Jeddah Convention) 1982, provides the legal foundation for PERSGA. The Secretariat of the Organization was formally established in Jeddah following the Cairo Declaration of September 1995. The PERSGA member states are Djibouti, Egypt, Jordan, Saudi Arabia, Somalia, Sudan, and Yemen.

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Abbreviations

GEF	Global Environment Facility (a partnership of the United Nations Development Programme, United Nations Environment Programme, World Bank)
IUCN	World Conservation Union
MPA	Marine Protected Area
MPA/WG	Marine Protected Areas Working Group
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
SAP	Strategic Action Programme for the Red Sea and Gulf of Aden
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WRI	World Resources Institute

Executive Summary

The Red Sea and Gulf of Aden are known throughout the world for their outstandingly beautiful marine and coastal environments, the diversity of species, including many endemics, and their value for human development. The local resources have been used in a sustainable manner by the inhabitants of the region for thousands of years. However, more recently the pressure on these environments and resources has substantially increased, with the development in several countries of petroleum-based economies that require sea transport for petroleum exports, the expansion of international dive tourism and general population growth in the coastal zone.

Marine protected areas (MPAs) have been established in many parts of the Red Sea and Gulf of Aden as tools to provide for sustainable resource use, economic development and conservation. Of particular importance is the need to conserve areas that represent the range of the region's unique habitats and biodiversity and to support national development. This has been initiated through the integration of 12 MPAs from throughout the region into a Regional Network of MPAs for the Red Sea and Gulf of Aden. These 12 MPAs are: Iles des Sept Frères and Ras Siyan (Djibouti); Ras Mohammed National Park; Giftun Islands and Straits of Gubal (Egypt); Aqaba coral reefs (Jordan); Straits of Tiran; Wajh Bank, Sharm Habban and Sharm Munaybirah; Farasan Islands (Saudi Arabia); Aibat and Saad ad-Din Islands, Saba Wanak (Somalia); Sanganeb Marine National Park; Mukkawar Island and Dungonab Bay (Sudan); Socotra Islands; Belhaf and Bir Ali area (Yemen).

This Regional Master Plan is a regionally agreed framework for the planning and management of each of the MPAs in the Regional Network that will facilitate the achievement of regional objectives for sustainable resource usage, conservation of biodiversity and for economic development. The Objectives, Goals, General Policies and Strategies presented here are regionally applicable and will facilitate regional consistency in the management of MPAs in the Network. Within each of the MPAs in the Regional Network a regionally standardised, site-specific Master Plan will be developed, which will serve as the long-term policy document for that MPA. This site-specific Master Plan will guide the development of a site-specific Management Plan for each MPA. This Regional Master Plan will also serve as a framework for the planning and management of other MPAs in each country that are not part of the Regional Network and where national planning and management have not yet commenced.

The development of a Regional Master Plan for MPAs in the Red Sea and Gulf of Aden is consistent with the objectives of the Convention on Biological Diversity (1992) and also parallels developments in a number of other regional sea areas (e.g. the Caribbean and Mediterranean) where similar regional networks of MPAs have been established.

The objectives of the Regional Master Plan are:

- to develop regional capacity in all aspects of MPA planning and management

- to provide for the sustainable use of living marine resources
- to support local and national economic and social development
- to involve local communities and stakeholders as partners in MPA management
- to conserve representative and prime examples of the biodiversity of the Red Sea and Gulf of Aden
- to conduct research and monitoring programmes for the benefit of MPA management
- to enhance public awareness of the marine resources and biodiversity of the Red Sea and Gulf of Aden and the principles of sustainable use
- to protect the unique cultural heritage of the marine and coastal environments of the Red Sea and Gulf of Aden
- to implement a regional legal framework for protected areas and biodiversity.

This Regional Master Plan includes guidelines based on currently accepted best practice in the planning and management of MPAs that have been adapted to suit the specific situations found in the Red Sea and Gulf of Aden. These guidelines include:

- the planning process
- the development of zoning plans
- research and monitoring
- public awareness
- stakeholder consultation and participation
- sustainable financing
- capacity building
- personnel requirements.

There are significant differences between the countries surrounding the Red Sea and Gulf of Aden in their level of technical and scientific capacity for planning and managing MPAs. This is due in part to differences in economic development and assistance from the international donor community. This Regional Master Plan outlines the strengthening required in national legal and institutional mechanisms, as well as the need for a regional protocol on MPAs to guide the development of national MPA legislation where it is lacking. The establishment of a Regional Activity Centre for MPAs will allow for the effective coordination of the Regional Network. Additional mechanisms are described for coordination among the MPAs in the Network, information exchange, capacity building, institutional strengthening and the establishment of linkages with other regional networks.

It is envisaged that the development of a strong Regional Network of MPAs, and growth of national capacity in the planning and management of MPAs, will foster the establishment of other MPAs in each country of the region. To further support this process, this Regional Master Plan includes guidelines for the identification and selection of other MPAs.

Résumé analytique

La mer Rouge et le golfe d'Aden sont renommés dans le monde entier pour l'extraordinaire beauté de leurs environnements marin et côtier, pour la diversité des espèces qui s'y trouvent, nombre d'elles endémiques, et pour leur valeur pour le développement humain. Les ressources locales ont été utilisées de manière durable par les habitants de la région pendant des millénaires. Toutefois, ces environnements et ces ressources ont été soumis récemment à des pressions considérablement accrues, du fait du développement dans plusieurs pays d'une économie basée sur les hydrocarbures, exportés par voie maritime, de l'expansion du tourisme international de plongée sous-marine et de la croissance démographique générale sur le littoral.

Des aires marines protégées (AMP) ont été établies en de nombreux pays de la région en tant qu'instruments visant à assurer l'utilisation durable des ressources; le développement économique et la conservation de la biodiversité. Il est d'une importance toute particulière de protéger les aires qui contiennent les habitats et les composantes uniques de la biodiversité régionale et d'appuyer le développement national. Il a donc été créé à cette fin un Réseau régional d'AMP pour la mer Rouge et le golfe d'Aden réunissant les 12 APM suivantes : îles des Sept Frères et Ras Siyan (Djibouti); Parc national de Ras Mohammed; îles Giftun et détroit de Gubal (Égypte); récifs coralliens d'Aqaba (Jordanie); détroit de Tiran; banc de Wajh, Sharm Habban et Sharm Munaybirah; îles Farasan (Arabie saoudite); îles d'Aïbat et de Saad ad-Din, et Saba Wanak (Somalie); Parc national marin de Sanganeb; île de Mukkawar et baie de Dungonab (Soudan); îles Socotra; région de Belhaf et Bir Ali (Yémen).

Le présent Plan directeur régional est un cadre convenu de planification et de gestion de chacune des AMP du Réseau, qui facilitera la réalisation des objectifs régionaux concernant l'utilisation durable des ressources, la conservation de la biodiversité et le développement économique. Les objectifs, buts, politiques et stratégies générales présentés ici s'appliquent à la région et vont promouvoir une gestion cohérente des AMP du Réseau. Dans chacune d'elles, il sera élaboré un Plan directeur standardisé spécifique au site qui fera fonction de document de politique à long terme et qui guidera la formulation d'un Plan de gestion spécifique au site. Le Plan directeur régional constituera également dans chaque pays un cadre de planification et de gestion d'autres AMP n'appartenant pas au Réseau régional et où la planification et la gestion nationales n'ont pas encore commencé.

L'élaboration d'un Plan directeur régional pour les AMP de la mer Rouge et du golfe d'Aden est conforme aux objectifs de la Convention sur la diversité biologique (1992) et s'inscrit en parallèle aux mesures prises dans d'autres mers régionales (telles que la mer des Caraïbes et la Méditerranée) où des réseaux régionaux d'AMP analogues a celui de la Mer Rouge ont été mis en place.

Les objectifs du Plan directeur régional sont :

- De renforcer les capacités régionales dans tous les domaines de la planification et de la gestion des AMP,
- D'assurer l'utilisation durable des ressources biologiques marines,
- D'appuyer le développement économique et social au niveau local et national,
- D'associer les communautés et les parties prenantes locales à la gestion des AMP en tant que partenaires,
- De conserver des exemples représentatifs et illustratifs de la biodiversité de la mer Rouge et du golfe d'Aden,
- De mener des programmes de recherche et de suivi au bénéfice de la gestion des AMP,
- De sensibiliser le public à l'importance des ressources marines et de la biodiversité de la mer Rouge et du golfe d'Aden et aux principes de leur utilisation durable,
- De protéger le patrimoine culturel unique des milieux marins et côtiers de la mer Rouge et du golfe d'Aden,
- De mettre en place un cadre juridique régional applicable aux aires protégées et à la biodiversité.

Le présent Plan directeur régional comprend des lignes directrices fondées sur les meilleures pratiques actuelles en matière de planification et de gestion des AMP qui ont été adaptées pour tenir compte de la spécificité des réalités de la région de la mer Rouge et du golfe d'Aden. Ces lignes directrices concernent notamment :

- Le processus de planification
- L'élaboration de plans de zonage
- La recherche et le suivi
- La sensibilisation du public
- La consultation et la participation des parties prenantes
- Le financement durable
- Le renforcement de capacités
- Les besoins en personnel.

Il existe entre les divers pays de la mer Rouge et du golfe d'Aden des différences significatives de niveau de capacités techniques et scientifiques en matière de planification et de gestion des AMP, différences qui proviennent en partie de leur stade de développement économique et de l'assistance qu'ils reçoivent des donateurs internationaux. Le Plan directeur régional signale les exigences du renforcement des mécanismes juridiques et institutionnels nationaux ainsi que la nécessité d'un protocole régional sur les AMP qui guidera l'élaboration de dispositions législatives nationales régissant les AMP dans les pays qui ne possèdent pas actuellement de telles dispositions. Un Centre régional d'activités pour les AMP, à établir, assurera une coordination efficace du Réseau régional. Il est également prévu de mettre en place entre les AMP du Réseau d'autres mécanismes de coordination, d'échange d'information, de renforcement des capacités et de renforcement institutionnel et de nouer des relations avec les autres réseaux régionaux.

Il est escompté que l'instauration d'un solide Réseau régional d' AMP et l'accroissement des capacités nationales en matière de planification et de gestion des AMP favoriseront l'établissement d'autres AMP dans chacun des pays de la région. En conséquence, de manière à appuyer ce processus, le Plan directeur régional comporte également des lignes directrices pour l'identification et la sélection d'autres AMP.

Introduction

The Red Sea and Gulf of Aden are globally renowned for their unique and beautiful marine and coastal environments, the diversity of species inhabiting them, the value of these resources for human development and as part of the cultural heritage of the region. The coastal and marine environments, and the animals and plants within them, have been used by the inhabitants of the Red Sea and Gulf of Aden in a sustainable manner for thousands of years. In more recent years the use of these environments and resources has substantially increased, with the development in several countries of petroleum-based economies that require sea transport for petroleum exports, the growth of international dive tourism in the region and general population growth in the coastal zone. Despite the enormous economic development that has occurred in some of the countries of the region in recent decades, many coastal communities continue to rely for their livelihood on the small-scale use of marine resources, especially fisheries.

Running parallel to the economic and social development that has occurred in the region, there has been a growing awareness of the regional and international significance of its environmental value, in particular:

- the diversity of coral reef habitats in the central Red Sea of Saudi Arabia and Sudan
- the distinct zoogeography and abundance of endemics within the Red Sea and Gulf of Aden
- the unique coral reefs around the Sinai
- the atoll-like formation of Sanganeb Atoll in Sudan
- the extensive stands of mangroves and populations of dugong and turtle in the southern Red Sea
- the unique biodiversity of the Socotra Archipelago
- the extensive stocks of commercial fishes in the Gulf of Aden.

There are gaps in our knowledge of many parts of the region, especially the coastal areas of the Gulf of Aden in both Yemen and Somalia, the reefs of the southern Red Sea and the Socotra Archipelago. Scientific surveys and research in recent years, especially in the latter areas, have provided more extensive and detailed information on the impressive conservation significance of the Red Sea and Gulf of Aden.

In some parts of the region, the rapidly growing population and rate of development threaten the sustainability of current patterns of resource use. Issues of particular concern include oil pollution from shipping; over-fishing; habitat destruction associated with coastal developments; tourism (PERSGA, 1998a; Gladstone et al., 1999; Wilkinson, 2000). Marine protected areas (MPAs) have been established in many parts of the Red Sea and Gulf of Aden as tools to manage these activities, to provide for sustainability and economic development and for conservation. Of particular importance is the need to conserve areas that represent the full range of unique habitats and biodiversity and also to support national development. This will be achieved through the integration of 12 MPAs into the Regional Network of MPAs for the Red Sea and Gulf of Aden (Appendix 1). The current status of these MPAs varies from those that have been established for many years with legal standing and well-defined management plans, to those that have

been proposed but not officially declared by their national government. This Master Plan is the long-term policy document that provides the framework for planning and managing the Regional Network in a consistent manner. It is also intended for similar purposes in other MPAs in the region, as well as for the identification and selection of additional sites for protection.

A synthesis is provided of current information on the physical and biological environments of the Red Sea and Gulf of Aden, their conservation significance, the socio-economic context, current human uses and impacts. The Master Plan aims to achieve a number of objectives and the means for achieving these are detailed in specific goals, policies and strategies for implementation. Important tools for planning and managing each MPA in the Regional Network are the site specific Master Plan and Management Plan. Guidelines for preparing these documents have been developed from internationally accepted procedures (e.g. Kelleher and Kenchington, 1992; Kelleher, 1999) to suit the context and accepted practices of the Red Sea and Gulf of Aden. The MPAs in the Regional Network vary in their current legal and management status. There is also a range of technical capabilities among staff and in scientific and socio-economic knowledge about the MPAs in the Network. Suitable mechanisms to strengthen the Network are included in this Master Plan.

Background

Physical Environment

Oceanography

The Red Sea and Gulf of Aden were created as a result of deep ocean rifting, which began about 70 million years ago, and saw the separation of the Arabian plate from the African plate (Sheppard et al., 1992). The Red Sea is approximately 2,100 km long from Suez to the Bab el Mandeb, with an average width of only 280 km, an average depth of 500 m but with maximum depths in places of more than 2,000 m. The Red Sea is divided at its northern extremity into the Gulfs of Aqaba and Suez. The Gulf of Aqaba, a continuation of the Red Sea rift, is 170 km long and 14-26 km wide, with the shorelines dropping steeply to depths of 2,000 m. It is separated from the Red Sea by a sill 250 m deep at the Straits of Tiran. In contrast, the Gulf of Suez is part of a wide valley and has a wide coastal plain. The Gulf of Suez is 280 km long, 20-40 km wide, with an average depth of less than 30 m, and a depth of about 100 m at its entrance to the Red Sea. The Gulf of Aden was also formed as a result of the separation of the Arabian plate from the African plate. It stretches for 800 km on the Somali coast and about 1,400 km along the Yemen coastline, and there is a maximum distance of about 350 km between the Somali and Yemeni coastlines (Sheppard et al., 1992). The Gulf of Aden has maximum depths of more than 3,000 m (Haddad et al., 1997).

The waters of the Red Sea are warm and saline. Seasonal surface water temperatures range from 21 °C-28 °C in the north to 26 °C-32 °C in the south (Edwards, 1987; Gladstone, 2000). Salinities in the Red Sea range from 37 ‰ in the south to 42 ‰ in the north. A consequence of these extreme conditions is that some species within the Red Sea (e.g. mangroves, shallow seagrasses) probably exist at the limits of their physiological tolerance. Sea temperatures and salinities along the Gulf of Aden coastline of Yemen are substantially less than in the Red Sea. They also differ over relatively short distances as a result of the varying influence of the summer upwellings. For example, the shallow temperatures during summer are about 19-20 °C in the vicinity of al-Mukallah (where the summer upwelling reaches the coastline) but reach 25-27 °C at Bir Ali only about 100 km away. These differences appear to be important in explaining pronounced differences in fish community composition between these locations (Kemp, 2000).

The Red Sea has been artificially linked to the Mediterranean Sea by the Suez Canal. In the south, the Red Sea is linked to the Indian Ocean at the Bab el Mandeb, which is 29 km wide. However, the presence of a sill at a depth of only 100-130 m at the Bab el Mandeb restricts the exchange of water between the Red Sea and the Indian Ocean. The width of the continental shelf in the Red Sea varies from only a few kilometres offshore in the north to about 100 km in the southern Red Sea, leading to a progressive change in the range of marine habitats present, from the northern to southern Red Sea.

There are no permanent streams or rivers flowing into the Red Sea. Land-based materials and fresh water only reach the Sea during occasional periods of heavy rain and flooding. Large-scale current patterns are generated from changes in the water density caused by changes in water temperature and salinity and from seasonal variations in the prevailing winds. Falling temperature and rising salinity (due to evaporation) in the north of the Red Sea cause the water mass to sink and return to the deeper parts of the Red Sea. Winter winds from the south-east drive surface water into the Red Sea from the Gulf of Aden, below which there is a flow of colder and more saline water in the opposite direction. Summer winds from the north-west force warmer surface waters out of the Red Sea through the Bab el Mandeb, below which there is a deeper inflow of water from the Gulf of Aden. The mean residence times for water masses in the Red Sea are quite long, ranging from five years for water in the upper 150 m to 200 years for the entire water mass (Sheppard et al., 1992).

There is a narrow tidal range in the Red Sea, with the greatest ranges occurring in the northern (0.6 m) and southern Red Sea (0.9 m) (Edwards, 1987). There is very limited tidal movement in the central Red Sea, apart from seasonal differences in sea level caused by south-east winter winds forcing water into the Red Sea, effectively raising sea level by an average of 0.8 m in the central Red Sea (Chiffings, 1989). Tidal range along the Gulf of Aden coastline of Yemen is 1.5–2.0 m (Haddad et al., 1997).

Pelagic primary productivity varies seasonally and spatially throughout the Red Sea and Gulf of Aden. Pelagic primary productivity (measured as total pigment concentration) is highest along the Gulf of Aden coastline of Somalia to the Socotra Archipelago during the summer months of May to September. This is a result of warm surface water being blown offshore by north-east winds during summer and its replacement by cool, nutrient rich water from the depths of the Gulf of Aden and Arabian Sea (Sheppard et al., 1992). Movement of Gulf of Aden surface water into the southern Red Sea extends the area of high pelagic primary productivity northward into the Red Sea to 19 ºN; beyond that the waters of the Red Sea and the Gulfs of Aqaba and Suez are nutrient-poor (Sheppard et al., 1992). These upwellings are the basis of the Gulf of Aden and southern Red Sea fisheries. There are no known upwellings in the Red Sea due to stratification and limited vertical mixing. Significant primary production still occurs at depths of 200 m in the Gulf of Aqaba due to the high transparency of the water.

Biodiversity and Biogeography

The Red Sea and Gulf of Aden are renowned for their diversity of ecosystems, habitats and species, the number of endemic species and their biogeographic significance. The following synthesis of the biodiversity and biogeography of the Red Sea and Gulf of Aden is based on Chiffings (1989); Sheppard and Sheppard (1991); Sheppard et al., (1992) and Chiffings (1995).

Diversity, Endemism and Important Species

One consequence of the diversity of habitats in the Red Sea and Gulf of Aden is the great species richness of marine flora and fauna. Much of the available information is based on research in the Red Sea, especially the northern Red Sea; far less is known of the flora and fauna of the Gulf of Aden (Kemp, 2000). The richness of hermatypic corals in the Red Sea has been estimated to be 180-200 species (Sheppard and Sheppard, 1991; Sheppard et al., 1992). However, a recent extensive study of the central-northern Red Sea coastline of Saudi Arabia increased this to a probable 260, based on recently described species and range extensions (De Vantier et al., 2000a). About 6 % of Red Sea coral species are believed to be endemic (Sheppard et al., 1992). Approximately 200 species of scleractinian corals have been reported from the Socotra Archipelago in the Gulf of Aden. This is significant for the conservation value of the Socotra Archipelago, given the small area of coral

communities, and the similarity in richness to the entire Red Sea (De Vantier et al., 2000b). One hundred and seventy species of echinoderms have been reported from the Red Sea, of which just over 5 % are endemics (Sheppard et al., 1992). About 500 species of benthic algae have been recorded from the Red Sea (Sheppard et al., 1992). Ormond and Banaimoon (1994) report 160 species of macroalgae from the Hadramaut region of the Gulf of Aden coastline of Yemen. Planktonic organisms in the Red Sea include 88 species of dinoflagellates and 60 species of calanoid copepods in the southern Red Sea and 46 in the north (Sheppard et al., 1992).

About 1,350 species of fishes are known from the Red Sea (Goren and Dor, 1994). Distinct assemblages of fishes occur in the Gulf of Suez; the Gulf of Aqaba and the central and northern Red Sea; the southern Red Sea and the Gulf of Aden (Sheppard et al., 1992). The level of endemism amongst Red Sea fishes is about 17 %; however, as Sheppard et al. (1992) point out, this average value has a great range. For example, the level of endemism amongst small benthic, territorial groups such as dottybacks (Pseudochromidae) and triple fins (Trypterygiidae) is about 90 %, while endemics are almost absent amongst pelagic species. Of the fauna associated with deep sea sediments in the Red Sea (i.e. at least 2,000 m), 30 % are believed to be endemic (Chiffings, 1995). There are very few accounts of the ichthyofauna of the Gulf of Aden. Al-Sakaff and Essen (1999) listed 195 species of fishes caught in commercial trawlers from the Gulf of Aden and Arabian Sea coastline of Yemen. Kemp (2000) surveyed the ichthyofauna of the Shabwa and Hadramaut provinces of the Republic of Yemen and recorded 267 species, including eight new records.

The Red Sea and Gulf of Aden are important for a number of significant marine species. Three species of sea turtle are known to feed and nest in the region: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and loggerhead (*Caretta caretta*). Important nesting grounds are located in the Tiran Islands, Wajh Bank and Farasan Islands (Saudi Arabia); the south Sinai of Egypt (IECD, 1997); Dahlak Islands (Eritrea); Ras Sharma and Dhobah (Yemen) (Miller, 1989; PERSGA, 1998a). The Ras Sharma nesting site for green turtles is internationally significant with about 10,000 females nesting there each year, making it the second largest in the Arabian region. In addition, the region between Jabal Aziz Island and Perim is the most important nesting ground for hawksbill turtles in the Arabian region (Haddad et al., 1997).

Surveys by Preen (1989) estimated that there were 4,000 dugong (*Dugong dugon*) within the Red Sea. They are dependent on healthy seagrass beds for food. Important areas for dugong within the Red Sea include the Tiran Islands, Wajh Bank, Farasan Islands and Jizan (Saudi Arabia) (Preen, 1989; Sheppard et al., 1992). A recent review (Marsh et al., in press) confirms the presence of dugong along other parts of the Saudi Arabian coast (Sharm Munaibara, Qirshan Island) and the existence of common populations between Saudi Arabia and Egypt around Tiran Islands and in the Gulf of Aqaba (Nabq and Abu Galum Marine Park). Dugongs are also found along the African coast of Egypt (south of Quseir) and of Eritrea (Dahlak National Park) (Marsh et al., in press).

Thirteen species of cetacean have been reported from the Red Sea and Gulf of Aden, including dolphins, toothed and baleen whales. There have been few systematic surveys, making the identification of significant sites for cetaceans difficult (Gladstone and Fisher, 2000).

Important nesting and feeding grounds for seabirds occur on the Gulf of Aden coast of Somalia (Mait Island, Aibat, Saad ad-Din Island, Saba Wanak; Ali et al., 1997); the Farasan Islands of Saudi Arabia (Gladstone, 2000) and the Aden wetlands in Yemen (Haddad et al., 1997).

Biogeography

The biogeography of the Red Sea and Gulf of Aden has been described at a range of scales, using information on large-scale patterns in the physico-chemical properties of seawater and the relative distribution and abundance of a range of species. The available information on temperature, salinity, surface nutrient status and primary productivity suggests that the Red Sea and Gulf of Aden can be divided into six regions, including five within the Red Sea itself. (Sheppard et al., 1992). The Red Sea regions are: northern, central, southern, Gulf of Suez and Gulf of Aqaba. The latter two regions are also well separated according to differences in physical properties: the Gulf of Suez is shallow (average depth of 50 m), is vertically well mixed throughout the year, with well-developed latitudinal gradients in salinity and temperature. The Gulf of Aqaba is deep (800-1,800 m), with vertical mixing that is seasonal, and less well-defined salinity and temperature gradients (Sheppard et al., 1992).

A range of authors has described patterns in the distribution of a variety of faunal groups, mostly fishes and corals. Ormond et al. (1984) recognised two faunal 'provinces': the Gulf of Aden and the Red Sea. Based on extensive survey work along the coastline of Saudi Arabia and water mass similarities between the western and eastern coastlines, Ormond et al. (1984) suggested that the Red Sea 'province' can be further sub-divided into four distinct 'sub-provinces' or regions: Gulf of Aqaba, northern Red Sea, Central Red Sea and outer Farasan Bank in inshore southern Red Sea. Kemp (1998) surveyed a number of reef-associated fish groups in the Socotra Archipelago. Using regional data on chaetodontid fishes, Kemp (1998) divided the Arabian representatives into three groups: Red Sea and western Gulf of Aden; Socotra, Oman and the Gulf; east Africa, the Seychelles and the Maldives. On this basis, the Socotra Archipelago has a regionally high conservation value because its fish fauna appears to be distinctly different from the rest of the Red Sea and Gulf of Aden. Using presence data for corals throughout the Arabian region, Sheppard and Sheppard (1991) described a regional zoogeography that consisted of two broad groups: Red Sea; and the Gulf, Gulf of Oman and Arabian Sea. Three regions were recognised within the Red Sea: (i) northern Red Sea, Gulf of Suez and Gulf of Aqaba; (ii) central Red Sea; (iii) southern Red Sea from Al Lith to the Bab el Mandeb. Results of a recent detailed survey of corals in the central-northern Red Sea of Saudi Arabia and the Socotra Archipelago (De Vantier et al., 2000b) indicate that the coral fauna of each area are a complex composite of species from a number of biogeographic provinces. The coral fauna of the central-northern Red Sea of Saudi Arabia includes representatives of species with the following distributions: Indo-west Pacific; Pacific Ocean; Indian Ocean; western Indian Ocean; Red Sea endemics and presently undescribed species. The coral fauna of the Socotra Archipelago includes species with the following distributions: Indo-west Pacific; Indian Ocean; western Indian Ocean; Oman–Arabian Gulf; Oman; species previously regarded as Red Sea endemics and several presently undescribed species (De Vantier et al., 2000b).

Key Habitats

Sabkha

Sabkha-based habitats exist at the highest level of the intertidal and are usually only seasonally inundated. They are composed of sparse halophytes embedded in a sodium chloride and gypsum crust, below which is a microbial/algal mat consisting of cyanophytes, bacteria and diatoms (Chiffings, 1989). They are a highly productive habitat with nitrogen fixation occurring in the microbial/algal mat. A characteristic feature of sabkhas is the presence of pools that, because of the high salinity and temperatures, contain a specialised fauna of benthic invertebrates and a complex microbial community (Sheppard et al., 1992). Large areas of sabkha exist along the Gulf of Suez (Egypt) and Saudi Arabian coastlines. Although little is known

of the ecology and biodiversity of sabkhas, they are a significant feature and in some areas occupy an area greater than that of mangroves and saltmarsh combined (Sheppard et al., 1992).

Saltmarshes

Saltmarsh communities in the Red Sea generally occur supratidally in the splash zone or in the high intertidal, and are important as localised sources of high primary productivity. Halophytic communities are categorised according to their dominant species, height above sea level and immersion periodicity (Chiffings, 1995). The most common species belong to the genera *Phragmites*, *Typha*, *Halocnemum*, *Limonium* and *Nitraria* (Sheppard et al., 1992). Significant areas of saltmarsh exist in the north-western area of the Red Sea along the Egyptian coastline (at Ras Mohammed, Abu Monqar, Wadi El Gemal, Jebel Elba) where it is estimated that 3 % of the Egyptian Red Sea coast is saltmarsh (Chiffings, 1995), along the Sudanese coastline (Sheppard et al., 1992) and around the Farasan Islands (Gladstone, 2000).

Sandy and Muddy Shores

Despite the small daily tidal range of much of the Red Sea, extensive intertidal areas exist as a result of the low-lying nature of most of the coastline. The predominant intertidal habitats are sandy and muddy shores, and rocky shores. Sandy shores in the north-central Red Sea exist as narrow beaches between rocky shores (of a range of types) and behind coral reef flats, and as wider beaches behind lagoons in the southern Red Sea. The majority (75 %) of the southern Red Sea coastline of Yemen is soft sediment (overlain in parts by sabkha and salt marsh) (Haddad et al., 1997). The western-central Gulf of Aden coastline of Somalia largely consists of high-energy sandy beaches (Ali et al., 1997). Sandy beaches and rocky shores are the major coastal habitats on the Socotra Archipelago (Haddad et al., 1997). There is a vertical zonation of beach fauna, with dominant groups on sandy beaches including ghost crabs, hermit crabs and amphipods, and with large populations of gastropods dominating muddy shores (Sheppard et al., 1992).

Rocky Shores

Rocky shore intertidal habitats exist on the undercut surfaces of raised coral reefs in the northern Red Sea, the Farasan Islands and Dahlak Archipelago; on beach rock in the central and southern Red Sea; and on volcanic rock that reaches the shore in parts of the southern Red Sea and along the Gulf of Aden coastline of Yemen (Sheppard et al., 1992; Haddad et al., 1997). In some parts of the region this habitat can be extensive e.g. occupying 20 % of the Egyptian Red Sea coast (Chiffings, 1995). High mountains located near the eastern Gulf of Aden coastline in Somalia produce a shoreline largely comprised of rocky shore and cliffs plunging directly into the sea (Ali et al., 1997). Large areas of the coastline of the Socotra Archipelago are comprised of rocky shores (Haddad et al., 1997). Major groups of invertebrates occupying this zone include gastropod molluscs, grapsid crabs, rock oysters, barnacles, chitons and mussels. Rocky shores in the central Red Sea are dominated by barnacles during winter when sea levels are higher. However, these die off during the summer sea level fall and only blue-green algae films remain (Sheppard et al., 1992).

Mangroves

Four species of mangrove exist within the Red Sea and Gulf of Aden, with the two most common being *Avicennia marina* and *Rhizophora mucronata*; other species known to occur in the region are *Bruguiera gymnorhiza* and *Ceriops tagal* (Sheppard et al., 1992). Mangroves occur throughout the region on the coastlines of all countries except Jordan; their occurrence in the Gulf of Aqaba is their northernmost distribution in the greater Indian Ocean. In most countries mangroves exist as distinct but isolated stands; extensive stands occur in the southern Red Sea of Saudi Arabia and Yemen, where

the continental shelf is widest and there is a greater depositional environment allowing for a stable sediment layer to develop (Sheppard et al., 1992; Chiffings, 1995). Mangroves are absent from the Gulf of Aden coastline of Yemen, apart from a unique, isolated population in the crater lake at Khor Shuran (Haddad et al., 1997). There are extensive areas of mangrove (*A. marina*) around the Socotra Archipelago (Haddad et al., 1997). Dense, healthy stands of both *A. marina* and *R. mucronata* were observed during site visits to Saad ad-Din Island on the Gulf of Aden coastline of Somalia (Ali et al., 1997; M. Younis *personal communication*). As a result of the great range of air and water temperatures, salinity and unreliable supplies of fresh water, mangroves probably exist in the region at the limit of their physiological tolerance.

A diverse fauna of more than 250 species of marine invertebrates and vertebrates occurs in association with mangrove systems in the Red Sea (Sheppard et al., 1992). However, this appears to be less than in comparable mangrove systems in the nearby Indian Ocean, presumably as a result of the harsh environmental conditions (of temperature and salinity) within the Red Sea. In addition to marine organisms, mangroves are used as a food source by terrestrial vertebrates (including the sand gazelle on Farasan Island) and as a roosting and nesting site by many species of birds. Apart from biodiversity surveys, there is limited information on the ecological processes and functions occurring within the mangroves of the Red Sea and Gulf of Aden. Assuming that these systems are functioning in a similar way to mangroves elsewhere in the world, they exist as a critical habitat, stabilising nearshore sediments, trapping nutrients, exporting energy to nearshore subtidal habitats and functioning as a nursery habitat for a range of fish and invertebrate species (Sheppard et al., 1992).

Seagrass

Eleven species of seagrass occur in the Red Sea and Gulf of Aden and, although they grow in all parts of the region (including the Gulfs of Aqaba and Suez), their distribution is poorly known (Price et al., 1988). There is a progressive increase in abundance of seagrass beds towards the southern Red Sea of Saudi Arabia, owing to the development of the wide, shallow continental shelf area (Price et al., 1988); for example, seagrass beds occur along 40 % of the Red Sea coast of Yemen (Haddad et al., 1997). There are few seagrass beds along the Gulf of Aden coastline of either Yemen or Somalia, or around the Socotra Archipelago, owing to the high-energy environment in both areas (Ali et al., 1997; Haddad et al., 1997).

Seagrass beds generally occur in protected areas in lagoons and bays (Gladstone, 2000), where they are an important habitat for juvenile fishes and crustaceans and a source of food for priority species such as dugong and green turtles. There appear to be three major groupings of seagrass assemblages along the eastern Red Sea that are separated by latitude, which suggests three distinct biogeographic groupings (Price et al., 1988). Similarly, three types of seagrass assemblage have been differentiated in the Gulf of Aqaba (Sheppard et al., 1992).

Seagrass beds in the Red Sea are inhabited by a diverse fauna, which increases from 49 species in the Gulf of Aqaba to 91 species further south. The major groups inhabiting seagrass beds include molluscs, polychaetes, crustaceans, echinoderms and fishes, with perhaps close to 10 % of species from seagrass beds being restricted to this habitat (Sheppard et al., 1992). The standing crop and productivity of Red Sea seagrass beds is comparable to that reported from other tropical regions (Sheppard et al., 1992). Like seagrass systems in other parts of the world, they stabilise nearshore sediments, provide a habitat for a range of commercially important crustaceans and fishes during the juvenile stages of their life history, provide an important source of food for many species and probably export nutrients and energy to adjacent subtidal systems (Sheppard et al., 1992).

Coral Reefs and Coral Communities

The Red Sea is most famous for its extensive fringing coral reefs that drop steeply into deep water and are swept by very clear water. There are, in addition, many other reef types that contribute to the great diversity of this system within the region, and hence support an enormous reef-associated biota. The two terms 'coral reefs' and 'coral communities' are used here to emphasise the distinction between biogenic, accreting reefs produced by scleractinian corals, and coral communities growing on rock or soft substrates. The following description of the coral reefs of the Red Sea and Gulf of Aden is synthesised from Sheppard and Sheppard (1991); Sheppard et al. (1992); De Vantier et al. (2000a, b); Kemp (1998) and Kemp and Benzoni (2000). Specific country descriptions have been synthesised from the country reports prepared for the Strategic Action Programme (PERSGA, 1998a).

Reef development varies from north to south in the Red Sea, with well-developed, narrow fringing reefs north of 20 ºN with steep slopes dropping into very deep water. The eastern shore of the Gulf of Suez has a limited area of reef development but extensive small coral patch-reefs. By comparison, the western shore has a well-developed system of fringing reefs. The Gulf of Aqaba has narrow fringing reefs that plunge vertically into deep water. An almost continuous band of fringing coral reefs occurs on both sides of the Red Sea southward to about 18-20 ºN. Reef types diversify toward the southern limit of this distribution as the width of the fringing reef increases and other reef types occur offshore. A longitudinal series of coral reefs exists within the Red Sea, effectively forming a series of barrier reefs. These barrier reefs are 10-40 km offshore of the Saudi Arabian coastline and extend southward for 400 km. Similar systems of reefs occur on the African side of the Red Sea. There are also isolated patch reefs and atoll-like structures, the most famous of which is Sanganeb Atoll in Sudan.

Thirteen types of coral communities have been identified for the Gulfs of Aqaba, Suez and the eastern Red Sea to the Yemen border, defined by the species presence and their relative abundance. There is a clear north-south trend in the occurrence of the different community types and it appears that latitude, bathymetry and coastal morphology are the underlying factors responsible for this pattern (Sheppard et al., 1992).

South of 20 ºN, the continental shelf widens so consequently reefs are less well developed vertically and often occur in more turbid water (Sheppard et al., 1992). In many places the coastal fringing reefs disappear and are replaced by stands of mangroves, sand beaches and scattered patch reefs near the coast. For example, fringing coral reefs occur along only 25 % of the Red Sea coast of Yemen (Haddad et al., 1997). Seasonal coverings of macroalgae are a feature of shallow coral reefs in the southern Red Sea and they often form the major cover of hard substrates in areas too turbid for coral growth (Haddad et al., 1997; Gladstone, 2000). Reef diversity in the southern Red Sea is greatest offshore and includes platform and patch reefs, barrier reefs, coral cays and extensive fringing reefs around island systems, especially the Farasan and Dahlak Island group.

Although surveyed to a more limited extent than the Red Sea, it appears that coral-based fringing reefs are less common in the Gulf of Aden. Fringing coral reefs occur on only 5 % of the Gulf of Aden coastline of Yemen, with extensive fringing coral reefs occurring only around the islands of Sikha and Halaneya in the Belhaf-Bir Ali area (Haddad et al., 1997). More recent studies along the northern Gulf of Aden coastline of Yemen have revealed extensive coral communities on all rocky coasts surveyed and in several areas with unconsolidated, sandy substrates. Three distinct community types were recognised that appear to be geographically based: southern Oman, Al-Mukalla and Shabwa province (Kemp and Benzoni, 2000). The absence of fringing reefs along this coastline is a result of higher

wave energies, nutrient enrichment from upwellings and the existence of large areas of unstable sandy substratum. There are extensive areas of coral reef found along the Gulf of Aden coastline of Somalia and the largest coral reefs in the Gulf of Aden may be around Saad ad-Din Island in the extreme north-west near the border with Djibouti. Smaller areas of coral reef exist west of Xabo and further east between Buruc and Bosaso. Elsewhere along the coastline of Somalia hard subtidal substrates are extensively colonised by macroalgae. The limited presence of coral reefs along the Gulf of Aden coastline of Somalia is probably a result of the lack of hard substrate, extensive areas of sandy beaches and high wave energies (Ali et al., 1997). It is worth noting that recent, more detailed surveys at a few locations in the Gulf of Aden (e.g. Kemp and Benzoni, 2000) have revealed extensive areas of coral communities in areas previously assumed to be unsuitable for coral development. More systematic habitat surveys involving actual searches by divers throughout the Gulf of Aden may reveal that coral communities occur more widely.

There is only minor coral reef development around the Socotra Archipelago, existing mostly as small reef flats at a few locations on the northern sides of islands. Coral communities are generally non-accreting, growing on rocky substratum or on fossil reef structures (De Vantier et al., 2000b). The dominant biotic habitat on the more exposed southern coasts of the Archipelago consists of macroalgal communities growing on non-reef rock (Kemp, 1998; De Vantier et al., 2000b). Despite the limited extent of coral reefs and coral communities in the Socotra Archipelago, the existing communities have a high regional conservation value. Cover of living stony corals approaches 100 % in some areas, and such high cover is rare elsewhere in the Gulf of Aden and Arabian Sea (De Vantier et al., 2000b).

Subtidal Soft Bottoms

Extensive areas of subtidal sand and mud occur throughout the region and each has distinct assemblages of flora and fauna. Sand-based systems occur in high-energy environments in shallow water close to reefs or on high-energy, exposed coastlines. Mud-based systems occur in protected, low-energy environments, such as khors and bays. Within the Red Sea soft bottoms of coarse sands and gravel mixed with mud are inhabited by a distinct community of crabs, bivalves and macroalgae. Gravel-shell substrates overlaying silty mud are inhabited by mollusc-dominated communities (Sheppard et al., 1992).

Socio-Economic Setting

The marine and coastal environments of the Red Sea and Gulf of Aden have a long history of traditional uses, for fishing, ports, trading and as navigation routes (Vine, 1986; Gladstone, 1996). Religious pilgrimages to the holy cities of Mecca and Medina have traditionally begun through Jeddah and Yanbu and trading routes have developed around these ports. This is also reflected in the presence of significant cultural heritage sites along the coast of the Red Sea, including the Islamic city of Aqaba, the old city of Jeddah and the port of Suakin (PERSGA, 1998a).

Coastal settlements have been widely dispersed in the past and there remain large stretches of coastline that are uninhabited, apart from some artisanal fishing camps. In recent years, conflict has restricted use of some coastlines (e.g. Somalia) and they remain in a largely undisturbed state. In contrast, rapid economic development has led to the great expansion of coastal urban areas in Jeddah and Yanbu (Saudi Arabia), Hurghada and Sharm El Sheikh (Egypt) and Aqaba (Jordan).

Artisanal fishing has been socially and economically important for centuries along the coastlines of all countries bordering the

Red Sea and Gulf of Aden. Low population densities, traditional management practices and limited commercial demand meant that this activity was ecologically sustainable (Gladstone et al., 1999). However, a number of developments threatens this sustainability: the use of more modern equipment, the availability of ice, the participation of foreign workers (especially in the Saudi Arabian Red Sea waters), Government support, the spread of illegal fishing (especially for shark fins), aquaculture and the rise of recreational fishing. Such developments have led to the decline of traditional community-based management practices. For example, the practice of cooperatively rotating fishing activities among reefs of the Farasan Islands (Saudi Arabia) shared by a number of villages (as a means of preventing the over-exploitation of fish stocks on shared reefs) has broken down in the face of increased fishing pressure from foreign workers, who do not understand local practices and have different economic needs (Gladstone, 2000). The isolation of the Socotra Archipelago from markets, seasonal weather that limits access to many reefs and a cooperative, traditional management system ensured that catches of fish and sharks were sustainable. However, increasing international demand for shark fins and the high prices paid for dried fins have caused this fishery to become unsustainable (MacAlister Elliott and Partners, 1996). Traditional fisheries management practices will need to be supplemented by alternative approaches (such as marine protected areas) to support sustainable use.

As a result of differences in natural resource bases, colonisation history and conflict, countries bordering the Red Sea and Gulf of Aden vary in their development status and, consequently, their planning priorities (for development, health, education, etc). While some countries show some of the lowest global per capita incomes, others have exhibited significant economic development (PERSGA, 1998a). Population growth rates of countries around the Red Sea and Gulf of Aden range from 1.8 to 5.1 % per annum, with an overall average of 3.1 % (ICED, 1997). There are no accurate population censuses for the coastal regions, but it is believed to be around five million people (ICED, 1997). Countries are attempting to develop a range of opportunities for sustainable use of natural resources, providing a diverse base for economic growth and social development. While tourism is being actively promoted in some countries (e.g. Egypt), other countries with similar opportunities (e.g. Sudan, Yemen) lack the necessary physical and technological infrastructure. A major challenge to the region in the near future will be to provide this development without threatening the ecological integrity of the natural systems upon which it depends.

There is a number of current pressures on the biodiversity and natural systems of the Red Sea and Gulf of Aden arising from this rapid development and new uses of the marine and coastal environments (PERSGA, 1998a; Wilkinson, 2000). These pressures include:

- disturbance to coastal wetlands
- clearing and degradation of mangroves
- loss of seagrass beds
- destruction of coral reefs
- unsustainable use of living marine resources (through over-fishing, unregulated shark fishing)
- threats to important species (such as marine turtles, marine mammals, seabirds)
- marine pollution
- poor coastal zone planning
- discharge of effluents
- dredging and filling of coastal habitats
- reduction of freshwater flows to the coastal zone.

The Role of Marine Protected Areas in Sustainable Resource Use and Biodiversity Conservation

MPAs can provide a range of benefits to local communities and national development through the sustainable use of living marine resources and biodiversity conservation (GBRMPA/World Bank/IUCN, 1995; Kelleher, 1999; Roberts and Hawkins, 2000; Salm et al., 2000), including:

Sustainable use of living marine resources: MPAs protect areas critical for commercially important species (e.g. spawning grounds and nursery habitats); provide refuges where stocks of target species can increase (after previous heavy exploitation) and act as a source of larval recruits and adult emigrants to replenish depleted areas outside the MPA. This can occur through a combination of protective zoning, management for sustainable use within MPAs and exclusion of extractive activities from particular areas within the MPA.

Conservation of biodiversity: By excluding threatening processes, managing uses, protecting significant habitats and allowing habitats and species to recover, MPAs protect endangered, vulnerable and threatened species; protect species with limited distribution; protect representative and unique examples of ecosystems, habitats or communities and maintain genetic diversity.

The maintenance of ecological processes essential to ecosystem function: Essential ecological processes and ecosystem services in the marine environment include primary productivity, nutrient cycling, gas exchange, the provision of food, coastal protection and sediment capture. MPAs accomplish this by controlling activities that disrupt ecosystems or physically damage habitats, by protecting critical habitats (such as mangroves, seagrass and coral reefs) and by allowing degraded ecosystems to recover.

Recovery of degraded marine environments: By excluding damaging human uses, MPAs allow degraded habitats to recover.

Provision of natural areas for education and research: By managing uses and excluding extractive activities from particular areas, MPAs act as valuable reference areas for long-term monitoring that aid in the understanding of the impacts of human uses. They also provide a valuable resource for education, tourism and the scientific study of processes operating in undisturbed natural systems.

Protection of cultural heritage: MPAs protect cultural heritage by facilitating the sustainability of traditional uses of marine resources and public education and awareness of the value of these uses, and by physically conserving culturally significant sites.

Support for development goals: By facilitating sustainable use of resources and by providing opportunities for recreation and tourism in unspoilt environments, MPAs increase the range of opportunities for business and employment, thereby supporting national and regional development goals.

International Context

The systematic selection, establishment and management of protected areas has the potential to contribute to the conservation of global biodiversity. Article 8 (*In-situ* Conservation) of the Convention on Biological Diversity (1992) requires contracting parties, as far as possible and as appropriate, to:

(a) establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity and

(b) develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas

where special measures need to be taken to conserve biological diversity (Glowka et al., 1994).

The first meeting of the Conference of the Parties to the Convention on Biological Diversity selected marine and coastal biodiversity as the first major theme to be addressed systematically in the Conference of the Parties' medium term work programme. Under the Jakarta Mandate on Marine and Coastal Biological Diversity (adopted by the second meeting of the Conference of the Parties, COP), a number of specific action items were approved for implementation that are relevant to this Regional Master Plan, notably:

Marine and Coastal Protected Areas

"…conservation measures should emphasise the protection of ecosystem functioning, in addition to protecting specific stocks"

"Parties should encourage local communities and resource users to participate in the planning, management, and conservation of coastal and marine protected areas"

"…enhance linkages and information exchange among the sites"

"Parties should promote the research and monitoring of MPAs to assess their value for the conservation and sustainable management of biodiversity" (de Fontaubert et al., 1996 p. 71)

This Regional Master Plan will facilitate the implementation of these actions in the Red Sea and Gulf of Aden, by providing a framework for a representative system of MPAs and by providing mechanisms for networking and coordination amongst the MPAs.

Regional Networks of Marine Protected Areas

Systems, or networks of protected areas, are established for the purposes of conserving representative examples of biodiversity, or protecting a set of unique and high profile features (McNeely and Thorsell, 1991; Lucas, 1992; Davey, 1998; Salm et al., 2000). Located and managed appropriately, a network of MPAs also has the potential to benefit both migratory species that require scattered habitats (e.g. sea turtles, sea birds) and transboundary or straddling stocks. In semi-enclosed seas shared by several countries, a coordinated approach to the selection and management of MPAs has the potential to prevent the transboundary spread of pollution and development impacts.

There are several important ecological reasons for ensuring a uniform approach to, and capability for, MPA management in the Red Sea and Gulf of Aden. The Red Sea is a semi-enclosed regional sea having a restricted exchange with the Indian Ocean and Mediterranean Sea (Sheppard et al., 1992). Large-scale pollution events could potentially travel across national borders, affecting habitats away from the source of the pollution event. Effective MPA management (that includes oil spill contingency plans) that limits the risk of these events in one country will reduce the chances of impacts to ecosystems and resources in neighbouring countries.

Most marine organisms have a dispersive larval stage lasting for periods that vary from a few days to several months. During this time larvae may cross national boundaries. A consequence of this is that unsustainable resource use has the potential to reduce stocks in neighbouring countries because of a reduction in parental stocks. In addition, species important for fisheries (e.g. tuna) often travel large distances, regularly taking them across national boundaries. A regional approach to sustainable resource usage (with MPAs as a key strategy) will facilitate regional sharing of benefits.

The regional benefits from a network of MPAs will only be realised if there is a coordination mechanism in place. There are good reasons for establishing such a mechanism:

- it allows for information and experiences to be shared amongst managers and their agencies and therefore facilitates more efficient management
- it facilitates more efficient use of limited financial and human resources
- it increases the chances of a consistent approach to management, with corresponding regional benefits for management of resource use and biodiversity conservation. Standard reporting procedures and monitoring systems will provide for reliable comparisons and data evaluation on a regional scale.

Regional networks of MPAs, networking and coordinating mechanisms, and regional protocols, have been developed in several regional seas and other shared water bodies (Table 1). For example:

The Mediterranean Sea: As part of the Mediterranean Action Plan a Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean was adopted by the Contracting Parties in June 1995. The Protocol calls for the establishment of a list of Specially Protected Areas of Mediterranean Importance (SPAMI), with the objectives of biodiversity conservation and protection of specific Mediterranean ecosystems. The Protocol also calls for species conservation, regulation of non-indigenous and genetically modified species and research relevant to the Specially Protected Areas. MEDPAN, the Mediterranean Protected Areas Network, was established in 1991 to facilitate the exchange of experience between protected area managers. This level of contact was missing in the initial system, the protected areas being represented in any meeting by the national authority for nature conservation. MEDPAN allows each manager to benefit from the knowledge, failures and success of any activity in the region.

The Wadden Sea: To protect the internationally significant tidal wetlands and dependent species of the Wadden Sea, a Joint Declaration on the Protection of the Wadden Sea was signed by the Netherlands, Germany and Denmark in 1982. The Common Wadden Sea Secretariat was established in 1987. About two-thirds of the Wadden Sea area is legally protected in the Trilateral Conservation Area, which includes an almost continuous series of protected areas, national parks and wildlife reserves. Cooperative management of the Trilateral Conservation Area occurs via the Wadden Sea Plan (1997), which includes common management principles, common management objectives for human activities, common ecological targets for the management of six major habitat types and programmes of shared research, monitoring and assessment (Enemark et al., 1998).

The Caribbean Sea: The Contracting Parties to the Wider Caribbean Seas programme adopted a Specially Protected Areas and Wildlife (SPAW) protocol that establishes a regional network of marine protected areas to conserve and restore regional ecosystems. Networking activities include the Wider Caribbean MPA Managers network and a supporting database, a regional guide to funding protected areas in the wider Caribbean, and common guidelines and criteria for protected areas (UNEP, 1996; Vanzella-Khouri, 1998).

Asia Pacific Region: One of the Indicative Actions of the APEC (Asia Pacific Economic Cooperation) Action Plan for Sustainability of the Marine Environment under the objective of Sustainable Management of Marine Resources is to "Establish an APEC network of marine protected areas" (Source: Internet site for APEC Action Plan for Sustainability of the Marine Environment).

Table 1. Regional sea areas containing representative networks of MPAs

Regional Sea	Convention	Relevant Protocol	Networking Mechanisms
Red Sea and Gulf of Aden	Jeddah Convention (1982)	Protocol Concerning Biological Diversity and Establishment of Protected Areas (in preparation)	Under development
Wider Caribbean	Cartagena Convention (1981)	Specially Protected Areas and Wildlife Protocol	Wider Caribbean MPA Managers network and a supporting database, a regional guide to funding protected areas in the wider Caribbean, and common guidelines and criteria for protected areas
South East Pacific	Lima Convention (1981)	Protocol for the Conservation and Management of Protected Marine and Coastal Areas	None
East African Seas	Nairobi Convention	Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region	None
Wadden Sea	Joint Declaration on the Protection of the Wadden Sea	No relevant protocol	Not Applicable
Gulf	Kuwait Convention (1978)	Protocol Concerning Biological Diversity and Establishment of Protected Areas (in preparation)	Not Applicable
Mediterranean	Barcelona Convention (1976)	Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean	Regional Activity Centres, including one on Specially Protected Areas (Tunisia)

The Red Sea and Gulf of Aden Regional Network of Marine Protected Areas

The Red Sea and Gulf of Aden region has many sites of unique beauty, which support populations of globally important species or contain ecologically critical habitats. These require management of human activities, to maintain their ecological importance and their availability to be appreciated and enjoyed by the region's inhabitants. If protected, they can also serve as areas for scientific research and as valuable assets for raising public awareness.

The SAP process identified 12 proposed or declared MPAs that were of regional or global significance, for inclusion in a regional network of MPAs (Figure 1 and Appendix 1). The network includes representatives of all major biogeographical sub-units, major habitat types within each sub-unit, prime examples of all types of coastal and marine habitats and species communities. These are outlined for each MPA in the representative network in Appendix 1. The regional network consists of the following MPAs:

Djibouti (Iles des Sept Frères and Ras Siyan)

Egypt (Ras Mohammed National Park; Giftun Islands and Straits of Gubal)

Jordan (Aqaba coral reefs)

Saudi Arabia (Sharm Habban and Sharm Munaybirah - Wajh Bank; Farasan Islands)

Saudi Arabia/Egypt (Straits of Tiran)

Somalia (Aibat and Saad ad-Din Islands, Saba Wanak)

Sudan (Sanganeb Marine National Park; Mukkawar [Magarsam] Island - Dungonab Bay)

Yemen (Socotra Islands Group; Belhaf and Bir Ali Area).

The legal and institutional framework for MPAs in the Regional Network is outlined in Appendix 2.

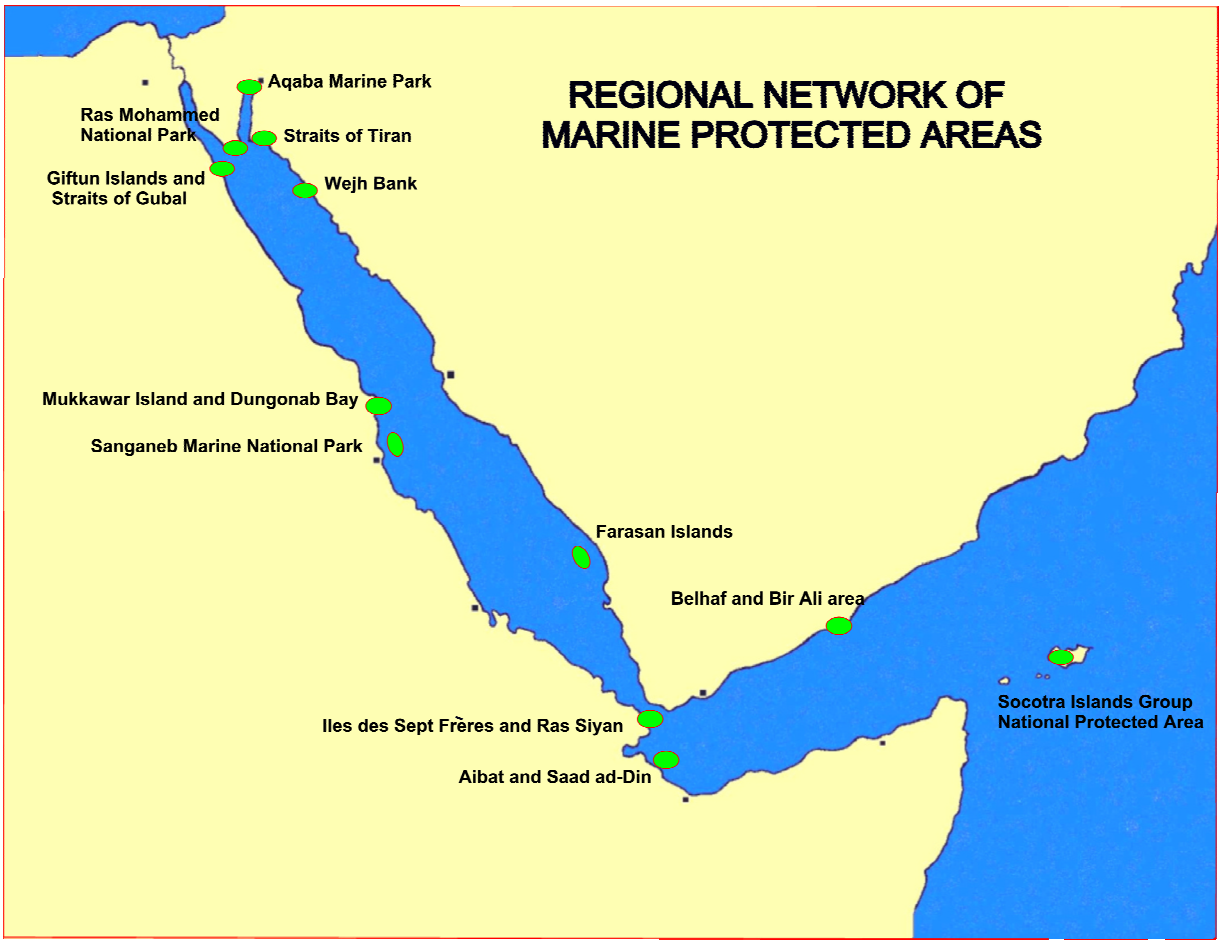

Figure 1. Red Sea and Gulf of Aden Regional Network of Marine Protected Areas

1. **Aqaba Marine Park (Jordan);**
2. **Straits of Tiran (Saudi Arabia/Egypt);**
3. **Ras Mohammed National Park (Egypt);**
4. **Giftun Islands and Straits of Gubal (Egypt);**
5. **Wajh Bank - Sharm Habban and Sharm Munaybirah (Saudi Arabia);**
6. **Mukkawar Island [Magarsam] and Dungonab Bay (Sudan);**
7. **Sanganeb Marine National Park (Sudan);**
8. **Farasan Islands Protected Area (Saudi Arabia);**
9. **Iles des Sept Frères and Ras Siyan (Djibouti);**
10. **Aibat and Saad ad-Din Islands, Saba Wanak (Somalia);**
11. **Belhaf and Bir Ali Area (Yemen)**
12. **Socotra Islands Group National Protected Area (Yemen);**

Purpose of the Regional Master Plan

This Regional Master Plan is a long-term policy document that will be used as a basis for the development of site-specific Master Plans and Management Plans in each of the MPAs in the regional network, where these do not already exist. The objectives, goals, general policies and strategies presented here are regionally applicable and will facilitate regional consistency in the management of MPAs in the Regional Network (see Figure 2).

Within each of the MPAs in the Regional Network a regionally standardised, site-specific Master Plan will be developed, which will serve as the long-term policy document for that MPA. This site-specific Master Plan will guide the development of a site-specific Management Plan for each MPA. These site-specific Management Plans are short-term, practical documents that describe the specific management actions required to achieve the objectives and goals listed in the Master Plan. The Management Plan is purposefully designed to be short-term (e.g. for a period of five years) so that it can be reviewed and updated in response to the results of monitoring of indicators of management success, scientific research and changes in local conditions.

This Regional Master Plan provides regionally standardised guidelines for the preparation of Master Plans and Management Plans, which can also be used as the basis for the development of both Master and Management Plans for MPAs outside the Regional Network. The guidelines for identifying and selecting MPAs provide a systematic and objective basis for the development of national system plans of MPAs in each country in the network.

In summary, a major long-term outcome of the establishment and operation of the Regional Network and the application of this Master Plan will be the development of experience that can be applied to all the MPAs in each country.

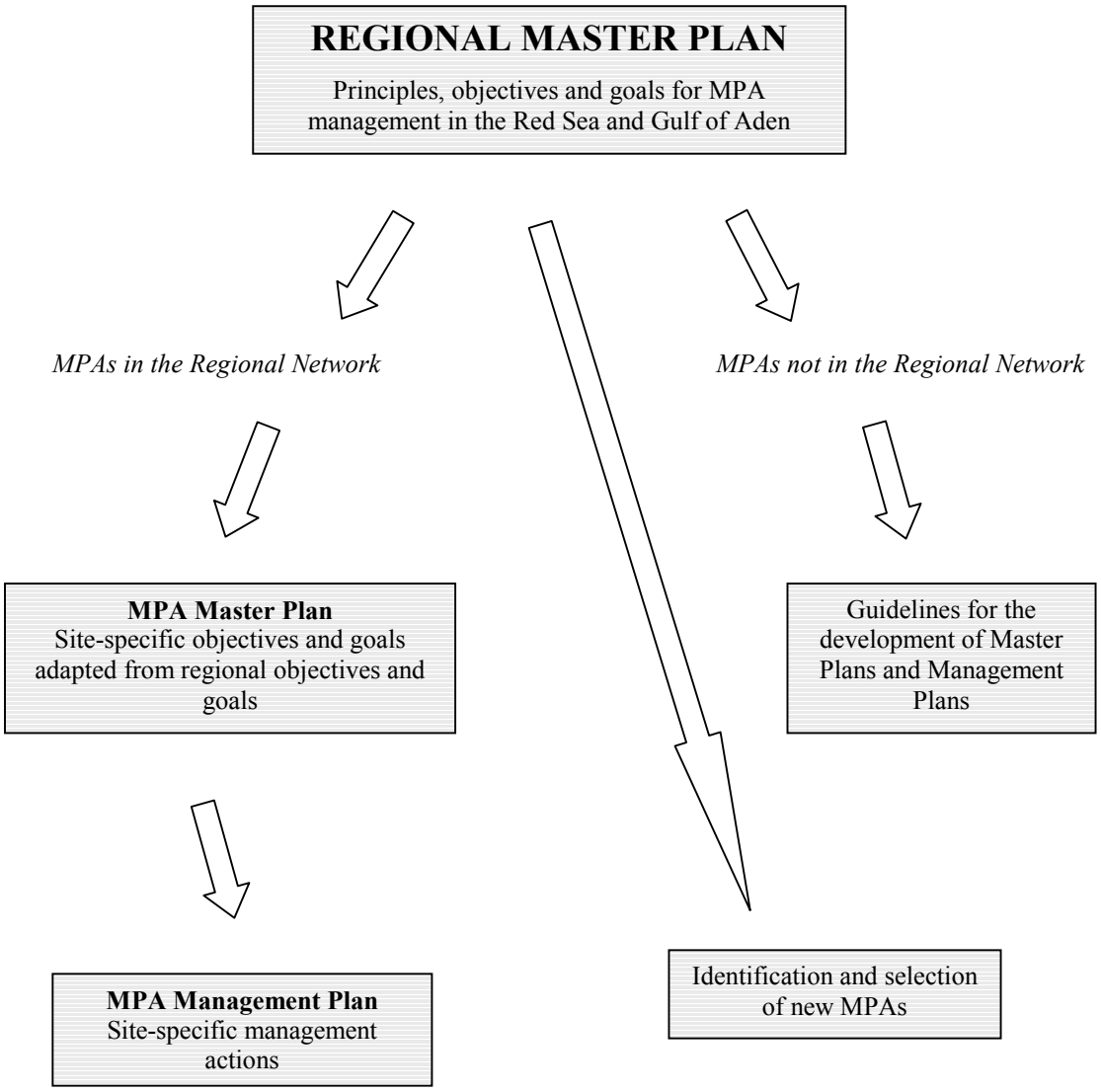

Figure 2. The relationship of this Regional Master Plan to MPAs in the Regional Network and its potential contribution to other MPAs in the region not represented in the Regional Network

Development of the Regional Master Plan

This Regional Master Plan was developed following review of the master and management plans of a number of established MPAs in the Regional Network, in particular Ras Mohammed National Park in Egypt (Jeudy de Grissac et al., 1998; Pearson and Shehata, 1998; TDA/EEAA/RSG, 1998) and the Farasan Islands Marine Protected Area in Saudi Arabia (Gladstone, 1994, 2000). The National System Plan for Saudi Arabia (Child and Grainger, 1990) provided information on zoning systems and the basis for developing representative networks. The Strategic Action Programme for the Red Sea and Gulf of Aden (PERSGA, 1998a; Gladstone et al., 1999) and supporting documents from that programme (Abdellatif et al., 1997; Ali et al., 1997; Haddad et al., 1997; ICED, 1997; PERSGA, 1998b) provided background information on the status of ecological systems. Internationally accepted practices and guidelines for planning and managing MPAs (Kelleher and Kenchington, 1992; Kelleher, 1999; Salm et al., 2000) provided the framework for the regionally adopted guidelines included here. The draft of the Regional Master Plan was reviewed at the PERSGA office in Jeddah and during a regional MPA workshop at Ras Mohammed National Park, in November 2000. The workshop was attended by MPA experts and representatives from all countries participating in the Regional Network. Their comments and suggestions were incorporated in the final document.

The Principles Underlying Management of Marine Protected Areas in the Regional Network

A number of principles, which have been adapted from principles of ecologically sustainable development and natural resource management, underlie this Regional Master Plan. These principles have guided the development of the objectives and goals. They provide planners and managers with a philosophical framework for the process of elaborating site-specific objectives and goals, or for discriminating between alternatives of each.

Intergenerational Equity

Future generations are entitled to inherit marine resources and biodiversity in a state that is as good as, or better than, their current state.

Ecological Sustainability

Ecological sustainability is the foundation of both social and economic development. Key elements of management and planning for ecological sustainability include ecosystem-based management, conservation of ecological processes, protection of critical habitats, use not to exceed maximum sustainable yield or carrying capacity, conservation of biodiversity in general and conservation of rare and endangered species in particular.

The Precautionary Principle

The absence of scientific certainty should not be a reason for postponing management of these MPAs. If an activity is assessed as having a low risk of causing serious or irreversible adverse impacts, or if there is insufficient information with which to assess fully and with certainty the magnitude and nature of impacts, decision-making should proceed in a conservative and cautious manner.

Integrated Planning and Management

Many of the activities that can potentially threaten MPAs occur outside their borders, including terrestrial areas, and often come under the jurisdiction of other management agencies. Management of MPAs should consider all potential sources of threats and develop management that addresses these threats. In order to achieve this, management of the MPA will need to be integrated with

the management responsibilities of the relevant agencies.

Stakeholder Consultation and Participation

MPAs in the Regional Network are used by a range of stakeholders, many of whom derive their livelihood from the MPA and have no alternative sources of livelihood. They are likely to be affected by management of the MPA and have the right to be consulted and to play an active part in the decision-making process. Many stakeholders also possess much knowledge and experience that will assist in planning and management.

Capacity Building and Technology Transfer

A key element to the successful implementation of MPA management is skilled and knowledgeable staff. Where skills and knowledge are limited, capacity building of staff will form a critical element in the long-term management of MPAs. Considerable technology is available that facilitates decision-making and the evaluation of management actions. A modern and appropriate technology base is a central component of MPA management. This includes computing and communication facilities, information resources and geographic information systems.

Adaptive Management

Management of MPAs needs to be viewed as an adaptive process or experiment that varies in response to changes in the character and intensity of threats, increased knowledge and changes in the composition of the local community. Adaptive management requires the establishment of performance measures at the outset of management. The results of systematic monitoring of key indicators are evaluated against the agreed performance measures, and management varied (if necessary) to ensure objectives and goals are being achieved.

Regional Master Plan

This Master Plan identifies the objectives and goals of the Regional Network and describes the policies and strategies to be used for achieving them. These objectives and goals reflect the fact that the Regional Network includes sites that are not only representative of the major habitats and ecosystems of the Red Sea and Gulf of Aden, but are also regionally and internationally unique and are therefore worthy of protection.

These sites also support a diversity of human uses, including artisanal and commercial fisheries, tourism, recreation and maritime transport, which are significant for local and national economies. For example, by the end of 1998 the estimated value of hotels and shops built by the private sector in the Sharm El Sheikh area (part of Ras Mohammed National Park, Egypt) was US$ 5 billion and the annual income associated with tourism activities for 1998 was US$6 billion (Jeudy de Grissac et al., 1998). The majority of Saudi Arabia's commercial fishing activity in the Red Sea occurs in the southern areas in the vicinity of the Farasan Islands Marine Protected Area (Gladstone, 2000). Fisheries, tourism and recreation depend on healthy ecosystems and the returns from these uses are vulnerable to the effects of over-exploitation. A primary objective of the Regional Master Plan is the protection of the resources that sustain these uses, which will in turn provide a basis for sustainable development of these activities and the provision of future use options that may arise.

A potential constraint to achieving the objectives and goals is the limited technical capacity and experience in MPA management that currently exists in the region. In some cases, individual countries lack experts with the necessary knowledge, training and skills required for MPA management. Much of the available experience currently resides within the Ras Mohammed National Park (Egypt) and is available for training of staff from other countries. A major objective of the Regional Master Plan is therefore capacity building of staff, which will occur through the implementation of the various activities associated with the establishment of the Regional Network.

A major regional initiative in the near future will be the development of a regional legal framework for protected areas and biodiversity. This is planned as a new protocol to the Jeddah Convention. The Regional Network of MPAs will play a major role in implementing the principles of this legal framework.

Objectives of the Regional Network of Marine Protected Areas

The objectives of the Red Sea and Gulf of Aden Regional Network of Marine Protected Areas are:

1. To develop regional capacity in all aspects of MPA planning and management.

2. To provide for the sustainable use of living marine resources.

3. To support local and national economic and social development.

4. To involve local communities and stakeholders as partners in MPA management.

5. To conserve representative and prime examples of the biodiversity of the Red Sea and Gulf of Aden.

6. To conduct monitoring and research programmes for the benefit of MPA management.

7. To enhance public awareness for the marine resources and biodiversity of the Red Sea and Gulf of Aden and the principles of sustainable use.

8. To protect the unique cultural heritage of the marine and coastal environments of the Red Sea and Gulf of Aden.

Goals, Strategies and Policies of the Red Sea and Gulf of Aden Regional Network of MPAs

Each of the objectives of the Regional Network has its related goals and specific strategies and policies for achieving them. These are outlined in Table 2 as shown opposite.

Table 2. Objectives, Goals, Strategies and Policies of the Red Sea and Gulf of Aden Regional Network of Marine Protected Areas

Objectives	Goals	Strategies and Policies
1. To develop regional capacity in all aspects of MPA planning and management	To increase staff capacity in the planning, establishment and management of MPAs. To establish a regional group of MPA experts. To establish communication networks and the exchange of information and experiences amongst MPAs in the Regional Network, and with regional networks in other parts of the world. To develop site-specific master plans and management plans for each MPA in the Regional Network where these do not already exist. To monitor and review management performance.	MPA staff to be trained in MPA selection, planning and management and in the relevant aspects of biodiversity conservation, fisheries, tourism, public awareness and marine ecology. This training to occur through formal courses and on-the-job training by staff participating in surveys and monitoring programmes. Relevant and up-to-date technology to be used for planning and management, such as GIS and remote sensing. Where this technology is not available, procedures are to be developed to seek funding and infrastructure support for its acquisition. Staff to be trained in the application of this technology in the planning and management of MPAs.
2. To provide for the sustainable use of living marine resources	To protect the habitats and ecological processes that sustain living marine resources at all stages of their life cycle. To manage the use of living marine resources, in consultation with local communities and commercial enterprises, and to ensure its sustainability. To establish monitoring programmes for species caught within the MPA. To re-establish traditional, community-based conservation practices. To coordinate with, and use the outcomes of, the relevant components of PERSGA's long-term programme of action.	Habitats critical for the support of living marine resources, such as breeding and nursery areas, and larval sources, to be protected. Fishing activities to be excluded from parts of each MPA so these areas can support fishing in surrounding areas of the MPA, through the emigration of adult fish and enhancement of reproductive output. Fishing activities in other parts of the MPA may be regulated from time to time in consultation with, or on the advice of, the traditional and commercial users e.g. via seasonal or temporary closures. Inventories of species caught within the MPA to be developed and stock assessments of key fisheries species undertaken. Stocks of key species caught within the MPA to be monitored using standardised techniques, to evaluate the effectiveness of management strategies. Areas within the MPA that have a high connectivity to other areas (in terms of their larval supply) to be protected. The construction of aquaculture facilities within the MPA to require a sound environmental assessment. National regulations relating to the capture of living marine resources to be enforced. All tourism operations to be ecologically and socially sustainable and subject to sound environmental and social impact assessment. Collection of curios to be forbidden within the MPA.

Table 2 cont'd.

Objectives	**Goals**	**Strategies and Policies**
3. To support local and national economic and social development	To encourage economic development activities based on the resources of the marine and coastal environments of the MPA, which are compatible with the objectives of the MPA. To ensure that all economic development activities and uses of the resources of the MPA are sustainable and subject to environmental and social impact assessment, according to the relevant legal instruments.	Where relevant and feasible, zoning plans to provide for areas to be set aside for development purposes. Options for alternative livelihoods to be investigated for members of the local community who will be significantly affected by the establishment of the MPA. Mechanisms for sustainable financing to be utilised to support the operations of the MPA. Cost-recovery mechanisms to be used to restore the resources of the MPA that are damaged by unlawful use. MPA staff to be available to provide free advice to developers on minimising the environmental effects of their activities.
4. To involve local communities and stakeholders as partners in MPA management	To involve the local community and stakeholders in a participatory manner in the development of management plans and in day-to-day management activities of the MPA. To engender within the local community a sense of partnership and commitment to the objectives of the MPA and its management activities. To provide employment opportunities for the local community in the operations of the MPA.	Local community members and stakeholders (or their representatives) to be invited to review and comment on draft zoning plans, management strategies and available information about the MPA. The comments of community members and stakeholders to be used in amending draft zoning plans and management plans. Local community members to be trained to undertake tasks that support the management of the MPA, such as community ranger duties, the collection of fisheries data, monitoring of key groups of flora and fauna, liaison with tourists.

Table 2 cont'd.

Objectives	Goals	Strategies and Policies
5. To conserve representative examples of the biodiversity of the Red Sea and Gulf of Aden	To conserve representative samples of the range of habitats, communities, species, landscapes and seascapes occurring within each MPA in the network, and the ecological processes upon which each of them depend. To maintain the natural coastlines within each of the MPAs in the network, because of their role in conserving the integrity of coastal ecosystems and habitats. To maintain water quality within each of the MPAs in the network, in recognition of the primary importance of water quality to the maintenance of ecosystem structure and function. To protect critical habitats within each of the MPAs in the network and, where necessary, restore those that have been degraded. To protect significant, rare and endangered species occurring within each of the MPAs in the network, and the habitats upon which they are dependent. To use the best available information for planning and management decision-making. To coordinate with, and use the outcomes of, the relevant components of PERSGA's long-term programme of action.	Comprehensive inventories and maps of all habitats to be compiled for each MPA where this has not already been done, using methods outlined in the Standard Survey Methods Manual. Representative examples of all habitats and the varieties of community types within them to be conserved by including them in protective zoning. Areas of high conservation value to be conserved by protective zoning. These areas include: areas of high species richness; areas with a number of different community types in close proximity to one another; areas important as sources of larval recruits; and areas of high aesthetic value. Activities occurring outside the MPA (including activities in adjacent terrestrial systems) that are causing, or likely to cause, damage to habitats within the MPA to be managed to reduce their impacts on the MPA. This needs to occur by coordination with the relevant agencies. The status of the major habitats within the MPA to be monitored annually using methods outlined in the Standard Survey Methods Manual. There are to be no alterations to natural shorelines, with the exception of development activities permitted in specified zones. Mooring buoys to be provided in areas of high recreational usage to prevent anchor damage to corals. Activities that remove or degrade mangroves not to be allowed. Restoration of cleared mangrove stands to be undertaken after the responsible activity has ceased, using local stocks for replanting. Surveys to be undertaken to determine the status of marine turtles, sea birds, and marine mammals occurring in the MPA and the areas important for these groups. Areas important for marine turtles, sea birds and marine mammals within the MPA to be conserved by protective zoning. Surveys of the use of marine turtles, sea birds and marine mammals by the local community to be undertaken to determine the magnitude of current threats to their status within the MPA. National legislation relating to the conservation of marine turtles, sea birds and marine mammals to be enforced. The status of marine turtles, sea birds and marine mammals within the MPA to be monitored annually using standard techniques outlined in the *Standard Survey Methods Manual*. Introductions of non-indigenous or genetically modified species into the waters of the MPA or adjacent land areas (i.e. in aquaculture facilities) to be forbidden.

		All developments within the MPA and in adjacent waters and terrestrial areas to require an environmental assessment, in accordance with the relevant legislation. Where this legislation does not exist, MPA staff to liaise with key decision-makes for its development and enactment. Pollution from shipping in the waters of the MPA, and in surrounding waters, not to be permitted. Surveillance for pollution incidents to be developed and implemented. The legislation and regulations relating to pollution to be enforced. Discharges from land-based and sea-based sources into the waters within or adjacent to the MPA to be forbidden. Oil spill contingency plans to be developed for the MPA and integrated with the relevant Marine Emergency Mutual Aid Centre
6. To conduct research and monitoring programmes for the benefit of MPA management	To support and facilitate management-related research and incorporate the results of this research in improved management practices. To establish monitoring programmes for key indicators and undertake regular evaluations of management against performance targets. To provide reference locations for research and monitoring that are undisturbed by human activities.	Monitoring programmes in each MPA to target the status of habitats, key fisheries species, marine turtles, sea birds and marine mammals. Standard monitoring techniques to be used and the programmes to have an appropriate statistical design incorporating levels of detectable change. Monitoring also to target public awareness and attitudes towards management, and infringements of MPA regulations. Data collected during monitoring to be added to a database within each MPA and also in a centralised, relational database within PERSGA. Results of monitoring to be compiled and reported annually and compared against performance targets during the evaluation and review process. At the end of each year the PERSGA MPA Coordinator to be responsible for producing a Status Report for the Regional MPA Network, summarising the results of the monitoring in each MPA. Programmes of applied research to be developed to support management, in consultation with local researchers. University researchers and students to be encouraged to participate in the research and monitoring programme. Results of the monitoring and research programmes to be made available to managers and to be included in public awareness programmes to demonstrate the benefits arising from the MPA.

Table 2 cont'd

Objectives	**Goals**	**Strategies and Policies**
7. To enhance public awareness for the marine resources and biodiversity of the Red Sea and Gulf of Aden and the principles of sustainable use	To develop public awareness programmes for the local community and all stakeholders. To provide opportunities for the public to appreciate the natural beauty of each MPA in an undisturbed setting. To conserve reference locations which contain the complete diversity of ecosystems, habitats and species in each MPA for their potential to educate the public. To coordinate with, and use the outcomes of, the relevant components of PERSGA's long-term programme of action.	Public awareness programmes to target the local community, all stakeholder groups and their employees, local educators (e.g. primary and high school teachers) and also key decision-makers in government. Public awareness programmes to provide the community with information on the following topics related to the MPA: the regional significance of the MPA; its management objectives and the reasons for its establishment; the results of research and monitoring programmes; the natural values and ecology of the marine and coastal environments; and the relationships between human activities and the health of these environments. In particular, public awareness programmes developed for investors and their staff to stress the close association between resource conservation and sustainable economic returns. The content of the public awareness programmes to be delivered through a variety of means, including brochures; articles in newspapers; feature stories on television and radio; home pages on the Internet; articles in *Al Sanbouk*; and visitor centres. Areas of the MPA that have a high aesthetic value or public appeal (e.g. especially beautiful coral reefs, impressive sections of coastline) to be conserved through protective zoning and to be a focus for public awareness activities. Where MPAs are used for recreational and tourist activities, the public awareness programme to include guidelines for recreational users to avoid damage to coral reefs through anchoring, littering, reef walking and diving.
8. To protect the unique cultural heritage of the marine and coastal environments of the Red Sea and Gulf of Aden	To provide for the maintenance of the traditional livelihoods of the inhabitants of the MPA. To protect areas that are culturally significant. To protect species that have a cultural significance, their habitats and to facilitate their sustainable use.	An inventory of culturally important sites to be prepared for the MPA and these sites to be protected. Traditional conservation practices used within the MPA to be documented and their continuation to be encouraged by integrating them into the MPA management. Social impact assessments to be undertaken prior to the establishment of MPAs and as part of the assessment process for developments within MPAs. Habitats and resources required by species that are exploited for cultural purposes to be conserved.

Guidelines for Developing Master Plans and Management Plans for MPAs in the Red Sea and Gulf of Aden Regional Network

The purpose of this section is to provide guidelines for the planning and management of MPAs in the Regional Network, where such plans do not already exist. Specifically, this section provides guidelines for the planning process (including the establishment of a management team); the development of zoning plans; research and monitoring programmes; the content of master and management plans; community awareness; stakeholder consultation and participation; and sustainable financing. These guidelines have been adapted from accepted international procedures (Kelleher and Kenchington, 1992; Kenchington and Ch'ng, 1994; English et al., 1997; Kay and Alder, 1999; Kelleher, 1999; Salm et al., 2000) to suit the context of the Red Sea and Gulf of Aden.

Effective establishment and management of MPAs need to be based on a systematic approach to defining management objectives and their implementation. Planning provides the foundation for decisions about how the resources of the organization will be allocated and why. Management involves implementing those decisions (i.e. the objectives of the management plan) and includes all those operations that collectively constitute day-to-day management. The outcome of the planning process is a site-specific master and management plan for the MPA.

The Planning Team

An important first step in planning the management of the MPA is to assemble an inter-disciplinary planning team. The planning team needs to be led by a project manager (who represents the agency charged with developing the plan and implementing the management) and include individuals with both expertise in the relevant disciplines and familiarity with the area. Members could potentially include marine scientists, ecologists and biologists, social scientists, lawyers, economists and information specialists. The terms of reference for the planning team include the following:

1. To assemble and synthesise all existing information on the MPA and assess the need for any additional information that is necessary for planning the management of the MPA.
2. To identify the stakeholder groups within the MPA and all relevant agencies that need to be consulted during the planning process.
3. To develop a draft master plan and management plan for the MPA.
4. To develop a community consultation process for the draft master plan and management plan and incorporate the outcomes of this process.
5. To develop the master plan and management plan and a process for its implementation.
6. To review the outcomes of the monitoring programme and assess the need for changes to management of the MPA.

The Planning Process

1. Initial Information Gathering

The planning team assembles and reviews existing information on the nature, use and conditions of the area. This information will be drawn from existing reports, scientific papers, previous surveys, knowledgeable individuals, maps and GIS databases. In addition, the planning team will seek out stakeholders in the MPA and interview them to gather knowledge and keep them informed of proceedings. If field surveys are required, they should occur at an early stage. The categories of information necessary will depend on the size of the MPA and its level of usage, but will be drawn from the following:

Bio-physical Information

- types, and extent, of ecosystems and habitats occurring within the MPA, including open water, coral reefs, other subtidal habitats, beaches, rocky shores, sabkha, mangrove, seagrass, intertidal, saltmarsh, wetland
- the flora and fauna of each of these habitats
- the structure and extent of coral communities and other benthic communities
- the composition of fish assemblages associated with the coral communities and other benthic communities
- areas that are unusually rich in biodiversity within the boundaries of the MPA, i.e. areas with a high diversity and richness in a particular, or several, groups
- areas used by fishes for spawning and as juvenile nursery areas
- the distribution of sea turtles, dugong and marine mammals and of habitats used by these groups
- seabirds and the areas used by them for feeding and nesting

Resource Use Information

- the types of use made of the living marine resources occurring in the area, the locations where these uses occur and the intensity of use of each of these locations
- species caught by fishermen and any seasonal patterns in species targeted
- historical records of catch and effort for species caught
- the types of fishing equipment used by fishermen
- the locations of fishing camps
- seasonal patterns in the use of living marine resources
- areas important for recreation and tourism and their levels of use
- areas important for research and education
- use of the area for navigation, shipping (including anchorages and ports), defence
- areas with traditional and cultural significance

Socio-Economic Information

- locations of towns, settlements and their populations, within the MPA or adjacent to the MPA
- numbers of people engaged in each of the resource uses and whether they work seasonally or full-time in these activities
- the economic significance of the area for each of the uses
- the income derived by users of resources within the MPA
- population growth rates and levels of education
- the use of customary or traditional management practices
- the role of local *sheikhs* in the local community and in resource usage
- the presence of other significant individuals (such as chief fishermen)

Adjacent Areas

MPAs do not occur in isolation from the surrounding environment. MPAs with a coastal component are vulnerable to impacts from unsustainable land-use practices (e.g. soil erosion leading to sedimentation) and nutrient pollution, and MPAs away from the coast are also vulnerable to unsustainable exploitation of nearby reefs and pollution events. However, experience in other parts of the world has shown that even MPAs located some distance from the coast are vulnerable to sedimentation and freshwater bleaching following large flood events. Although located outside the management responsibilities of the MPA, the managers will reduce the likelihood of these events by coordinating their activities with the relevant agencies. The following information will need to be collected:

- major coastal landscapes and drainage patterns
- the uses of these areas and an assessment of the state of the land
- the human uses occurring outside, but in the vicinity of, the MPA on land and on water

In addition to those groups already mentioned, the planning team will identify the stakeholder groups who may have an interest in the management of the MPA. These other stakeholders might include: scientists, community leaders, non-government environmental organisations, dive clubs and local businesses. The nature of the interest in the MPA of each of these stakeholder groups is determined, along with their contact details. Stakeholders also include other government agencies whose management responsibilities overlap with the management roles of the MPA e.g. wildlife, conservation, fisheries, water, local development, military, ports authorities and municipalities.

2. Surveys

In some areas the existing information might be limited or unavailable. In this situation it is important to identify the information gaps and, if time and resources permit, arrange for surveys to obtain the necessary information. If surveys are required the 'Guide to Standard Survey Methods for Key Habitats and Species' will be used for surveying the bio-physical parameters.

All information collected during this preliminary phase, and also during surveys, will be entered into a relational database and GIS. Maps will be produced to display all of the information.

3. Preparation of a Draft Plan

The planning team prepares a draft Master Plan and Management Plan based on the information gathered. The required content of these Plans is outlined in Appendix 3.

An important step at this stage is the elaboration of the objectives, goals and general policies and strategies for the master plan. These are defined by the planning team to reflect agency priorities, as well as national and regional goals for biodiversity conservation and sustainable use of living marine resources. These goals will be based on the same broad goals outlined in this Regional Master Plan.

At this stage the planning team considers the range of strategies available to it to manage human use in the MPA in order to achieve the objectives and goals for the MPA. These options can include:

- zoning
- the use of traditional management practices, including the involvement of significant individuals in the society
- collaborative and community-based management

- public education and awareness
- research and monitoring
- environmental assessment for possible commercial uses of the MPA
- surveillance and enforcement
- economic instruments
- specific regulations, that might include:
  - seasonal closures of ecologically important areas (e.g. fish spawning locations, or when birds and turtles are nesting) or for the recovery of damaged habitats
  - controls on the use of specific types of equipment (e.g. dynamite for fishing; spear guns; limitations on net mesh; numbers of fish traps). In some cases this will simply be an extension of existing national fisheries regulations
  - quotas (including fisheries and tourism)
  - development controls (e.g. the establishment of a minimum set back for coastal constructions).

After the draft management plan has been compiled, the planning team prepares the necessary materials to present the draft plan to stakeholders. This will include the management plan document, as well as any maps showing the locations of proposed zones and options for management.

4. Development of a Zoning Plan

A zoning plan is a common component of management plans for MPAs and is appropriate for MPAs that include a range of human uses, conservation values and conflicts. The zoning plan is used to separate conflicting uses within the MPA and includes a range of zone types, each with a specific management objective. Box 1 provides examples from the region of zoning systems and the management objectives of different zones. The management objectives for each zone type need to be specified, along with the range of uses that will be permitted and prohibited within each one. The following guidelines for the development of zoning plans are based on general guidelines (e.g. Kelleher and Kenchington, 1992; Kelleher, 1999; Salm et al., 2000) and specific case studies from the region (Child and Grainger, 1990; Pearson and Shehata, 1998; EPC, 1999; Gladstone, 2000).

The following are guidelines for developing zoning plans:

1. The zoning plan should be clear, simple and understood by the range of users of the MPA. Where users have little or no experience in interpreting maps (e.g. some indigenous fishermen), the boundaries of the zones should be explained during public meetings. To aid compliance and interpretation, the boundaries of zones should coincide with obvious geographic features (e.g. distinct headlands, the edges of reefs).

2. The zoning plan should use a system of buffering to minimise sudden transitions from highly protected zones to general use zones. Zones providing a high degree of protection should be adjacent to zones providing a moderate degree of protection.

3. A single zone type should be used around a discrete geographic entity (e.g. an island or reef). However, where enforcement is possible, split zones may be appropriate to support fisheries-related activities.

4. Zoning plans should complement, rather than duplicate, existing regulations and management practices.

5. Protective zoning should be considered for areas within the MPA that:

- are of world, regional or national significance (e.g. areas important for significant species)

- contain critical habitat (e.g. seagrass, mangroves) or significant breeding or nursery sites (e.g. for fish, birds, turtles)
- contain representative samples of characteristic habitat types. Where possible, multiple samples or large areas of each habitat type should be protected. This will reduce the risks of a single sample of a habitat in pristine condition being damaged by a catastrophic event e.g. oil spill
- are important for non-extractive activities (e.g. SCUBA diving, snorkelling, recreation) and will provide a focus for public awareness activities
- have a high connectivity to other parts of the MPA (via larval transport) and are therefore likely to act as important sources of recruits to these areas, and thereby sustainable extractive activities (e.g. fishing).

6. National and local development needs should be provided for in the zoning plan. General use zones should be considered for areas of the MPA that were modified by development prior to the establishment of the MPA, or to focus development activities (that might involve habitat modification) in specific areas that will have minimal impact on the conservation values of the MPA.

7. Zoning of reefs and waters adjacent to existing terrestrial national parks or reserves should complement the management objectives of these areas.

8. Areas recognised and/or used for reasonable extractive activities and have a long-term significance for the livelihood of local inhabitants should be zoned to allow these activities to continue.

9. Traditional or cultural uses of an area, that are likely to remain sustainable, should be zoned so that they can continue.

10. Areas used as anchorages should be zoned to allow most of the activities associated with anchoring to continue. However these zones should not allow for the disposal of wastes or habitat damage.

11. The zoning plan should not impede shipping access to recognised navigation routes or to existing or potential ports.

12. Public awareness, monitoring and scientific research are essential activities in MPAs. Areas of the MPA that can play an important role in public awareness (e.g. areas of beauty or high species richness that are easily accessible) should be given a form of protective zoning. The zoning plan should allow scientific research throughout the MPA. Areas of the MPA should be zoned as reference areas (i.e. from which all use and visits are excluded, apart from monitoring and research) to gauge the effectiveness of MPA management.

13. The zoning plan should provide for areas to be temporarily closed to all activities to allow restoration.

Box 1: Zoning Systems currently in place, or recommended, for MPAs in the Red Sea and Gulf of Aden.

Ras Mohammed National Park Sector (Egypt). Source: Pearson and Shehata (1998)

Name	National Zoning Category	Management Objectives
Ras Mohammed	National Park	Conservation of national and internationally significant coral reef ecosystems and of representative examples of biodiversity.
Tiran-Senafir	National Park	Conservation of national and internationally significant coral reef ecosystems and of representative examples of biodiversity.
Sharm-el Sheikh	Protected Coastline	To provide for infrastructure and economic development under strict control.
Nabq	Managed Resource Protected Area	Conservation of ecosystems and biodiversity, while providing for sustainable use by local fishermen.
Abu Galum	Managed Resource Protected Area	Conservation of ecosystems and biodiversity, while providing for sustainable use by local fishermen.
Taba Coast	Protected Coastline	To provide for infrastructure and economic development under strict control.
Taba	Natural Monument	Conservation of unique natural features.

Zoning Plan for Socotra Archipelago (Yemen). Source: EPC (1999)

Name of Zone	Management Objectives
Resource Use Reserve	Long-term protection of the biodiversity of the Socotra Archipelago, while providing for sustainable use by the local community.
General Use Zone (occurring within the Resource Use Reserve)	To include sites where habitats have already been modified by development and/or resource exploitation and to allow for the development of essential infrastructure.
National Park	To protect the unique natural habitats and landscapes; to support the needs of the local community, especially subsistence users; to protect representative examples of biodiversity.
Nature Sanctuary	To preserve rare and fragile habitats, ecosystems, species and unique landscapes in an undisturbed state; to provide opportunities for future generations to experience and enjoy undisturbed areas; to maintain natural attributes of the environment; to enable the existing local community to maintain their lifestyle.

Farasan Islands Marine Protected Area (Saudi Arabia). Source: Gladstone (2000)

Name of Zone	Management Objectives
Resource Use Hima	Relatively large areas in which the emphasis is on sustainable resource management.
Biological Hima	Small areas set aside to protect critical habitats e.g. seagrass, mangroves, turtle nesting beaches.
Natural Hima	Small areas of high natural excellence established for the conservation of particular species (e.g. waterbirds) and for public education, low impact recreation and scientific research.
Special Natural Hima	Areas important for the conservation of biological diversity, which contain representative examples of biodiversity; habitat required for significant species; fish nurseries.
Recreational Hima	Areas of high scenic and amenity value managed for their educational and recreational values.

Aqaba Marine Park (Jordan). Source: Al-Saifi (2000)

Name of Zone	Management Objectives
Strict Reserve Zone	Preservation of marine communities in their natural state; reference areas for monitoring and scientific research.
Beach Recreation and Swimming Zone	Safe beach recreation, by excluding fishing and motorised boat activities.
Multi Use and Boat Access Corridors	Safe boating passages and access to the beach for boats, without endangering people using the beach.
Diving and Snorkelling Zone	Safe diving and snorkelling, for the observation and study of marine life.
Bait Fishing Zones	Capture of bait by licensed fishermen.
Beach Zone	Management of beach activities; development control near beaches.

5. Review of Draft Plan

The planning team publishes or distributes the draft plan and seeks comment from stakeholders. Stakeholders are invited to identify alternative solutions that are consistent with the goals and objectives for the MPA.

The process of the review can consist of public meetings where all stakeholders are invited to attend and at which the draft plan is presented and discussed, or meetings with representatives of the different stakeholder groups, or written submissions. Whatever process is used, comments of support or objection to specific components of the plan are noted and summarised and referred to when assessing the need to revise the plan. A detailed analysis of the review is produced within a few weeks of the completion of the public consultation.

6. Plan Finalisation

Using the report of the public consultations on the draft plan, the planning team meets to discuss and evaluate possible changes to the plan. Substantial changes to the draft plan should be discussed with stakeholder groups likely to be affected and the reasons for the changes discussed at length.

After all the necessary changes have been made to the detail of the plan, the content of the management plan is determined by the planning team (see the next section) and all the necessary information is compiled. The precise cartography of the MPA and any zones are completed and checked. The plan must also be checked by the agency's legal officer. The final management plan is submitted to the responsible Minister or agency official for final approval or endorsement as required.

7. Monitoring and Evaluation

According to the principle of adaptive management, the management plan is not a fixed document, but should be viewed as an experiment that is varied according to the results of the monitoring programme. Evaluation of the plan is undertaken regularly (e.g. every 5-7 years) as a result of information from the monitoring programme on impacts of activities, usage patterns and the effectiveness of specific management activities (such as zoning, development controls, public awareness programmes). It will also be necessary as a result of improved scientific understanding of the MPA and the activities occurring there.

Box 2. Case Study: Management of Traditional Fishing in Nabq Managed Resource Protected Area, National Parks of Egypt, South Sinai, Egypt.

The management of fisheries activities in Nabq Protected Area is conducted both by National Parks of Egypt Environmental Officers and by Bedouins associated with the Park's activities for negotiation, follow-up and daily data collection.

Nabq Protected Area, within the Ras Mohammed National Park Sector, is one of the most important fishing areas of the Egyptian coast of the Gulf of Aqaba due to the presence of large nursery grounds including mangroves, seagrass beds and areas of coral reefs. Nabq also has the largest lagoon system of the Gulf of Aqaba with a width of about 1km. The Nabq fishing village of Ghargana consists of 12 resident families with nearly 70 fishermen.

In order to conserve the marine resources and to maintain sustainable exploitation within Nabq Protected Area, the National Parks Sector has prepared a management policy for traditional fishing in Nabq. A management plan began in 1994 after discussion and agreement with the Bedouins who had been informed about the long-term role of the Protected Area and the potential benefits from management for the Bedouins.

In 1995, a survey was conducted of the Bedouin experience and exploitation of the area. Following this survey, the National Parks Sector prepared a management agreement that included regulations concerning fishing methods, equipment, fish catch, fishing location and period of fishing. In 1996, a meeting with all the fishermen of Nabq was held in their village to adopt a new management policy of opening and closing specific fishing grounds. The Bedouin fishermen accepted the new policy and about 50 % of the Nabq Protected Area coast has been closed for fishing. Studies have shown the effectiveness of this management tool for conserving both the fish stocks and also the coral reef ecosystem.

Since 1996, National Parks Sector management has been monitoring the coral reefs and fishes of the closed and opened areas using visual census techniques. Fishing activities and environmental data are monitored daily. Bedouins have been trained to identify fish species, to collect data and to report on changes in the environment or on the importance of catches. A major result of this cooperation has been a better understanding of the fishing policy amongst the Bedouins and the Bedouins have recently proposed reductions in the catches of some species due to a slow turnover of the stock.

The involvement of Bedouin fishermen in the management of marine resources in Nabq has allowed the National Parks Sector to implement its fishing management policy successfully within traditional fisheries.

This case study was prepared by Ayman Mabrouk, Mohamed El Helw, Marwan Abdellatif, Selmi Soliman, Auda Ali, Ottayeg Auda and Mohammed Soubayel of the Ras Mohammed National Park Sector.

Research and Monitoring

Research

Information is required to support the ongoing management of protected areas (Rodgers, 1991; Kenchington and Ch'ng, 1994; Kelleher, 1999). Although information is normally collected as part of the planning process, research will also continue after the MPA has been established to gather information that will assist in continued management. Research needs will be highlighted during the regular reviews of the performance of the MPA. It is important that additional information needs are prioritised and focused.

Research priorities to support ongoing management should be determined by collaboration between managers and scientists and ought to be reviewed regularly. Research commissioned by management agencies should include specific objectives and the management agency should ensure that the research has a sound design with appropriate statistical analysis of the results. The results (in the form of a draft report) should undergo peer review prior to final acceptance by the agency. A project manager within the management agency is nominated to initiate, oversee and manage the research, and is also responsible for arranging peer review and acceptance or rejection of the final report. This is best accomplished through regular liaison between the project manager and scientists.

The contents of the research programme will depend on the particular MPA (its size, management objectives etc.), the information already available and the technical expertise and funding available. Information that supports management and might not be available in the early stages of the planning process includes:

- patterns of water movement within the MPA, and between the MPA and surrounding waters, which can be used to predict patterns of connectivity and the likely spread of pollutants
- life history and population dynamics of exploited species and, in particular, their use of specific habitats at different stages of their life cycle or breeding
- life history and population dynamics of species that form important components of benthic habitats, especially corals and seagrasses
- biodiversity inventories
- socio-economic significance of the area covered by the MPA for local inhabitants and for the national economy.

Monitoring

Monitoring is undertaken in MPAs for a variety of reasons:

- as part of the management evaluation process; monitoring will determine the baseline conditions at the time the MPA is established so that management performance can be assessed
- to understand the natural variations in the ecosystem so that impacts from human activities can be distinguished from normal, background variation
- to assess the impacts of particular activities (e.g. establishment of a tourist operation or port).

Long-term monitoring is a critical part of the assessment and review of MPA performance, i.e. in determining whether the MPA is achieving its goals and objectives as specified in the management plan. It is therefore essential that the monitoring programme be designed during the planning for the MPA and that it commence prior to, or at the time of, establishment of the MPA and be used as a baseline study.

The monitoring programme will include the objectives of the monitoring, a list of the indicators to be measured, the methods, a

sampling regime (i.e. where and how often they will be measured), who will undertake the monitoring, how the data will be assembled into a database and reporting procedures.

The following points need to be considered in the design and implementation of a long-term monitoring programme used to review and assess the effectiveness of MPA management:

1. Identification of the specific objectives of the monitoring programme.

2. The choice of indicators that are likely to be responsive to changes in critical pressures and can be easily measured (e.g. abundance of fish species, coral cover, water quality, awareness and attitudes); critical pressures can include fishing, tourism, pollution and development.

3. The design of the sampling programme takes account of natural variations in the indicators being measured and is capable of discriminating changes due to human activity (including management) from natural changes.

4. The appropriate choice of sites for monitoring. Sites should be representative of the habitats found in the MPA; the design should include a range of control or pristine sites that are similar in all ways to the impacted sites. Site selection can proceed following a pilot programme, in which all potential sites are identified, possibly through the use of aerial photos, satellite images and charts. The number of sites chosen will be a compromise between the amount of information that is required and the resources available to undertake the monitoring.

5. The limits of acceptable change in the indicators need to be discussed and agreed upon at the beginning of the monitoring programme. This information can be obtained from existing studies on the limits of acceptable change and can be modified as more information becomes available in the local situation.

6. The design of the monitoring programme needs to be statistically sound and include adequate replication and an assessment of the programme's power to detect specified amounts of change in the indicators being monitored. This may require a number of pilot studies to determine the amount of replication needed to detect the specified change.

7. Staff undertaking the surveys need to be appropriately trained and to receive regular training updates. Where possible, it is most desirable for the same team of people to undertake the monitoring from year to year.

8. Monitoring needs to be conducted over a long time period using standard techniques.

9. The intensity of monitoring may vary from detailed monitoring of small areas by specialists, to broadscale monitoring of larger areas by trained non-specialists (e.g. interested dive clubs). Where non-specialists are used, they should receive appropriate training prior to participating and their performance should be assessed regularly.

10. Results of the monitoring programme need to be entered into a relational database at the conclusion of each survey and checked for the accuracy of data entry. The database needs to be designed so that information can be retrieved quickly and analysed.

11. Annual reports of the monitoring programme should be prepared to summarise the results in relation to the MPA goals and objectives. These results should form part of the regular review and evaluation of the MPA (e.g. at intervals of 5-7 years).

Box 3: Current Monitoring and Research Programmes in MPAs in the Regional Network

Farasan Islands Marine Protected Area (Saudi Arabia)

The management plan for the Farasan Islands MPA includes a monitoring programme, with baseline information that has been collected on a range of indicators. The monitoring programme is designed to: (1) gather baseline information on natural variations in the abundance of a range of indicators, against which impacts caused by human activities can be evaluated, (2) test the effectiveness of management of the MPA. The following indicators were selected: benthic lifeform coverage, Tridacna clams, coral predators and their effects (specifically crown-of-thorns starfish *Acanthaster planci*, and *Drupella* sp. snails), seagrass coverage and fish stocks (Gladstone, 1994). The monitoring was repeated in 2000 and revealed declines in the coverage of live coral (possibly associated with a wide scale bleaching event in the southern Red Sea), a decrease in the numbers of recently dead Tridacna clams and inconsistent changes in the densities of fishes (Rouphael and Al-Yami, 2000).

Monitoring and Research by the National Parks of Egypt of Five Egyptian Offshore Islands before Opening to Tourism and Underwater Activities

An exploratory survey of five offshore islands in the Egyptian Red Sea (Small and Big Brothers, 26º 18' N, 34º 52' E, Abu El Kizan, 24º 56' N, 35º52' E, El Zabarghad, 23º 36' N, 36º 12' E, Rocky Island, 23º 33 N, 36º 15'E) was undertaken in December 1997 by the Egyptian Environmental Affairs Agency, Nature Conservation Sector. The objectives of the survey were to evaluate the importance of natural resources in terms of their biodiversity values and to provide baseline data for monitoring studies, prior to the opening of these areas on 30 May 1998 to recreational diving.

The benthic ecology of these offshore islands, which were declared protected in 1985, had not been previously investigated. The expedition of J.Y. Cousteau in 1951-52 focused primarily on the islands' geomorphology. A particular study on coral bioerosion and bioaccretion was made in El Zabarghad by Hassan in 1997. In the present study, line transects were laid on the leeward SE reef side of each island at 3 m, 8 m and 15 m depth along an 80 m line. Quadrats (2 x 2 m) were placed every 10 m along the transect to describe patterns quantitatively in coral communities and to evaluate the variability of coral cover and distribution along a depth gradient.

Results of the survey confirmed that these islands are of great interest to science and to underwater tourism and that the leeward SE reef side of each island is more suitable for mooring. The results of the survey confirmed that in sheltered areas coral cover exceeds 60 % and on the leeward side of Abu El Kizan Island it reached 72 %. There was also a relatively high cover of soft coral (46 %), probably due to its topography as a massive intertidal reef flat totally exposed to currents and swell. The fact that the leeward sides of Small Brother and El Zabarghad Islands displayed a higher percentage cover of hard corals than the other islands was probably linked to the fact that these sites are relatively more sheltered and on gentle slopes, thus more suitable to hard coral colonies in shallower depths (3 and 8 m). The richness of hard coral genera was highest in Small Brother and Abu El Kizan and was lowest in Rocky Island. Depth was not a significant parameter controlling these coral assemblages. Cluster analysis returned 2 clusters (based on pooled data on hard and soft coral cover percentages) and was used to describe epi-benthic assemblages at different depths for each island.

The results showed that these pristine islands are of major interest to science and to underwater tourism. The observations confirmed the literature although several trends are particular to these specific areas. More than depth, topography and exposure to wind, currents and swell exert strong controls on coral assemblages. These assemblages appear fragile when impacted by natural disturbances such as crown-of-thorns starfish outbreaks as observed on Rocky Island.

The baseline data collected at the planned mooring sites of each island allows the monitoring programme to detect impacts from anthropogenic and natural phenomena on the reefs. The future monitoring work will include: a more specific evaluation of the carrying capacity of the sites for visitor numbers and related infrastructure (e.g. moorings); extending the survey to all sub-habitats of each island including windward sides; to sample at a standard series of depths up to 40 m for both benthic and pelagic resources in order to make inter-site comparisons; to include associated species assemblages and comprehensive fish census monitoring with selected key families or groups used as indicators; to monitor the crown-of-thorns starfish outbreaks and bleaching events in the area.

This case study is an extract from Tilot. et al., (in press).

Case Study: Monitoring Coral Reefs and Fishes along the Egyptian Coast of the Gulf of Aqaba by the National Parks of Egypt, South Sinai Region

Monitoring is conducted by the National Parks of Egypt Environmental Officers with the assistance of international researchers and institutions such Suez Canal University, York, Newcastle and Essen Universities.

Previous studies have been undertaken along the coast of the Gulf of Aqaba at Eilat (Israel) by Loya in 1972, at Aqaba (Jordan) by Mergner in 1971, Mergner and Schumacher in 1974 and Bouchon in 1980. Quantitative work was undertaken at Sharm El Sheikh and Ras Mohammed (Egypt) by Kotb in 1991, Medio in 1997 and Riegl in 1993-1994.

A first extensive marine monitoring programme was undertaken on the Egyptian coast of the Gulf of Aqaba during the summer of 1996 by the Egyptian Environmental Affairs Agency (National Parks of Egypt) and the Tropical Marine Research Unit of the University of York. This monitoring programme was initiated in reaction to the very rapid development of several parts of the Sinai coastline and diving tourism in the past 5-10 years. A total of 22 stations are sampled from Taba to Ras Mohammed along the Gulf of Aqaba. Basic information on each site was initially collected and an overall assessment undertaken. Coral assemblages were then surveyed using a photo quadrat method laying 3 transects at the reef edge and at 8 and 15 m depths, with 12 x 1 m^2 quadrats at intervals of 5 m. Separately, quadrats along the same transect were surveyed for signs of coral damage or mortality. Counts were also made of large sea-urchin species, large molluscs and, if present, crown-of-thorns (*Acanthaster planci*). The monitoring was completed by underwater visual counts of fish belonging to selected key families or groups along 200 m length transects at depths of 3 m, 10 m and 17 m.

Results indicated that the form and extent of development of reefs varied in a relatively systematic manner from north to south. In the northernmost Gulf of Aqaba, the reef face has a sea bed which slopes more steeply away and develops a coral cover often higher, up to 80 %, than on the upper reef face. By contrast, in the south, the reef form changes in that below the upper reef face there is only a fairly narrow, partly sandy, reef terrace sloping from 10-20 m. Around Ras Mohammed the fringing reef becomes even narrower and the reef face larger. The results show no clear-cut classification of assemblages on different transects into separate groups, although there is a slight tendency for northern and southern sites to cluster out separately from each other. This pattern probably reflects the fact that while there is no marked pattern of dominance by different genera or species, there is a slight tendency for reefs to be dominated either by *Porites* sp. and *Millepora* sp. or by *Acropora* sp. The overall hard coral cover varied from 11 % to 64 %, which is comparable with the range of values found by other researchers who have used quantitative techniques in the same region. There was a typical pattern of recently dead coral, the greatest amounts of which were due to algal turf, sediment damage, physical damage from human activities and, to a lesser extent, *Drupella* and to white-band disease.

The 2001 monitoring programme along the Gulf of Aqaba will include:
*An experimental protocol surveying the former 22 stations and additional ones when necessary (such as lagoons and wadi mouths), using different techniques including video transects, in comparison to the photo-quadrat method along 3 transects at 1, 8 and 15 m depths and fish counts along 200 m lengths at the same depths.
*A comprehensive survey of Marsa Bareika (inside Ras Mohammed National Park) chosen as pilot site for the use of monitoring techniques in shallow waters (using diving techniques) and deep water to 250 m (using ROV with a camera video coupled to a sonar system).

This case study was prepared by Dr. Nasser Galal, Dr. Mohamed Salem, Essam Saadalla, Belal Saleh, Yasser Awadalla, Ayman Mabrouk and Dr. Virginie Tilot.

Public Awareness

Achieving the goals and objectives of management requires the support and cooperation of a diverse range of people, including the people whose activities are being managed and the key decision-makers in other government agencies. A public awareness programme is an integral component of the management plan. The role of the public awareness programme is to achieve the support and cooperation of stakeholders for the goals of the MPA, by providing them with the information to:

- "support the concept of the MPA
- comply with MPA regulations
- understand why those regulations are there in the first place" (Kenchington and Ch'ng, 1994).

Support for the establishment and management of the MPA will be most successful when trust is developed within the community and the community understands the reasons for management and the potential benefits from the MPA. This will occur when the community is informed at all stages of the process and continuously throughout the life of the MPA. In general terms, management will benefit if the community is informed about the MPA and the reasons for its establishment, the significance of the area covered by the MPA and the management process. Support will also develop when the community experiences the benefits derived from the MPA, in employment, income, business opportunities and a sustainable resource base.

The goals of the public awareness programme are to:

- provide the information required by all stakeholders
- solve conflicts of use within the MPA and in adjacent areas
- develop and strengthen support for conservation and sustainable use.

Information Needs

- Stakeholders will require the following information:
- a description of the MPA, its boundaries and its objectives
- the significance of the area covered by the MPA, including any unique features
- the ways in which they will have to modify their activities and behaviour to comply with management objectives
- the benefits to stakeholders from the MPA
- the costs of infringement.

Particular groups may require more specific information about the MPA. Examples of these groups, and their information needs, include:

- the wider community: the nature of the coral reef and other tropical ecosystems, including their requirements and significance; important species; the sensitivity of these ecosystems to human disturbances
- fishermen: the boundaries of the MPA and zones; the potential benefits to fisheries; specific management provisions relating to fishing
- tourist operators: the long-term benefits to them from sustainable use of the resource they depend on; relevant zones and their provisions; more specific information on the nature of the coral reef ecosystem that they can deliver to tourists
- high level decision makers in other relevant government agencies and at different levels of government (e.g. national, provincial, municipal): the wider benefits and outcomes for the country; especially linkages between the conservation of resources and natural

systems; the long-term provision of economic and social benefits

- other government agencies: linkages between MPA management and other forms of resource and environmental management; the roles of MPAs in strategies for integrated coastal zone management; the range of activities occurring within the MPA; the values of the MPA that are relevant to the different agencies.

Guidelines for Planning a Public Awareness Programme

1. A public awareness expert should be an integral member of the planning team and also a staff member of the management agency. The role of the public awareness expert will be to plan, coordinate and implement the programme.

2. Determine the community's information needs and the management issues within the MPA. The management issues will be determined from information provided by the planning team and also from workshops or meetings with rangers and stakeholders. A critical step is to understand the background and underlying causes of the issues, so that the potential contribution of public awareness programmes can be assessed. All stakeholder groups will need information and these information needs will differ between the various stakeholder groups.

3. Determine the goals of the programme, which will reflect the goals of the MPA.

4. Develop specific objectives for the programme. These will be based on an analysis of the issues and the users' needs for information and will be a specific elaboration of the programme's goals. A specific objective might be "To have local fishermen use the MPA in accordance with the zoning plan".

5. Understand the audience. The review of management issues and stakeholders' needs for information will identify the major groups involved in the MPA and their different characteristics, e.g. education, awareness and attitudes. This information can be used to design the content of the programme and the most effective way to present it.

6. Develop specific strategies to achieve the objectives of the public awareness programme. The specific strategies can be built using understanding of the community (e.g. level of education and literacy, venues for public meetings, the role of village or religious leaders) and the range of subject matter that might be used as vehicles for information.

7. Develop a monitoring and evaluation process. The success of the programme in achieving the goals and objectives will be assessed by appropriate monitoring and evaluation. This can be achieved by surveys, questionnaires and interviews conducted before the programme begins and again at the conclusion. The results should be used to evaluate the success of the programme and as a guide to improving or changing future programmes. Monitoring should be based on standard methods and a statistically sound sampling design.

Topics for Public Awareness Programmes

- the benefits to be derived from MPAs and their importance in conservation
- the concept of sustainable development
- the nature of the coral reef ecosystem and links between the health of the ecosystems and human activities
- the link between long-term conservation of coral reefs and their value in generating income for developers
- the value of biodiversity, rare and endangered species
- regulations relating to the MPA.

Strategies for Public Awareness Programmes

- use religious and tribal leaders as spokespersons
- hold public meetings, field visits, school visits and workshops
- information programmes on TV, radio and in newspapers
- provide messages on handicrafts, such as t-shirts and mugs, postcards, stamps, brochures
- provide signage in prominent public places
- target NGOs and involve them in the delivery of educational material
- establish a visitor information centre
- provide free information to developers and conduct education sessions for the staff of local businesses and tourist operations
- use special event days (e.g. World Environment Day, Eid festivals) as a focus for education and awareness about the MPA
- use contact with the local community during surveys and research as an opportunity to educate and increase awareness about the MPA
- present papers at scientific conferences and international meetings to inform the wider, international community about the MPA.

Stakeholder Consultation and Participation

Background

A range of individuals and stakeholder groups within the local community is likely to be affected by the decision to establish an MPA, including local artisanal fishermen, industrial fishing operators and tourist operators. These effects will occur through some form of restrictions on the activities of these stakeholders (e.g. through declaration of protective zoning) or requirements (e.g. environmental assessment, the need for permits) or controls (e.g. development controls). Other stakeholders in the MPA include a range of government agencies. Successful planning and management of MPAs relies on the active participation of a range of government agencies whose responsibilities coincide with the objectives of the MPA, including fisheries, tourism, municipalities, development authorities, ports and shipping, and the military. MPAs will have a greater chance of success if they have the participation of all stakeholders in the planning and implementation and if they are aware of the advantages arising from the declaration and management of a MPA (Davey, 1998; Kelleher, 1999).

There are a number of potential advantages for the MPA to be gained from involving stakeholders in management (Kelleher, 1999), including:

- more effective management, resulting from the use of local knowledge and skills
- reduced enforcement costs and a reduction in the burden of management for the management agency
- more effective means of preventing the entry of outside groups into the MPA for illegal exploitation
- development of greater trust between managers and stakeholders and the prevention of disputes between management and stakeholders
- an increased sense of stability and confidence in the long-term future of the MPA, which will facilitate investment decisions
- greater awareness of the MPA and conservation within the local community
- support for the integration of conservation issues in other planning decisions

- the overall development of a more participatory approach to management and decision-making.

Stakeholder involvement in MPA planning and management needs to occur at two levels: consultation and participation. Stakeholders should be consulted at various stages in the planning process - during the initial information-gathering phase, the identification of issues for management and for comments on drafts of the management plan. MPA planning staff may need to be trained in the techniques of stakeholder consultation, in particular in the techniques of communication skills, running meetings, resolving conflicts and dealing with difficult people.

Opportunities for Consultation and Participation

There are many opportunities for involving stakeholders in the planning and management of the MPA (some examples are provided in Box 4). These opportunities will depend on the management objective of the MPA and the level of willingness of stakeholders to be involved. Some potential opportunities include:

- preliminary surveys for the accumulation and synthesis of existing information and knowledge about the area. Local stakeholders should be consulted at this stage because they can be a significant source of valuable planning information e.g. fishing practices and trends in catch and effort; the range of habitat types; the locations of areas important for fish spawning, turtle and bird nesting; traditional management practices. This information may help focus subsequent detailed surveys. This early consultation will also engage stakeholders at the outset of the planning process and should occur through a number of meetings.
- discussions and negotiations during the development of zoning plans and management strategies through consultative workshops;
- the training and recruitment of local residents as staff for the MPA, possibly as community rangers, for technical assistance (e.g. during surveys and monitoring), or as guides and extension officers
- support for cooperative business ventures involving the local community
- involving representatives of stakeholder groups as members of committees that provide oversight and strategic advice on the management of the MPA. These might include steering committees, scientific advisory committees and boards of management.

Box 4: Stakeholder Consultation and Participation in MPAs in the Red Sea and Gulf of Aden

The following examples illustrate a number of different approaches, which reflect differences in the usual level of involvement of the community in decision-making, and the support available during the MPA planning process.

Farasan Islands Marine Protected Area (Saudi Arabia)

As part of the development of the management plan for the Farasan Islands MPA by the National Commission for Wildlife Conservation and Development, interviews were conducted with individual representatives of all stakeholders (including traditional and commercial users) about their use of the MPA and their opinions of a range of proposed management options. The most numerous users of the MPA are artisanal fishermen and meetings were held with groups of fishermen and with the representatives of the fishermen from each village, the so-called 'chief fishermen'. These meetings were especially useful for gaining additional information on their knowledge of important species and habitats and traditional management practices. The approach taken, especially with the artisanal fishermen, reflected the importance of the chief fishermen in village fishing activities, the mistrust of the fishermen towards government management, the primary management goal of supporting the sustainable use of the MPA by the traditional users.

Socotra Islands Group National Protected Area (Yemen)

An integrated programme of community consultation and participation occurred during the development of the zoning plan for the conservation and sustainable use of the natural resources of the Socotra Archipelago. Practical steps taken to develop public understanding of the zoning process included the employment of extension officers, village meetings, an environmental education and awareness campaign, and regular meetings with local authorities. A preliminary draft zoning plan was developed by the project team (from the results of extensive scientific studies throughout the Archipelago), which was reviewed at a technical workshop in Sana'a attended by community and government representatives, international experts and the project team. The resulting draft zoning plan was reviewed through 12 public meetings held throughout the Archipelago and attended by about 500 local *sheikhs*, *muqaddams* and government representatives. The draft zoning plan was amended to reflect concerns raised during the meetings and most of the changes reflected the community desire for a more conservation-oriented approach (EPC, 1999).

Gulf of Aqaba Protectorates (Egypt)

Having established the network of MPAs along the Gulf of Aqaba coastline of Egypt, there is a need to maintain functional partnerships with financial investors in the tourism sector (the largest stakeholder group) and the local Bedouin communities. Parks staff maintain continuous dialogue with all stakeholders, provide services (such as free advice on minimising the environmental impacts of developments) and allow local Bedouin communities to participate in management. The latter has occurred through the establishment of zones closed to fishing, which are nominated and enforced by the local Bedouin fishermen (Pearson and Shehata, 1998).

Sustainable Financing

Financing of the operations of MPAs has largely been the responsibility of governments. Economic constraints, and other development priorities, have limited the amount of funding available for establishment and management of MPAs. This has been a global trend in protected area management (Geoghegan, 1995; Davey, 1998; Kelleher, 1999) and limits the ability of MPAs to achieve their objectives. Managed properly, MPAs have the potential to provide significant economic benefits to the local community and national government. A sustainable stream of income can potentially be generated through ventures in tourism, fishing, biotechnology and aquaculture that are ecologically and socially sustainable. The ecological integrity of the MPA and the social structure of local communities should not be jeopardised by these ventures. Stakeholders need to be aware of the benefits for them that arise from the management they are financing.

- In developing a sustainable financing mechanism, MPA planners and managers will need to address the following:
- the anticipated costs of establishing an MPA and implementing the management plan
- the amount of funding that can be expected from government to do this
- additional funding that might be possible from donor agencies in the establishment of the MPA
- the identification of fund-raising opportunities associated with the MPA (e.g. tourism, fishing, biotechnology and aquaculture)
- the need to ensure that revenue collected within the MPA returns to the relevant management agency and is used for visible management activities
- a study demonstrating the economic benefits arising from the MPA.

Opportunities for Sustainable Financing

This is a very new field in the Red Sea and Gulf of Aden because, to date, there are very few operational MPAs and costs associated with running them have come from government operations or international donor agencies. The use of tourism as a source of revenue for MPA operations has been successfully applied in Egypt in the Ras Mohammed National Park. In this case the collection of visitor entrance fees to the National Park has allowed the Gulf of Aqaba Protectorates to be financially sustainable and not to require a subsidy from central government (Pearson and Shehata, 1998). However, elsewhere in the region there has been minimal development of tourism and, with limited infrastructure, it is unlikely that such an option will be transferable to other MPAs in the Regional Network in the near future.

Potential opportunities for sustainable financing and cost recovery include:

- Fees collected from visiting live-aboard dive boats that stop in the MPA
- A licensing system for commercial operations using the resources of the MPA e.g. tourist diving and fishing operations
- Fines for violations and infringements of the MPA regulations
- Payment for damages caused to resources of the MPA that act as a source of revenue (e.g. damage to coral reefs by ships' grounding).

Capacity Building

The planning and management of MPAs are complex tasks requiring a wide range of skills. In addition to formal education and experience in planning and management, staff require regular training updates through seminars, workshops and short courses. For many MPAs in the Regional Network, training will be required at all levels i.e. from

rangers to managers. It will be the function of the MPA manager to identify the training needs of the staff. Also, for many MPAs in the Regional Network it will be necessary to employ new staff such as rangers, who will require training in their relevant duties and also information about the management agency and its operations.

There are presently four centres in the region that may provide some of the training needs for the Regional Training Network: Ras Mohammed National Park (Egypt); the National Commission for Wildlife Conservation and Development Training Centre in Riyadh (Saudi Arabia); the Train-Sea-Coast Regional Training Centre (Port Sudan); the Fisheries Training Centre in Aden (Yemen).

Training Needs in the Regional Network

- General need for skills in MPA planning, management, monitoring and evaluation, with specific needs for communication, negotiation, conflict resolution, project management, development of annual workplans, running meetings, public speaking, public relations
- Ranger duties and associated field skills, law enforcement
- Marine biology, ecology and biodiversity
- Conservation and resource management
- Programme evaluation and monitoring
- Socio-economic aspects of MPA management
- English language
- Technical skills including SCUBA diving, boat handling, mapping, standard survey and monitoring techniques, identification of species of flora and fauna within the MPA, database design and operation, GPS and GIS.

Training Options

- Short, intensive training courses conducted regionally
- Specialist courses through international training organisations
- On-the-job training by participation in surveys and monitoring
- Job exchanges with other MPAs in the Regional Network and internationally
- Internet-based training programmes.

Personnel and Organizational Structure

The planning, management and day-to-day activities carried out within the MPAs in the Regional Network will involve a great variety of tasks, skills and experience. The personnel required to run the MPA will assume the core responsibilities, which include planning and management, public awareness and community participation, monitoring and evaluation, and ranger duties. In addition, there are the associated support activities of information technology, finance and administration.

The following Organizational structure reflects the key management activities undertaken. The number of staff involved in each section or department will depend on local circumstances.

MPA Management

- Overall management and responsibility for the operations of the MPA
- Strategic, long-term management of the MPA
- Coordination and direction of the activities of each section within the MPA management structure
- Liaison with the lead agency and other relevant government agencies

- Representation of the MPA on advisory councils, stakeholder groups, community groups
- Financial planning for MPA operations
- Initiation and coordination of management reviews and evaluations
- Coordination of staff training and capacity building.

Planning and Management

- Development of the MPA master plan and management plan and their regular review and evaluation
- Coordination of the MPA planning team
- Provision of planning advice to the MPA management team
- Overall responsibility for assessment of impact of activities and developments within the MPA and provision of advice to MPA management relating to development approvals
- Development of options for sustainable financing of the MPA.

Public Awareness, Consultation and Participation

- Development and implementation of the public awareness programme, its regular review and evaluation
- Liaison with community leaders and stakeholder representatives
- Implementation of the community consultation phase and incorporation of the results
- Development of opportunities for continued community participation and coordination of implementation
- Provision of educational programmes and materials about the MPA for local stakeholders, community leaders, school teachers and interested individuals.

Monitoring, Research and Evaluation

- Development and implementation of the MPA monitoring programme and the evaluation of its results in light of management targets
- Development and implementation of the research programme of the MPA
- Provision of technical advice to management with regards to the biodiversity and ecosystems of the MPA and their relationship to human uses.

Rangers

- Daily local enforcement of the regulations of the MPA
- Day-to-day liaison with the local community, stakeholders and traditional users of the MPA
- Provision of information about the MPA to the local community, stakeholders and users of the MPA
- Participation in monitoring and surveys.

Information Technology

- Management of computer systems, databases and GIS facilities that support management of the MPA
- Incorporation of results from monitoring into the MPA database
- Provision of computing support to staff
- Planning and implementation of staff training, and training updates, in relevant aspects of information technology.

Personnel, Finance, Administration

- Financial management of the MPA according to the budget designed by the MPA Manager
- Purchasing and travel
- Recruitment process for new staff
- Administration of the MPA office.

Strengthening the MPA Network

Achieving the aims of the Regional Network of MPAs will be greatly facilitated by strengthening of the legal framework, coordination of activities and networking amongst the individual MPAs. This will ensure that regional goals are being addressed through local management actions. A coordination and networking mechanism that facilitates communication and the sharing of knowledge and experiences amongst MPAs will strengthen overall regional capability in MPA management and the achievement of regional goals for sustainable resource use, development and conservation. In addition, regional coordination and networking will strengthen the management capabilities of individual MPAs. A coordinated approach to the activities of the Regional Network will produce substantial benefits to individual countries and the managers of the MPAs in the Regional Network. This will arise as a result of the proposed training initiatives, the opportunities that arise from networking with experienced individuals and exposure to a range of management approaches.

There are many other MPAs in the Red Sea and Gulf of Aden, in addition to those in the Regional Network. It is essential that any strategies developed to facilitate coordinated management of MPAs in the Regional Network include all other MPAs in the region, given that the same agency in each nation is responsible for management of the MPA in the Regional Network and other MPAs not in the network. To this end, the following mechanisms for strengthening, coordination and networking apply to all MPAs in the Red Sea and Gulf of Aden.

National Legal and Institutional Frameworks and Development of a Regional MPA Protocol

1. The majority of countries in the region have enacted legislation relevant to environmental management and possess the necessary institutional framework for implementing this legislation (Appendix 2). Most countries of the region have also enacted site-specific legislation related to the establishment of specific MPAs. Only two countries (Egypt and Saudi Arabia) have enacted framework laws to support the establishment and management of protected areas throughout the country. In Egypt, Law 102 Concerning Natural Protectorates (1983) includes articles that: define a protected area; forbid certain activities within a protected area; control activities in adjacent areas; specify the administrative body responsible for enforcement. In Saudi Arabia, Royal Decree M/12 of 1995 enacted the Protected Areas Act, which sets out the requirement for a network of protected areas to be established and managed and sets out the range of activities prohibited within all protected areas. Such framework legislation, necessary for the establishment and management of MPAs in other countries, is missing.

2. As Appendix 1 shows, only the following MPAs in the Regional Network have been established with appropriate legislation: Ras Mohammed National Park (Egypt); Farasan Islands Protected Area (Saudi Arabia); Sanganeb Marine Park (Sudan); Socotra Islands Group National Protected Area (Yemen). There is a need to develop national legal frameworks that provide for the establishment and management of the remaining MPAs in the Regional Network, and provide a general legal basis for the establishment and

management of MPAs throughout each country.

3. A regional framework for cooperative management of the marine and coastal environments of the Red Sea and Gulf of Aden came into effect in 1982, with the signing in Jeddah of the Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (the "Jeddah Convention"). The Jeddah Convention contained a number of articles relating to the need for measures to prevent and combat oil pollution. The Action Plan for the Conservation of the Marine Environment and Coastal Areas in the Red Sea and Gulf of Aden was also signed in Jeddah at the same time. The Action Plan outlined a programme for environmental assessment throughout the region to gather information on the distribution of habitats and important species. The Action Plan also outlined a programme of environmental management, which included the establishment of MPAs as tools for the sustainable use of living marine resources. Much information has been collected since the signing of the Jeddah Convention and the implementation of the Action Plan and many MPAs have been established as a result (as outlined earlier in this document).

4. Efforts of individual countries to establish MPAs in the Regional Network will be facilitated by the development of a regional protocol that provides a legal framework for governments to prepare legislation for the establishment and management of MPAs. The proposed Protocol Concerning Biological Diversity and the Establishment of Protected Areas for the PERSGA region will provide this legal framework. The protocol will oblige contracting states to protect regionally representative areas, as well as areas that are unique and highly sensitive. The implementation of the proposed protocol will significantly strengthen national and regional efforts to establish the Regional Network.

Coordination

The following activities should take place to aid coordination between the MPAs:

1. The establishment of a Regional Coordinating Committee. The PERSGA MPA Coordinator may act as Chair of the Committee, which will meet annually in one of the network countries. The Committee will be comprised of national MPA Focal Points; scientists with leading experience in MPAs, sustainable use and biodiversity; experts in socio-economic and public awareness aspects of MPAs. The terms of reference for the Committee will be:

- to assist countries in implementing the Protocol Concerning Biological Diversity and the Establishment of Protected Areas
- to review progress in establishment and management of MPAs in the Regional Network and other MPAs in each country
- to facilitate, where necessary, the processes occurring in each country to establish and manage MPAs in the Regional Network and elsewhere by providing advice and by facilitating access to technical support and resources
- to foster capacity building and training for MPA staff
- to promote government and community awareness about the value of MPAs
- to act as a management committee for the activities of the Regional Activity Centre for MPAs
- to oversee the establishment of linkages between the Regional Activity Centre and other similar centres throughout the world
- to initiate, monitor and review the implementation of the other networking and coordinating mechanisms.

2. The establishment of a Regional Activity Centre for MPAs at the PERSGA headquarters in Jeddah. The PERSGA MPA Coordinator may be the Coordinator of this

Regional Activity Centre. The functions of the Regional Activity Centre will be:

- to provide assistance to countries in establishing and managing their Network MPAs and other MPAs. In particular, the staff of the Regional Activity Centre will provide advice on the identification and selection of MPAs, the development of management plans, monitoring and research programmes, and community education and awareness programmes
- to prepare reports and technical studies on MPAs, as directed by the Regional Coordinating Committee
- to develop, coordinate and provide training programmes and staff exchanges;
- to provide the physical location and resources for the web page and electronic databases
- to provide a regional library of resource material on MPAs
- to carry out other functions as directed by the Regional Coordinating Committee.

3. The establishment of MPA Focal Points in each country. The MPA Focal Points will be appointed by the relevant national authority in each country that is responsible for MPA establishment and management. They will sit as members of the MPA Coordinating Committee and will act as the national contact person for the PERSGA MPA Coordinator. MPA Focal Points will provide the PERSGA MPA Coordinator and staff of the Regional Activity Centre with technical and management information on MPAs in their country. The Focal Points will be official representatives of the national authority for nature conservation, senior MPA managers or planners.

Information Exchange

The following activities will be undertaken by the Regional Activity Centre for MPAs:

1. The establishment of an Association of Red Sea and Gulf of Aden MPA Managers and Scientists, to function as an active, professional society. The Association will stage an annual conference and meeting at which management, monitoring and research relating to MPAs are presented and discussed, and a series of proceedings produced.

2. The establishment of an MPA web site in the Regional Activity Centre that will serve as a source of information for, and about, MPAs in the region. The web site will contain links to all the MPAs in the Regional Network and other national MPAs, an electronic document database with reports and publications and links relevant to the management of MPAs. For countries with restricted access to the Internet the Regional MPA Coordinating Committee will act as the vehicle for securing international development funds to assist in the establishment of these facilities.

3. The establishment of a regular MPA feature in the PERSGA newsletter *Al Sanbouk*. This newsletter is distributed throughout the region to marine scientists and environmental managers and is an important medium for regional information exchange. This MPA feature could also contain some of the information housed on the MPA web page, thereby supporting MPAs in countries with limited/no access to the Internet.

4. The preparation, and update as necessary, of a booklet/CD on the Regional MPA Network and other MPAs in the region. Topics to be covered will include: the biodiversity of the Red Sea and Gulf of Aden; the role of MPAs in sustainable resource use and conservation; the unique characteristics of the MPAs in the region; current management activities within the MPAs. Distribute the booklet/CD to all environmental management agencies, NGOs, major stakeholder groups and donor agencies in the region. Funding for production and

distribution could come from stakeholder groups (e.g. tourism, fishing operations).

5. The development and publication of a directory of regional specialists in MPA planning and management, socio-economics, living marine resources and their management, biodiversity, public awareness, GIS, research and monitoring.

6. The development of collaboration with the proposed Protected Areas Learning Network. This web-based resource will be a collaboration of the World Resources Institute (WRI), the World Conservation Union (IUCN) and the United Nations Education, Scientific and Cultural Organization (UNESCO). The aim of the Learning Network is to provide current information via the Internet on management issues in protected areas.

Capacity Building and Institutional Strengthening

1. Staff exchanges are an important means of training and of gaining experience in alternative approaches to MPA planning and management. A process of exchanging staff amongst MPAs in the region, and with MPAs in other regions, should be formulated and implemented by the Coordinating Committee. As a first priority, MPA planners and managers from countries with limited experience (Djibouti, Somalia, Sudan and Yemen) should undertake supervised apprenticeships in MPAs in Egypt, Jordan or Saudi Arabia. Subsequently, a programme of work placements should be organized with MPA management agencies in other countries outside the region (e.g. with the Great Barrier Reef Marine Park Authority in Australia) as a means of exposing staff to alternative approaches to management and technological developments. The Coordinating Committee should source funding for this programme from regional and international donor agencies e.g. Islamic Development Bank, European Union.

2. The formal training requirements of MPA planners and managers will be identified by the Coordinating Committee. Potential training priorities include the development of master and management plans, processes of public consultation and participation, sustainable financing, GIS, the use of web pages as a support tool for management and community awareness. Potential international training initiatives that could be investigated include IW: Learn; Train-Sea-Coast; the Strategic Initiative in Coastal Area Management.

3. The Regional Activity Centre should assess the infrastructure requirements of the relevant agencies in each country and, with the support of the Coordinating Committee, secure international funding to provide it.

Wider Linkages

There are a number of regional networks of MPAs in other parts of the world that have been established for some time and have experience in cooperative and coordinated activities. These include networks in the Mediterranean, Wadden Sea and the wider Caribbean. The Regional Activity Centre, under the guidance of the Coordinating Committee, should establish relationships with each of these networks and arrange for exchange visits by staff of the Regional Activity Centre to investigate the operation of these networks and their associated activity centres.

An Expanded Network

1. The original concept for the Regional Network was for a network of MPAs that were representative of major habitats and bio-regions throughout the Red Sea and Gulf of Aden. The Regional Network includes a single MPA from each participating country in the region. In addition, there are many other MPAs in each country that represent nationally significant examples of unique and pristine habitats and areas important for economic development. These additional

MPAs are not included in the activities of this Master Plan, although the guidelines are applicable to any MPA.

2. The long-term management of all MPAs in the Red Sea and Gulf of Aden will be facilitated by their inclusion in the Regional Network. As a first step, the Regional Activity Centre should be established for MPAs in the representative Regional Network. With the development of experience and capabilities of staff in the Regional Activity Centre, and in the MPAs of the Regional Network, the activities of the Regional Activity Centre should be expanded to include all MPAs in the Red Sea and Gulf of Aden. The timing for this should be determined by a review of the activities of the Regional Activity Centre by the Coordinating Committee.

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Internet Resources

APEC (Asia Pacific Economic Cooperation) Action Plan for Sustainability of the Marine Environment
http://www.apecnetwork.org/marine_plan.html

Caribbean Seas Programme
http://www.unep.org/regseas/carib.htm
http://www.cep.unep.org

Common Guidelines and Criteria for Protected Areas in the Wider Caribbean Region: Identification, Selection, Establishment and Management
http://www.cep.unep.org/pubs/techreports/tr37en/content.html

Convention on Biological Diversity
http://www.biodiv.org/index.html

Convention on Biological Diversity: Jakarta Mandate
http://www.biodiv.org/jm.html

Coral Health and Monitoring Program (NOAA)
http://coral.aoml.noaa.gov/index.html

Global Coral Reef Monitoring Network
http://coral.aoml.noaa.gov/gcrmn/

IUCN: World Conservation Union
http://iucn.org/

Mediterranean Action Plan
http://www.unep.org/regseas/medu.htm
http://www.unepmap.org

Mediterranean: Regional Activity Centre for Specially Protected Areas
http://www.rac-spa.org.tn/

PERSGA: Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
http://www.unep.ch/seas/main/persga/red.htm

Reef Check
http://www.reefcheck.org/

Wadden Sea Programme
http://cwss.www.de/trilat/brochure/brochure.html

World Commission on Protected Areas
http://wcpa.iucn.org/wcpainfo/aboutwcpa.html

Appendices

APPENDIX 1: Red Sea and Gulf of Aden Representative Network of Marine Protected Areas

Country	Protected area	Size	Year declared	Major habitats and regional significance	Impacts and conflicts	Management/ Projects
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
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
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
Jordan	Aqaba coral reefs	7 km length	Declared	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

Saudi Arabia/ Egypt	Strait of Tiran	Undefined Ras Mohammed National park marine section	Proposed Exist for Egypt	Islands and extensive coral reefs with diverse reef associated fauna in transition area between Gulf of Aqaba and Red Sea, turtle nesting, dugong	Part of the area used by divers/tourists from Egypt	None
Saudi Arabia	Wajh Bank, Sharm Habban and Sharm Munaybirah (Wajh Bank)	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
Saudi Arabia	Farasan Islands Protected Area	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
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

Sudan	Sanganeb Marine National Park	12 km²	1990	Atoll-like reef with highly diverse and complex coral reefs, diverse reef associated fauna, sharks, marine mammals, manta rays	Recreation pressure, anchor damage from tourist boats	Low
Sudan	Mukkawar (Magarsam) Island and Dungonab Bay	300 km²	Proposed	Coral reefs, whale sharks, largest schools of manta rays known in the entire Red Sea, bird nesting sites, oyster beds	Shark fisheries, oyster culture	None
Yemen	Socotra Islands Group National Protected Area	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
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

APPENDIX 2: National Legal and Institutional Frameworks for Marine Protected Areas in the Red Sea and Gulf of Aden

Country	Legal Framework	Institutional Framework
Djibouti	Decree on the Protection of Sub-Marine Fauna and Flora (1980); Framework Law on the Environment (2000)	Ministry of Housing, Urbanism, Environment and Land-Use Planning
Egypt	Law Concerning Natural Protectorates 102 (1983); Law Concerning Protection of Environment 4 (1994)	Egyptian Environmental Affairs Agency; Tourism Development Authority
Jordan	Aqaba Region Authority Law No. 7 (1986) and Marine Park by-law (pending); Aqaba Region Authority Board of Directors Decree No. 5 (1997)	Aqaba Regional Authority
Saudi Arabia	Royal Decree M/22 establishing the National Commission for Wildlife Conservation and Development (1986); Royal Decree M/12 Protected Areas Act (1995); Royal Decree M/19 concerning regulations for catching, investing and protecting marine resources (1990)	National Commission for Wildlife Conservation and Development; Ministry of Agriculture and Water
Somalia	No relevant existing legislation. The need for legislation relevant to MPAs has been highlighted in Marine and Coastal Resources in Somaliland: A Policy White Paper (2000)	Ministry of Fisheries and Coastal Resources; Ministry of Marine and Coastal Resources (proposed)
Sudan	Sudanese Fishery Ordinances and Regulations (1937, 1975, 1978); Environmental Health Act (1975)	Ministry of Environment and Physical Development (Higher Council for the Environment and Natural Resources); Ministry of Interior (General Administration for Wildlife Conservation); Ministry of Animal Wealth (Marine Fisheries Administration); Marine Fisheries Research Centre; Wildlife Research Centre
Yemen	Prime Ministerial Decree No. 4 of 1996 (establishing Socotra as a protected area); Fisheries Law No. 42 of 1991	High Committee for Development of Socotra; Ministry of Tourism and Environment (Environment Protection Agency); Ministry of Fish Wealth;

APPENDIX 3: Contents of Site-Specific Master Plans and Management Plans

The Master Plan for each of the MPAs in the network (where these do not exist already) will have the following structure:

A. TITLE PAGE

- the name of the area
- the words Master Plan
- the name of the responsible agency
- the date of Plan preparation

B. EXECUTIVE SUMMARY

- Objectives
- Goals
- Management policy
- Policy definitions for Master Plan, Management Plan and the zones used in the Plan

C. DESCRIPTION OF THE AREA

- The area of the MPA will be described under the following headings:
- Location, size, topography
- Geology and soils (where the MPA includes a terrestrial component)
- Climate: causal factors, precipitation, temperature, evaporation
- Hydrology: salinity, water temperature, tidal patterns, currents
- Habitats: where the MPA includes a terrestrial component the following should be described (where relevant): locations of bedrock surfaces and escarpments, sand sheets and sand dunes, sabkhas. The following intertidal systems should be described (where relevant): sand flats, sandy beaches, rocky shores, saltmarshes and mangroves. The following nearshore subtidal ecological systems should be described (where relevant): macroalgal beds, seagrass beds, fringing reefs, patch reefs. The following offshore ecological systems should be described (where relevant): islands and their fringing coral reefs, coral reefs. Issues observed for any of these systems should also be described in this section
- Flora: the range of flora to be described will depend on whether the MPA includes a terrestrial component, but (where relevant) should include microalgae, macroalgae, seagrass, intertidal vegetation, terrestrial vegetation. The issues for flora in the MPA should also be described here
- Fauna: the range of fauna to be described will depend on whether the MPA includes a terrestrial component, but (where relevant) should include subtidal and intertidal invertebrates, terrestrial invertebrates, fishes, amphibians and reptiles, birds, marine and terrestrial mammals. This description will include the locations of areas important for particular fauna (e.g. turtle nesting beaches, bird nesting locations), and any issues for fauna
- Non-indigenous and genetically modified species, that are within the MPA or have been introduced as part of some human activity
- Resource uses: these will depend on the range of uses of the MPA and whether the MPA includes a terrestrial component. Uses that are most likely to be included in this section include fishing, defence, recreation, shipping, navigation, cultural uses and tourism. Other uses that might occur within the MPA include seabird egg collecting, hunting, education, research, curio collecting and aquarium fish collecting.

D. GENERAL POLICIES AND STRATEGIES

This section lists the general policies and management strategies that apply throughout the MPA for each of the topics in the

previous section (i.e. habitats, flora and fauna, resource use). It also describes the content of the specific management strategies to be implemented in the MPA. The following headings will be covered:

- Biodiversity, for each of the components identified in Section C
- Resource use, for each of the uses identified in Section C
- Zonation, a description of the zones used in the MPA, their management objectives, management responsibilities and the activities allowed and prohibited within each zone
- Cultural heritage, the policy of the MPA with regards to the protection of cultural heritage within the MPA and the strategies that will be used to achieve this
- Capacity building and technology transfer, the policy of the MPA towards staff capacity building, training needs, the role of technology in the management of the MPA and strategies for incorporating technology into management
- Community consultation and participation, the rationale for involving stakeholders, the means by which stakeholders will be consulted and the stages of the planning process when this will occur and the means by which stakeholders will participate in management
- Research and monitoring, the significance of research and monitoring in management of the MPA and topics for research
- Public awareness and education, the role of public awareness and education in MPA management and the strategies that will be implemented
- Infrastructure, the infrastructure required for management of the MPA and the locations where it will be required. The actual infrastructure required will depend on the requirements of the individual MPA but may include visitor centres, roads, fencing, mooring buoys, information panels, walkways, garbage bins, toilet facilities and ranger stations.
- Defence, strategies for liaising with defence authorities and any requirements for management of defence activities within the MPA (e.g. timing of exercises in relation to nesting by sensitive species)
- Oil spill contingency, the role of the MPA management in the event of an oil spill
- Sustainable financing, mechanisms for sustainable financing of the operations of the MPA.

E. THE MANAGEMENT PLAN

The Management Plan is a specific document that outlines strategies for implementing the objectives, goals and general policies in the Master Plan. The Management Plan has a life of around five years and is evaluated and amended, following the results of the monitoring programme. The Management Plan includes the following contents:

1. Management of Natural Resources

1.1 Biodiversity, in which the specific management strategies are described for each component of biodiversity within the MPA

1.2 Resource Use, in which the specific management strategies are described for each type of resource use occurring within the MPA

2. Zonation

The zones used in the MPA are specified, along with their locations (via a map) and a table of the activities permitted and prohibited in each zone.

3. Research and Monitoring

3.1 Research: the applied research programme that will be undertaken in the life of the management plan to provide information that will support improved decision-making.

3.2 Monitoring: the biological, environmental, socio-economic and resource use monitoring that will be undertaken in the

MPA. The frequency of monitoring and the monitoring techniques should be described and baseline information provided in an appendix. The procedure for using monitoring results in the review of the management plan should also be described.

4. Public Awareness

This section describes the requirements and focus for public education and awareness programmes. It should also list the organisations and stakeholder groups to be targeted for these programmes. The objectives of education and interpretation programmes are to advise stakeholders of the benefits and management arrangements of the MPA and to enhance their enjoyment and understanding of the marine environment.

5. Oil Spill Contingency

6. Infrastructure

F. PERSONNEL AND FINANCES

1. Personnel: the range of personnel required to implement the management plan and for day-to-day management activities within the MPA and detailed job descriptions for each category of personnel.

2. Capacity Building: the training required for each category of personnel and a schedule of training activities.

Finances: establishment (if relevant) and recurrent expenditure.

G. IMPLEMENTATION

This section outlines the schedule for implementing the management plan through a log frame analysis, including objectives, indicators, means of verification and critical assumptions.

H. APPENDICES

Appendices provide detailed information required as a resource for the more general parts of the Management Plan. The following appendices are recommended:

- legal description of the boundaries of the MPA, including all relevant latitude and longitude measurements
- the legislation and regulations relating to the MPA
- lists of plant and animal species
- descriptions of special features and their locations.

Maps. Maps are essential for displaying the borders of the MPA, the locations of uses and locations of conflicts between uses. Where practical, transparent overlays can be used to depict overlap between features (e.g. topography and plant/animal communities) and overlap between resources/special features and conflicts or issues. The following maps are recommended:

- the location of the MPA, in relation to the region, and a smaller scale map showing the actual boundaries
- land/water tenure and jurisdiction
- topography of the nearby land (where relevant for coastal MPAs) and the seabed bathymetry
- geology
- locations of major plant and animal communities
- locations of major uses
- locations of major 'use conflicts' and threatened resources
- zoning plan.

APPENDIX 4: Guidelines for the Identification and Selection of Additional MPAs in the Red Sea and Gulf of Aden

The Regional Network of MPAs includes representative examples of the major biogeographic regions of the Red Sea and Gulf of Aden, as well as prime examples of particular habitat types. Most countries of the region have also declared or nominated other MPAs (summarised in PERSGA, 1998a). However, apart from Saudi Arabia (Chiffings, 1989; Child and Grainger, 1990) and Egypt (TDA/EEAA/RSG, 1998) there have been no attempts to strategically identify national systems of MPAs. It is likely that increasing pressures on living marine resources and biodiversity, the need for alternative and sustainable sources of national income, and increasing information about the value of the nation's biodiversity will strengthen the need for countries to identify more MPAs. The following guidelines for the identification and selection of MPAs are intended to support the development of national system plans for MPAs. These guidelines are intended to be used to select MPAs additional to those already chosen for the regional network of representative MPAs.

Background

The theory and practice of systematically identifying and selecting protected areas in marine and coastal environments has lagged behind terrestrial environments. This is because there is more information and understanding of the distribution and abundance of biodiversity in terrestrial environments, and a longer history of human impacts and the application of protected areas as a management strategy (Pressey and McNeill, 1996). The development of systematic and objective criteria for selection of terrestrial protected areas was driven by an awareness of the consequences of *ad hoc*, subjective and politically expedient decision-making (Pressey, 1996). Similarly, within the marine environment, *ad hoc* decisions and a focus on the inclusion of fisheries-related habitats in MPAs (e.g. seagrass and mangroves) has led to many current systems of MPAs being biogeographically unrepresentative (McNeill, 1994; GBRMPA/THE WORLD BANK/IUCN, 1995; Walls, 1995; Yurick, 1995).

Several schemes of criteria have been developed and employed for identifying and selecting MPAs, which typically include criteria relating to biodiversity, ecology, social acceptability and practicality (Bakus, 1983; Kelleher and Kenchington, 1992; Done, 1996; Thackway, 1996; Kelleher, 1999; Salm et al., 2000). Unlike the terrestrial environment there has been limited use of selection algorithms (but see Ward et al., 1999; Gladstone, 2002) and population viability analysis has not been attempted. A major constraint to the use of the latter techniques will be the limited availability of systematic inventories of either habitats or species across a range of locations, and technical and logistic constraints to obtaining these in the region. In some countries of the region however, large scale, systematic surveys have been undertaken as a first step in the identification of potential MPAs (see Box 5).

Perhaps of greater significance in the Red Sea and Gulf of Aden is the identification and selection of MPAs as a strategy for fisheries management. This will require information for a range of target species on habitat preferences, locations of breeding and juvenile nursery grounds, and patterns of larval connectivity amongst candidate locations. The majority of decision-making schemes referred to in the preceding paragraph include some form of social component. However, there is very limited information on the social constraints to, and opportunities for, the establishment and operation of MPAs in the region and the social and economic benefits derived from

existing MPAs (Pearson and Shehata, 1998; Gladstone, 2000).

Criteria for Identification and Selection of MPAs

The following criteria provide systematic guidelines for the identification of candidate MPAs and their selection. The criteria have been divided into those useful for identifying a list of potential or candidate areas for MPA designation (mostly employing biodiversity, ecological, fisheries-related criteria) and those subsequently applied to these candidate areas to select the MPA (primarily social, economic and management-related criteria). These guidelines have been adapted for the situation of the Red Sea and Gulf of Aden from guidelines in Kelleher and Kenchington (1992); ANZECC (1999); Kelleher (1999); and Salm et al., (2000).

The information used to identify the candidate sites can come from a variety of sources, including knowledgeable experts, scientific studies and unpublished reports. Candidate sites are ideally chosen using detailed quantitative data on the distribution of biodiversity obtained during field surveys (Jennings et al., 1994; Edgar et al., 1997) or from museum records (Emanuel et al., 1992); however, these data may not be available and the resources to collect them may not be available. Alternatives include rapid field assessments based on standard, accepted methods (e.g. De Vantier et al., 1998) or the use of a physical surrogate for different habitat types that can either be remotely sensed or analysed from maps and charts (Belbin, 1993), from which representative areas are selected. It is critical that the information collected is stored in some form of database and able to be retrieved easily.

Identification of Candidate MPAs

Surveyed locations will be evaluated according to the following criteria:

Biodiversity Value

Areas that are particularly rich in species, habitats, communities or ecosystems will protect a significant proportion of biodiversity if they are conserved and these areas should receive a high priority for protection. Areas that contain habitat for endemic, rare or endangered species will also have a high priority for protection.

Representativeness

If the goal of establishing an MPA is to support biodiversity conservation then it is important that representative samples of the range of habitats, communities or ecosystems are conserved. Each area is assessed according to the degree to which it includes a sample of one or more of types of habitats, communities or ecosystems and the degree to which they add to the representativeness of existing MPAs. Potential MPAs can be assessed according to whether they include a representative sample of either national or regional biodiversity. In either case, assessing representativeness requires some form of biogeographic classification, in which the range of habitats, communities or ecosystems is identified and mapped.

Ecological Importance

Each area is assessed according to whether it:

- contributes to the maintenance of essential ecological processes or life-support systems e.g. areas that act as sources of larvae for downstream areas
- contains areas on which species or other systems are dependent e.g. breeding, nursery or juvenile areas; feeding, breeding or resting areas for migratory species
- contains one or more areas which are a biologically functional, self-sustaining ecological unit e.g. an isolated reef or island system that is self-replenishing. Such areas will be less susceptible to external influences and easier to manage.

International, Regional or National Importance

Each area is assessed according to whether it:

- has global, regional or national significance
- has the potential to be declared as a Biosphere Reserve
- is subject to an international, regional or national conservation agreement.

Naturalness

Each area is assessed according to the degree to which it has been protected from, or not been subjected to, human induced change. Degraded areas will make little contribution (without restoration) to the conservation of biodiversity or the maintenance of productivity.

Uniqueness

Each area is assessed according to whether it:

- contains unique species, populations, communities or ecosystems;
- contains unique or unusual geographic features.

Productivity

Each area is assessed according to its biological productivity, measured in terms of the abundance of primary producers, and/or the abundance, growth, survivorship and reproductive output of other trophic components.

Vulnerability

Each area is assessed according to its vulnerability to natural processes e.g. storms, unusual flood events from the land, bleaching, outbreaks of crown-of-thorns starfish. This information may be found in records of previous surveys or monitoring programmes, scientific papers or through interviews with the local community. Given a choice of a number of candidate areas, those vulnerable to natural processes will have a lower priority for designation as an MPA.

Selection of MPAs

The preceding criteria are used to compile a list of candidate MPAs. The choice of which areas to nominate as MPAs is based on the following socio-cultural, economic and management criteria:

Economic Value

Each candidate area is assessed according to whether it makes a contribution to economic value, or has the potential to contribute to economic value if protected. Candidate areas that are likely to lead to positive economic outcomes from protection should receive a higher priority for nomination as MPAs. The economic value of an area can occur through:

- its potential or current use for ecologically sustainable recreation or tourism
- its role as a breeding ground or nursery area for commercially important species
- its role as a source of larvae for other areas of commercially important species
- its potential or current use for the exploration or extraction of resources
- its use by shipping and/or trade
- its use by traditional users including artisanal fishermen.

Social and Cultural Interests

Each candidate area is assessed according to whether it has existing or potential value to the local, regional, national or international communities because of its heritage, cultural, traditional, aesthetic, recreational or economic values. Areas important for these values will have a higher level of public support for nomination as an MPA and for management activities.

Scientific and Educational Interests

Each candidate area is assessed according to whether it:

- has existing or potential value for research or monitoring e.g. as an undisturbed area useful for understanding natural processes
- has values for education e.g. a range of habitat types, important species.

Practicality/feasibility

The decision to establish an MPA will need to consider the actual feasibility of doing so, and implementing management actions. Each of the candidates for declaration will vary in their practicality and feasibility, according to:

- its degree of insulation from external destructive influences, such as pollution and coastal developments. Areas that are further away from these influences have a greater chance of maintaining their conservation values
- the urgency for its declaration as an MPA
- its social and political acceptability as an MPA and the degree of community support for declaration and management
- whether it has access for recreation, tourism, education, research and whether it is safe for these activities
- the relative ease of managing the area as an MPA. This will depend not only on the level of political and community support, but also on the financial resources and infrastructure available, the availability of skilled personnel and their commitment to living in the area
- the size of the area able to be declared as an MPA. Larger MPAs will have a greater chance of including a range of biodiversity values and of buffering impacts from external activities.

Box 5. Identification and Selection of MPAs in the Red Sea and Gulf of Aden

Saudi Arabia Marine Conservation Programme

This project was undertaken with the aim of developing a network of representative MPAs for the Red Sea coast of Saudi Arabia. Surveys were undertaken in a hierarchical manner with five increasing levels of detail, providing more comprehensive information at each level: (1) satellite imagery and aerial photos of the entire coastline and offshore areas were used to define major features and depth boundaries; (2) brief inspections at more than 1200 sites to map habitats, critical habitats, turtles and seabirds; (3) qualitative underwater observations at more than 350 sites of shore and subtidal profile, aesthetic and recreational values, pollution impacts and estimates of the richness and abundance of fish, corals, crown-of-thorns starfish, sea urchins, triggerfish, pufferfish; (4) rapid, quantitative surveys of 22 sites, in which abundances of fish, corals, sea urchins and other invertebrates were recorded; (5) detailed, quantitative surveys at eight sites for fish, corals and other invertebrates using replicate transects. The results of these surveys were significant because they identified biogeographic sub-divisions of the Saudi Arabian coastline within which representative areas could be chosen for MPAs. As a result, 74 candidate sites were selected as potential MPAs (Ormond et al., 1984; Price et al., 1998). A subsequent review of these candidate sites (MEPA, 1987) recommended that sites be combined to encompass natural ecosystem boundaries, giving a total of 46 areas as candidate MPAs. The Draft MPA System Plan for Saudi Arabia (Chiffings, 1989) developed this approach further by combining sites into (1) four large resource use reserves (Farasan Islands, Farasan Bank, Tiran Islands, Al Wajh Bank) and a strict nature reserve (Ras Suwahil) that provide for sustainable resource use, represent each of the biogeographic sub-areas and encompass ecosystem boundaries and (2) 38 smaller reserves along the coastline.

Egyptian Red Sea Coastal and Marine Resource Management Project (GEF/World Bank)

A major objective of this project was the development of a Red Sea Coastal and Marine Protected Area (CMPA) Strategy, including the identification and selection of sites as MPAs. As a first step in the identification of potential MPAs based on biodiversity value, 116 sites were surveyed over 700 km of coastline from 40 km north of Hurghada to Shalatein, between April 1996 and April 1998. For the subtidal surveys at each site a belt transect was run from the highest water mark to 25 m depth, with the following parameters recorded: percentage cover and number of species comprising major benthic lifeforms, percentage cover of non-living substrate and the numbers of species of crustaceans, molluscs, echinoderms and fishes. These 116 sites were amalgamated into 33 areas based on shared geographic and ecological features. These 33 areas were subjected to a progressive screening process using criteria of biodiversity value and the IUCN selection criteria; in the latter screening, each area was assigned a value of 1 to 5 representing high to low value for each criterion. The outcome was that eight candidate areas were subsequently screened for their size, representative habitats, conservation status, level of support from partner management agencies and stakeholder concerns. Three CMPA sites were ultimately selected: Hurghada Islands, Wadi El-Jimal Area and Hamatah Area (Source: TDA/EEAA/RSG, 1998).

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ملخص تنفيذى

يشتهر البحر الأحمر وخليج عدن في جميع أنحاء العالم ببيئته البحرية والساحلية الجميلة وتنوع الأنواع فيه ، بما فى ذلك الأنواع المستوطنة ، وأهميتها بالنسبة للنمو البشري. ولقد تمت الاستفادة من الموارد المحلية البحرية بطريقة مستدامة عبر آلاف السنين من قبل سكان هذا الإقليم ، غير أنه في الآونة الأخيرة ازداد الضغط على هذه الموارد والبيئات بصورة جوهرية وذلك بسبب نمو اقتصاديات بعض الدول التي تعتمد على النفط مما يستلزم تصدير النفط عبر البحر وكذلك التوسع فى صناعة سياحة الغطس العالمية فضلاً عن النمو السكاني في المناطق الساحلية.

لقد تم إنشاء مناطق محمية بحرية في جهات متعددة فى البحر الأحمر وخليج عدن كوسيلة للصون والاستخدام المستدام للموارد البحرية والنمو الاقتصادي. وتدعو الحاجة إلى أهمية صون المناطق التي تمثل سلسلة من المواطن الطبيعية والتنوع الحيوي الفريد في الإقليم ودعم التنمية الوطنية في هذا المجال. ولقد تم إنشاء هذه الخطة من خلال تكامل 12 محمية بحرية عبر الإقليم فى منظومة إقليمية من المحميات البحرية فى البحر الأحمر وخليج عدن ، وتتكون هذه المنظومة من : جزر السوابع ورأس سيان (جيبوتى) ؛ محمية رأس محمد الوطنية ، جزر جفتون ، ومضيق جبل (مصر) ؛ محمية العقبة الوطنية (الأردن) ؛ مضيق تيران ، الوجه ، وجزر فرسان (السعودية) ؛ عيبات وجزر سعد الدين (الصومال) ؛ متنزه سنقنيب البحري القومى ، جزيرة مكور ، وخليج دنقناب (السودان) ؛ مجموعة جزر سقطرى ومنطقة بلحاف بير على (اليمن).

هذه الخطة الرئيسية الإقليمية هي إطار إقليمي متفق عليه للتخطيط والإدارة لكل محمية بحرية ضمن المنظومة الإقليمية والتي سوف تساعد فى تنفيذ الأهداف الإقليمية فيما يتعلق بالاستخدام المستدام للموارد، وصون التنوع الحيوي، والنمو الاقتصادي. إن الأهداف والسياسات العامة والإستراتيجيات المطروحة هنا يمكن تطبيقها إقليمياً وسوف تسهل عملية الانسجام الإقليمى فى إدارة المحميات البحرية ضمن المنظومة المذكورة. ومن خلال كل محمية فى المنظومة الإقليمية سيتم تطوير خطة رئيسية ذات معيار إقليمى خاصة بكل محمية ؛ وهذه الخطة سوف تمثل الوثيقة العامة للسياسة بعيدة المدى لتلك المحمية، وستساعد فى وضع خطة إدارية لكل محمية بحرية. كما أن الخطة الرئيسية الإقليمية ستمثل إطاراً للتخطيط والإدارة لمحميات بحرية أخرى في كل

بلد والتي لا تعد جزءاً من المنظومة الإقليمية حيث لم يبدأ فيها وضع خطة وطنية أو إدارية للمحمية.

إن تطوير خطة رئيسية إقليمية للمحميات البحرية في البحر الأحمر وخليج عدن تنسجم مع أهداف اتفاقية التنوع الحيوي (1992) ومتوازية أيضاً مع التطورات الجارية في بعض البحار الإقليمية الأخرى (مثل البحر الأبيض المتوسط والبحر الكاريبي) حيث تم إنشاء منظومة من المحميات البحرية المماثلة.

الأهداف المرجوة من الخطة الرئيسية الإقليمية هي:

- تطوير القدرات الإقليمية في كل ما يتعلق بالتخطيط والإدارة للمحميات البحرية.
- تأمين الاستخدام المستدام للموارد البحرية الحية.
- تدعيم التنمية الاقتصادية والاجتماعية المحلية والوطنية.
- تضمين المجموعات المحلية والجهات المستفيدة في إدارة المحميات البحرية كشركاء.
- حماية النماذج والأمثلة الأساسية للتنوع الحيوي في البحر الأحمر وخليج عدن.
- القيام ببرامج بحث ومراقبة لصالح إدارة المحميات البحرية.
- تعزيز التوعية العامة بالموارد البحرية والتنوع الحيوي في البحر الأحمر وخليج عدن وأسس الاستخدام المستدام.
- حماية الإرث الثقافى الفريد للبيئة البحرية والساحلية للبحر الأحمر وخليج عدن.
- تنفيذ إطار إقليمي قانوني للمناطق المحمية والتنوع الحيوي.

تتضمن الخطة الرئيسية الإقليمية إرشادات مبنية على أحسن الممارسات المقبولة حالياً في الإدارة والتخطيط للمحميات البحرية، والتى تم تعديلها لتناسب الأوضاع المعينة الموجودة في البحر الأحمر وخليج عدن. وتتضمن هذه الإرشادات ما يلي:

- عملية التخطيط
- تطوير خطط التمنطق
- البحوث والمراقبة
- التوعية العامة
- مشاورة ومشاركة الجهات المستفيدة
- التمويل المستديم
- تعزيز القدرات
- متطلبات الموظفين

يوجد هناك تباين واضح بين الدول المطلة على البحر الأحمر وخليج عدن فيما يتعلق بالإمكانيات الفنية والعلمية للتخطيط والإدارة للمحميات البحرية. ويعزى ذلك جزئياً إلى فوارق في التنمية الاقتصادية والمعونات المقدمة من المجتمعات الدولية. وتضع هذه الخطة الرئيسية الإقليمية الخطوط العريضة تجاه التعزيزات المطلوبة فى الآليات القانونية والوطنية والمؤسسية وكذلك الحاجة إلى وضع بروتوكول خاص بالمحميات البحرية لتم الاسترشاد به فى تطوير التشريعات الوطنية للمحميات البحرية فى حالة عدم وجودها. إن إنشاء مركز نشاط إقليمي للمحميات البحرية سيساعد فى التنسيق الفاعل بين المحميات البحرية فى المنظومة الإقليمية، وتبادل المعلومات، وتعزيز القدرات، وتقوية المؤسسات وإيجاد ترابط مع منظومات إقليمية أخرى.

ويتصور أن تطوير منظومة قوية من المحميات البحرية وتنمية القدرات الوطنية في التخطيط والإدارة لهذه المحميات سوف يسهمان في إنشاء محميات بحرية أخرى في كل دولة من دول الإقليم. ولتعزيز هذه العملية فإن الخطة الإقليمية الرئيسية تتضمن إرشادات لتحديد واختيار محميات بحرية أخرى .

"الهيئة الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن"، هي هيئة حكومية تعنى بالمحافظة على البيئات الساحلية والبحرية في الإقليم.

تستمد الهيئة قاعدتها القانونية من الاتفاقية الإقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن (1982) . وقد تم إعلان إنشائها فى القاهرة فى سبتمبر 1995 حيث تتخذ من مدينة جدة مقرا لها. تضم الهيئة في عضويتها كل من الأردن ، جيبوتي ، السعودية ، السودان ، الصومال ، مصر، واليمن .

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تم تنفيذ العمل من خلال مكون المناطق البحرية المحمية فى إطار برنامج العمل الإستراتيجي للبحر الأحمر وخليج عدن، وهو مشروع يموله مرفق البيئة العالمي وتنفذه الهيئة وتشارك فى تنفيذه الجهات المانحة (برنامج الأمم المتحدة الإنمائي ، برنامج الأمم المتحدة للبيئة ، والبنك الدولي) .

إن الملاحظات الواردة في هذه الوثيقة تمثل وجهة نظر المؤلّف/المولّفين وتحت مسئوليتهم الخاصة ولا تمثل بالضرورة وجهات نظر الهيئة ، أو الجهات التي ساعدت فى تمويل إعداد هذا التقرير . وكذلك لا يعبر أي وصف أو تفاصيل إجمالية ، وردت فى التقرير ، عن فكرة معينة تنسب للهيئة أو لأى جهة مانحة، فيما يتعلق بالحدود القانونية لأي دولة أو منطقة أو مدينة .

الصور الفوتوغرافية من : الدكتور ف. كروب ، السيد ج. كتشنكى ، الدكتور ن. بلشر ، والأستاذ محمد يونس

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الهيئة الاقليمية للمحافظة على بيئة البحر الأحمر وخليج عدن

المنظومة الإقليمية للمناطق المحمية البحرية
فى البحر الأحمر وخليج عدن

الخطة الرئيسية الإقليمية