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Conservation Management Plan for the Southern Red Sea

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Table of Content

Acronyms and Abbreviations ..... **iv**
Executive Summary **1**
1. Introduction **3**
Purpose of the Plan 4
Scope and Limitations of the Plan 4
Structure of the Plan 5
Vision Statement 5
Strategic Goals 5
Area 6
2. Existing Legal Framework **7**
2.1 International Legal Framework 7
2.2 Egyptian Legal Framework 7
2.2.1 Administrative Responsibilities 8
2.2.2 Legislation and Decrees 9
2.2.3 Maritime Boundaries 10
2.3 Non Governmental Organizations 11
3. Physical, Biological, and Social Description **12**
3.1 Physical Description 12
3.1.1 Climate 12
3.1.2 Oceanography 12
3.1.3 Water Quality 13
3.1.4 Coastal Geomorphology 13
3.2 Biological Description 14
3.2.1 Marine Habitats and Zonation 14
3.2.2 Other marine flora and fauna 20
3.3 Social description 24
3.3.1 Cultural and social settings 24
3.3.2 Archaeology 25
3.3.3 Socio - economic activities 25
4. Management Issues **32**
4.1 Current Management Issues 32
4.1.1 Habitat destruction 33
4.1.2 Exploitation of marine resources 37
4.1.3 Threatened species 38
4.1.4 Ship-originated pollution 40
4.1.5 Land-originated pollution 40
4.1.6 Indigenous people 42
4.2 Potential future issues 42
4.2.1 Introduced marine species 42
4.2.2 Major oil spill 42
4.3 Synthesis of management issues 43
5. Management **51**
5.1 Management objectives 51
5.2 Management strategies 51
5.3 Management effectiveness 52
5.3.1 Indicators 52
5.3.2 Monitoring 53

5.3.3 Description of Tables 9 and 10. 54
6. Management Tools and General Recommendations 67
6.1 Protected Areas 67
6.1.1 Recommendation 67
6.2 Stakeholder participation and interaction 68
6.2.1 Recommendation 68
6.3 Environmental Regulations 68
6.3.1 Recommendation 69
6.4 Law Enforcement 69
6.4.1 Recommendations 69
6.5 Coastguard Participation 69
6.5.1 Recommendations 69
6.6 Community and Volunteer Rangers 70
6.6.1 Recommendations 70
6.7 Public Awareness 70
6.7.1 Recommendations 70
6.8 EIA 71
6.8.1 Recommendations 71
6.9 GIS 71
6.9.1 Recommendations 71
6.10 Species Action Plans 72
6.10.1 Recommendation 72
7. Zoning 73
7.1 Introduction 73
7.2 Indicative WGHPA Zoning Scheme 74
8. Site Plans 79
8.1 Recommendation 80
9. Mooring Strategy 81
10. Building Capacity 82
10.1 Personnel, Offices, and Accommodation 82
10.2 Office and Field Equipment 82
10.3 Communications 82
10.4 Vehicle Transport and Heavy Equipment 83
10.5 Vessel 83
10.6 Indicative Budget for the CMA 83
11. Consultation 86
References 88
Appendix A: Seagrass meadows in the Wadi Gemal - Hamata Protected Area, Egypt 95
Study Area 96
Survey Approach 96
Statistical Analysis 96
Limitation of Study 96
Locations Surveyed 97
Species 97
Spatial Distribution 98
Variation in percent cover 98
Variation among water depths 98
Variation among and within locations 98
Appendix B: Provisional site plan for Ras Bhagdadi 105
Appendix C: Maps 108

Acronyms and Abbreviations

CMA	Southern Red Sea Conservation Management Area
CZMP	Coastal Zone Management Plan
EEAA	Egyptian Environmental Affairs Agency
EEPP	Egyptian Environmental Policy Program
EIA	Environmental Impact Assessment
GEF	Global Environment Facility
HEPCA	Hurghada Environmental Protection and Conservation Association
IUCN	World Conservation Union
NCS	Nature Conservation Sector
NOSCP	National Oil Spill Contingency Plan
PA	Protected Area
PSU	Policy Support Unit
RSG	Red Sea Governorate
RSSTI	Red Sea Sustainable Tourism Initiative
SEA	Strategic Environmental Assessment
SWMP	Solid Waste Management Plan
TDA	Tourism Development Authority
USAID	United States Agency for International Development
WGHPA	Wadi El Gemal – Hamata Protected Area

Executive Summary

This Plan has three main aims. First, it describes the natural and social resources of the southern Red Sea Conservation Management Area (CMA). Second it lists and prioritizes threats to these resources. Third, it recommends strategies to respond to these threats. Importantly, this Plan is not prescriptive because EEAA managers and rangers will need to be adaptable in order to meet emerging and unpredicted issues. In addition, it is not a legal document because much of the CMA is not a Protected Area (PA) under Egyptian law. This Plan provides guidance to conserve the biological values of the CMA and to ensure that the existing and future threats on the area's natural values are managed within an ecologically sustainable framework. This reflects a pro-active approach to managing human usage of the area rather than waiting until it is degraded before implementing reactive management strategies.

The CMA includes all Egyptian territorial waters between Ras Toronbi and Ras Banas, inclusive of the Wadi Gemal – Hamata Protected Area (WGHPA)[1]. The CMA is an area of phenomenal biological diversity and natural beauty. Ninety-seven species of soft and hard corals, and 141 species of fishes are known from the CMA. At least six species of seagrass and one species of mangrove are found in the CMA. Indeed, it contains a substantial proportion of the total mangrove resources of Egypt. At Hamata, *Avicennia marina* extends 12 km in a semi-continuous fringe. The CMA has seagrass meadows that provide food for green turtles (*Chelonia mydas*) and dugongs (*Dugong dugon*). At least two species of marine turtle, the green and hawksbill (*Eretmochelys imbricata*), nest on islands and mainland beaches in the CMA. Both species and the dugong are frequently observed in the CMA. The coral reefs, wadis and other natural values of the CMA also have enormous economic value by providing the basis for international tourism activities. However, in contrast to the natural values near Hurghada and Safaga, the coral reefs and wadis in the CMA remain comparatively undisturbed by human activity. This is due, in part, to their remoteness from large urban and industrial centers. Nevertheless, not all habitats in the CMA have been spared from human activity. Anchors and anchor chains have damaged many offshore coral assemblages. Tar balls and plastic bags litter beaches and rocky shores. Unregulated fishing continues throughout the Egyptian Red Sea and little is known of the long-term ecological effects of this activity. Livestock graze mangroves and sparse desert flora, and local people harvest mangrove wood. Tourists and fishermen have been reported disturbing nesting seabirds. Further, the Tourism Development Authority (TDA) is proposing major coastal development adjacent to the CMA.

[1] Importantly, this Plan has been developed concomitantly with a plan of management specifically for the WGHPA.

This Plan follows a structure developed by EEAA and World Conservation Union (IUCN) for use in Egypt. It begins with a general introduction that includes: a description of the purpose of this Plan; its scope and limitations; the Plan's structure; a vision statement for the CMA; the strategic goals for the CMA and a description its boundaries. Section 3 provides an overview of the existing legal framework relating to marine conservation management in Egypt. Next is a description of its physical, biological and social values (Section 4), followed by a summary of the main management issues (Section 5). Proposed management objectives, strategies and evaluation are presented in Section 6. Sections 7, 8, 9 and 10 reports on the proposed management tools, zoning, site plans and mooring strategy, respectively. Section 11 illustrates how to build capacity to achieve the Plan's objectives. Section 12 is a list of people consulted during the preparation of the Plan, while Section 13 contains the references. Section 14 holds the maps and Section 15 is the Appendices.

The Plan was developed using an outcome-based approach to facilitate effective auditing of the implementation of the Plan. The integration of evaluation programs into management plans offers a number of significant benefits for natural resource management. The ability to demonstrate the results or outcomes of management has the following advantages:

- Providing feedback to management about the extent to which previous actions are achieving management objectives
- Providing the opportunity to learn from past management experience and so progressively improve management performance
- Providing a more informed basis from which to make ongoing management decisions and for allocating and prioritizing management effort and resources
- Providing the necessary link to public accountability and to those funding management by demonstrating the outcomes for expenditure on protected area management

PSU and EEAA staff based in Hurghada developed this Plan. Key stakeholders who operate in or adjacent to the CMA provided input into the issues and recommendations.

1. Introduction

The Red Sea coastline of Egypt is approximately 1800 km long, with a hinterland characterized by rugged mountains and numerous dry river courses. The adjacent waters support a diverse range of marine habitats, such as coral reefs, mangrove stands and seagrass meadows. These resources support major marine-based activities including semi-subsistence based harvesting, tourism, shipping, fishing and aquaculture. These industries represent a significant component of Egypt's economy by providing employment for many thousands of Egyptians.

In light of the growing pressures on the Red Sea resources, the Egyptian Environmental Policy Programs (EEPP) has proposed that a management plan be prepared for marine waters between Ras Toronbi, 40 km south of El Quseir, and Ras Banas, inclusive of the marine component of the WGHPA. This combined marine (≈ 5556 km²) area is known as the Southern Red Sea Conservation Management Area but, for convenience, is hereafter called the Conservation Management Area (CMA).

The CMA is an area of phenomenal biological diversity and natural beauty (NCS/EEAA 2002). Ninety-seven species of soft and hard corals (Kotb *et. al.* 2001), and 141 species of fishes are known from the CMA. At least six species of seagrass and one species of mangrove are found in the CMA. Indeed, it contains a substantial proportion of the total mangrove resources of Egypt. At Hamata, *Avicennia marina* extends 12 km in a semi-continuous fringe (Razek *et. el.* 1998). The CMA has seagrass meadows that provide food for green turtles (*Chelonia mydas*) and dugongs (*Dugong dugon*). At least two species of marine turtle, the green and hawksbill (*Eretmochelys imbricata*), nest on islands and mainland beaches in the CMA. Both species and the dugong are frequently observed in the CMA.

The coral reefs, wadis and other natural values of the CMA also have enormous economic value by providing the basis for international tourism activities. However, in contrast to the natural values near Hurghada and Safaga, the coral reefs and wadis in the CMA remain comparatively undisturbed by human activity. This is due, in part, to their remoteness from large urban and industrial centers. Nevertheless, not all habitats in the CMA have been spared from human activity. Anchors and anchor chains have damaged many offshore coral assemblages. Tar balls and plastic bags litter beaches and rocky shores. Unregulated fishing continues throughout the Egyptian Red Sea and little is known of the long-term ecological effects of this activity. Livestock graze mangroves and sparse desert flora, and local people harvest mangrove wood. Tourists and fishermen have been reported disturbing nesting

seabirds. Further, the Tourism Development Authority (TDA) is proposing major coastal development adjacent to the CMA.

Purpose of the Plan

This Plan has three main aims. First, it describes the natural and social resources of the CMA. Second it lists and prioritizes threats to these resources. Third, it recommends strategies to respond to these threats. Importantly, this Plan is not prescriptive because EEAA managers and rangers will need to be adaptable in order to meet emerging and unpredicted issues. In addition, it is not a legal document because much of the CMA is not a PA. This Plan provides guidance to conserve the biological values of the CMA and to ensure that the existing and future threats on the area's natural values are managed within an ecologically sustainable framework. This reflects a pro-active approach to managing human usage of the area rather than waiting until it is degraded before implementing reactive management strategies.

Scope and Limitations of the Plan

This Plan provides only a preliminary framework of management given the limited information on the marine biological values of the CMA and the processes that threaten them. For example, scientists in the region have limited knowledge of the abundance and distribution of seagrasses, dugongs, cetaceans, subtidal and intertidal infauna in the CMA. There are no detailed inventories of scleractinian corals, soft corals and fishes. This is partially due to the lack of taxonomists and because of the size and remoteness of the region. For these reasons it is difficult, at this time, to provide reliable predictions of all potential threats to the CMA values.

In this Plan, management strategies are specified for issues where there is evidence of detrimental change associate with human activities. Alternatively, recommendations are given where there is a need for further assessment of a potential threat. In addition, the management strategies focus on issues primarily under the jurisdiction of the EEAA and are realistically achievable in the time frame of this Plan (5 years). By definition this excludes urban and industrial planning on the coastline beyond the setback. Thus, the Plan does not focus on important management initiatives that should take place outside the CMA, such as a Coastal Zone Management Plan (CZMP) and a Solid Waste Management Plan (SWMP). Although the EEAA should provided advice on these issues they belong under the mandates of the TDA and Red Sea Governorate. Importantly, CZMP and a SWMP have been prepared for the Egyptian Red Sea, but appear not to have been implemented. Fortunately, some recent initiatives by the Red Sea Sustainable Tourism Initiative (RSSTI) may rectify a lack of land use planning adjacent to the CMA, but their recommendations will need to be reviewed by EEAA to ensure they are consistent with the objectives of the CMA [2].

[2] RSSTI, in conjunction with the TDA, is preparing a Land Use Management Plan for areas immediately adjacent to the CMA. RSSTI has also prepared guidelines for hotels and resort on best

Further, this Plan excludes issues relating to policy change, such as institutional strengthening and human resource development. These are important long-term goals that are being addressed by EEAA. Because of the rapid development of the Egyptian Red Sea region and the difficultly in providing reasonable predictions of the consequences of development on the natural environment, it is proposed that this Plan be reviewed in 5 years starting in 2003.

Structure of the Plan

This Plan follows a structure developed by EEAA and World Conservation Union (IUCN) for use in Egypt. It begins with a general introduction that includes: a description of the purpose of this Plan; its scope and limitations; the Plan's structure; a vision statement for the CMA; the strategic goals for the CMA and a description its boundaries. Section 3 provides an overview of the existing legal framework relating to marine conservation management in Egypt. Next is a description of its physical, biological and social values (Section 4), followed by a summary of the main management issues (Section 5). Proposed management objectives, strategies and evaluation are presented in Section 6. Sections 7, 8, 9 and 10 reports on the proposed management tools, zoning, site plans and mooring strategy, respectively. Section 11 illustrates how to build capacity to achieve the Plan's objectives. Section 12 is a list of people consulted during the preparation of the Plan, while Section 13 contains the references. Section 14 holds the maps and Section 15 is the Appendices.

Vision Statement

In the year 2008, the flora and fauna, habitats and water quality of the CMA will be in the same or better condition than in 2003. The area will support viable and ecologically sustainable fishing, recreation and tourism, and the community will consider the area an important asset.

Strategic Goals

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practises to dispose of solid waste. According to Ihab Shaalan, RSSTI, a pilot study using these guidelines will be conducted this year near Marsa Alam (pers. comm. May 2003). In addition, the National Steering Committee for Coastal Zone Management, created under Law 4 (1994), has issued environmental guidelines for development in coastal areas published in 1996 under the title: *Environmental Guidelines for Development in the Coastal Areas.* A comprehensive CZMP, funded by GEF, already exists for the Egyptian Red Sea: *Integrated Coastal Zone Management Action Plan for the Egyptian Red Sea* (1998), but it remains unclear why it was not implemented. Similarly, a Solid Waste Management Action Plan was prepared as part of the Environmental Sustainable Tourism Project (EPAT 1997), but also was not implemented.

The strategic goals of the CMA are:

- To protect and maintain the biological diversity and other natural values of the CMA.
- To protect the natural resources base from being alienated for other land-use purposes that would be detrimental to the biological diversity of the CMA.
- To contribute to regional and national development.

Area

The CMA encompasses all Egyptian Red Sea waters (≈ 5556 km²) between Ras Toronbi to Ras Banas (Figure 1).[3] The northern boundary will be contiguous with the line of latitude 25° 39' 31.2'' N, which crosses the mainland immediately north Ras Toronbi. The southern boundary will be contiguous with the line of latitude 35° 52' 1'' N, which crosses the mainland immediately south of Ras Banas. The eastern or maritime boundary will extend 12 nautical miles (nm) offshore, which is the limit of Egypt's territorial waters[4]. The mainland or western boundary of the CMA will be the highest equinox line (Highest High Water Spring)[5], which is consistent with existing Egyptian marine PAs.

The proposed boundary of the CMA was selected to include:

- Representative examples of all marine and coastal habitats in the Egyptian Red Sea south of El Quseir and north of Ras Banas.
- The main seabird and turtle nesting areas between El Quseir and Ras Banas.
- The main mooring and diving locations in Egypt's central Red Sea waters.
- All of all Egyptian territorial waters between Ras Toronbi and Ras Banas.
- Waters adjacent to the WGHPA .

[3] All figures, which are maps, can be found in Appendix C.

[4] This differs from the approach taken for Ras Mohammed National Park. Decrees 33 (1996) and 2035 (1996) state that the eastern or maritime boundary of Ras Mohammed National Park extends to the 500 m isobath (EU 1998).

[5] A terrestrial setback is not proposed for the CMA because the 200 m strip of land adjacent to the reef flat is already managed in accordance with Law 4 (1994) and enforced by the EEAA (see Section 3.2.2).

2. Existing Legal Framework

This section illustrates Egypt's international and national obligations to protect its natural resources. It clearly demonstrates that Egypt has a comprehensive legal framework to conserve and manage its natural resources.

2.1 International Legal Framework

Egypt is signatory to eight international conventions[6] which are relevant to environmental protection in the CMA.

- Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment (Jeddah Convention 1982).
- International Convention of Pollution of the Sea by Oil (1954).
- International Convention of Prevention of Pollution from Ships (MARPOL, 1973).
- Convention of the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention, 1973).
- Convention for the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention 1989).
- Convention of Biodiversity (Rio Convention, 1992).
- Convention of Migratory Species (Bonn Convention).
- The Law of the Sea.

2.2 Egyptian Legal Framework

This section summarizes the administrative responsibilities of key agencies and national legislation pertaining to natural resource protection in Egypt.

[6] A description of these conventions and how they apply to Egypt is given in: *Gulf of Aqaba Environmental Action Plan Egypt* (1998)

2.2.1 Administrative Responsibilities[7]

The main government agencies responsible for protection of natural resources in the CMA are the EEAA, TDA and RSG. The EEAA has the national lead role for PAs. However the TDA and RSG have direct and indirect roles, which can be positive or negative in terms of resource protection. The EEAA, TDA and RSG are described in more detail below.

Egyptian Environmental Affairs Agency

The EEAA is the central institution concerned with environmental protection and co-ordination in Egypt. EEAA's responsibilities include: a) administering to the provision of Laws No. 4 (1994) and 102 (1983); b) setting up of general environmental preservation policies and programs; c) adjusting and drafting environmental legislation; d) and preparation of environmental studies, standards, specifications and conditions for the control of environmental pollution, and e) management of the protectorates. The agency has the lead role in the preparation of the National Plan for Environmental Protection, National Oil Spill Contingency Plan, the National Biodiversity Strategy and National Coastal Zone Management Framework Program.

Tourism Development Authority

The TDA is autonomous agency with substantial jurisdiction authority over tourism development areas. TDA's roles are to: a) provide support for coherent private sector tourism development; b) to provide institutional framework for environmentally sound private investment participation in tourism development, and c) to help safeguard the resources of Egypt from environmental development degradation. TDA has the authority to acquire and sell tourism development lands and retain the income; to charge fees for the assessment and monitoring of projects; and to borrow, repay loans, and receive grants from national and international institutions.

Red Sea Governorate

The Egyptian Red coast is under the supervision of three Governorates: Suez, South Sinai and Red Sea. Although the responsibilities and powers are centralized in sectoral ministries, the coastal Governorates have budgets and administration, social and economic development at the provincial level. The Red Sea Governorate (RSG) controls the local administration of two municipalities in the CMA – Marsa Alam and Hamata. Within the RSG boundaries, the Governor of the Red Sea Governorate (RSG) has the responsibilities for co-coordinating activities of different ministries, promoting tourism development construction, for issuing building permits and for selling municipal and Governorate controlled land within the town limits of Marsa Alam (14 km north and south of the town). All municipal zoning, tourism projects and building permits are authorized and issued by the RSG.

[7] This summary was taken from the GEF (1998b)

2.2.2 Legislation and Decrees

There are approximately 200 national laws and decrees in Egypt that both directly and indirectly regulate coastal development, and aim at the protection of the marine and coastal environment. Ibiary (2002) provided a detailed synopsis of Egyptian law relating to the conservation of marine resources. The most relevant laws to the conservation of marine resources in the CMA are:

- Law No. 102 (1983) regulating protected areas.
- Prime Minister's Decree No. 450, 1986 Elba Protectorate.
- Law No. 4 (1994) for the Environment, which resulted in the foundation of the EEAA.
- Prime Minister's Decree No. 143 (2003) Establishing a protected area in the Wadi Gemal – Hamata area in the Red Sea Governorate.

These laws are briefly described below.

The Egyptian Conservation Law no. 102 (1983) established the framework for the creation of protected areas. The Nature Protection Department (NPD) of EEAA administers its enacting. The Law provides an extra level of protection by prohibiting exploitation and disturbance of both living and non-living resources and restricting both the level and scale of activities that take place within protected areas.

Prime Minister's Decree No. 450, 1986, gave protected area status to the Elba region, the Red Sea islands off the Egyptian coast and to all mangroves. The Prime Minister's Decree 642 (1995) listed 22 islands and stated that the PA status included adjacent waters out to 1 km.

The main provisions of Law No. 4 (1994) address the operational role of the EEAA by:

- Providing EEAA with enforcement powers to co-ordinate environmental management and pollution control.
- Ensuring that all development is subject to an appropriate level of EIA supervision and guidance.
- Setting up an Environmental Protection Fund with sufficient resources
- Establishing an Environmental Management Unit (EMU) in each Governorate to help co-ordinate and implement EEAA's mandate on the local level.
- Establishing and co-coordinating environmental information and monitoring networks to guarantee an effective implementation of the Agency's mandate.

Articles 59 and 60 of Law 4 (1994) have far-reaching implications for the design of new coastal resorts. Article 59 prohibits the construction of any establishment within 200 meters of the shoreline, except with the approval of the Egyptian General Authority for the Protection of Shores (GAPS), in co-ordination with EEAA, and after the approval of a satisfactory Environmental Impact Assessment (EIA). Furthermore, Article 60 prohibits all activities that cause any alteration or modification to the natural shoreline.

Prime Minister's Decree No. 143 (2003) legally established the WGHPA. The decree describes the boundary of the PA and what activities are permitted within it.

2.2.3 Maritime Boundaries

This section provides a brief overview of Egypt's maritime boundaries. An understanding of these is important when establishing maritime boundaries for PAs.

Upon ratification, the Government of Egypt, under the provisions of article 310 of the *United Nations Convention on the Law of the Sea*, made the following declaration[8]:

Declaration concerning the territorial sea

The Arab Republic of Egypt establishes the breadth of its territorial sea at 12 nautical miles, pursuant to article 5 of the Ordinance of 18 January 1951.

Declaration concerning the contiguous zone

The Arab Republic of Egypt has decided that its contiguous zone extends 24 nautical miles from baseline.

Declaration concerning the exercise by Egypt of its rights in the Exclusive Economic Zone (EEZ)

The Arab Republic of Egypt will exercise its rights attributed to it by the provisions of Parts V and VI of the United Nations Convention on the Law of the Sea in the EEZ situated beyond and adjacent to its territorial waters. The declaration also states that Egypt will exercise its sovereign rights in this zone for the purposes of exploring and exploiting, conserving and managing the natural resource.

[8] The source of this information is the UN Division of Ocean Affairs and Law of the Sea: www.un.or/Depts/los/convention_agreements/convention_declaration

2.3 Non Governmental Organizations

The two major non-governmental organizations actively involved in Egypt's Red Sea region are the Hurghada Environmental Protection and Conservation Association (HEPCA) and the Red Sea Diving Association. The former has been instrumental in the establishment and maintenance of moorings in the Egyptian Red Sea, while the latter is primarily a marketing association aimed at promoting diving in the Red Sea. Recently, dive tourism operators, based between El Quseir and Ras Banas, have established a Southern Red Sea Tourist Association (Kirsten Ehlert, Wadi Gemal Dive Center, April 2003). One of the tasks of the Association is the promotion environmental protection of coral reefs and other resources in the CMA. For example, at its second inaugural meeting, held 7 May 2003, the Association members proposed to establish guidelines for tourists/dolphin interactions at the Dolphin House (Hossam Helmy, pers. comm. May 2003).

3. Physical, Biological, and Social Description

In this section the physical, biological and socio-economic descriptions of the CMA are based on the results of EEAA, Global Environment Facility (GEF) and United States Agency for International Development (USAID) funded surveys in the 1990's (Riegl and Luke 1997a, Riegl and Luke 1997b, Borhan 1998, Kotb *et. el.* 2001, Razec *et. el.* 1998a, Razec *et. el.* 1998b, Baha El Din *et. al.* 2003) and more recent surveys funded by EEAA and USAID in 2002 and 2003. EEAA scientists and rangers provided considerable amount of unpublished data and anecdotal information.

3.1 Physical Description

3.1.1 Climate

Throughout the year the wind direction is NNW except for occasional southerly winds that blow during winter. Mansour (2003) reported that the velocity averages 22 km/h in summer and 19 km/h in winter, and, in general, wind velocity is higher during daytime. The air temperature in the Egyptian part of the Red Sea ranges between 6 to 39°C in the north and between 13.5°C to 42°C near the Sudanese border. Rainfall over the Red Sea as a whole is very sparse, occurs intermittently and is often localized. The northern part of the Red Sea receives rainfall (c. 25 mm/yr.) only for six months (Sept-March), while Hurghada and the coast southwards receives almost no rain. Such small amount of rain is accompanied by low humidity for most of the year, except during parts of winter where it reaches about 70% in the south. Mansour (2003) calculated that the area between Marsa Alam and Ras Banas receives an average rainfall quantity equal to 98.78 million cubic meters/year. He said that a large amount of this rainfall is evaporated, but some percolates into the sediments to replenish aquifers.

3.1.2 Oceanography

The direction and speed of currents in Egypt's Red Sea have not been described in detail. Seasurface currents typically flow in the same direction as the prevailing wind. In the Red Sea, the prevailing wind off Egypt is N – NW for most of the year, with a more western component from December to February (NOSCP 1997). Therefore, nearshore seasurface currents, particularly in the south, flow north to south parallel to the Egyptian coast. The direction and speed of subsurface currents in the same area are less predictable.

Tides and tidal streams within the CMA presumably reflect those recorded in other areas of the northern Red Sea. That is, the tide is semidiurnal, with high water (HW) and low water (LW) occurring more or less simultaneously all along the northern Red Sea (Davies and Morgan 1995). HW is about 1-1.5 hrs after LW at Shadwan Island, Egypt. Spring tidal range is 0.6 – 1.2 m.

In the northern Red Sea (30°N) water temperatures range from 17°C in February to 27°C in August (Davies and Morgan 1995), with greater extremes in shallow water near the coast. This compares with the southern Red Sea (15°N) where the seasonal range of water temperature is considerably less, but mean monthly temperatures are much great (for example 26°C in February and > 31°C in August).

3.1.3 Water Quality

Water masses of the central-northern Red Sea have low levels of nutrients. Nevertheless, there is a clear latitudinal pattern in concentrations (Medio *et. el.* 2000) with levels decreasing from south to north. In summer, nutrient rich water from the Gulf of Aden enters the Red Sea and flows as far north as the Farasan Islands, Saudi Arabia (Moore 1989). Levels of nutrients, hydrocarbons and heavy metals in the CMA have not been described in detail. Localized contamination of nutrients, hydrocarbons and heavy metals is likely in harbors at Abu Ghuson, Marsa Alam and Hamata.

Monsour (2003) provided estimates of dissolved oxygen, salinity, pH, Eh and total dissolved salts from Hurghada, Safaga, El Quseir and Marsa Alam. However, he does not provide information on the sample site (e.g. distance from shore, depth, from inside or outside the harbors etc.) or on the number of replicates taken.

3.1.4 Coastal Geomorphology

The coastline of the CMA has a general north-south alignment. It is dominated by a well-developed coral reef that forms an almost continuous fringe along the coast. The reefs are occasionally broken by marsas, which are drowned river valleys (Jones *et. el.* 1987). Marsas are uncommon features in the CMA[9] and support marine benthic assemblages that differ from those occurring on the more exposed areas.

Kotb *et. el.* (2001) described six examples of fringing reef along the Egyptian Red Sea, all of which are found in the CMA. These include:

- Wide rocky reef flat (>100 m distance) and gently sloping reef face.
- Narrow reef flat (<50 m) with deep lagoons with distinct reef edge.

[9] For example, between Marsa Alam and Wadi Lahmi there are only 8 marsas, including Sharm El Luli.

- Very narrow reef flat without distinct reef edge.
- Narrow reef flat without obvious reef edge.
- Similar to above except with distinct reef edge and steep reef face.
- Moderately wide reef flat (100 – 200 m) and steep reef face.

There are five islands in the CMA. Wadi Gemal Island is located 5 km off Ras Baghdadi. Northeast of Hamata is the Qulan Archipelago – sometimes called the Hamata Islands. The Archipelago consists of four islands. They are, from north to south, Siyul, Showarit, Umm Ladid and Mahabis Islands. The islands in the Qulan Archipelago range from 3 to 7 km off the mainland. All are low-lying islands with sandy beaches and raised fossil reefs, purportedly of Pleistocene origin.

3.2 Biological Description

3.2.1 Marine Habitats and Zonation

In this Plan, marine habitats are broadly defined according to their dominant biota, physical environmental influences and or substratum type. Given the lack of accurate quantitative mapping of marine biota in the CMA[10] it was deemed unnecessary, at this stage, to attempt a more detailed classification scheme. However preliminary observations indicate that there seven broadly defined marine habitats in the CMA:

1. Coral reefs
2. Seagrass meadows
3. Mangrove stands
4. Intertitidal pavement with algae
5. Intertidal sand
6. Subtidal sand
7. Pelagic

These habitats and their characteristic biota are described below. For many habitats only a broad overview could be given because of the lack of scientific investigations in the CMA.

Coral reefs

[10] At the time of preparing this report the GIS Section of the EEAA/PSU only had access to Landsat imagery with a pixel resolution of between 15 x 15 m for the pancromatic imagery and 30 x 30 m for the multispectral imagery. Both have limited water depth penetration. This made it impossible to delineate among most habitats even at a coarse scale.

The Red Sea has some of the most attractive and biologically diverse coral assemblages in the world. About three hundred species of scleractinian corals are recorded from the Red Sea, with over 250 species, from 58 genera, reported in the central-northern Red Sea (DeVantier *et. el*. 2000). Two hundred and five species of scleractinian coral are known from the Sinai Peninsula (Riegl and Luke 1997a) and one hundred and thirty-two species of hard and soft corals have been recorded from Egypt's Red Sea coastline between Jernsa and Shalateen (Kotb *et. el*. 2001).

In the CMA the percent cover of coral is highly variable, even over short distances. Kotb *et. el.* (2001) reported coral cover, in the CMA, ranged from 0 to >50%. *Stylophora* is the dominant genus on the reef flat and *Porites* and *Montipora* the dominant genera in deeper water (GEF 1997). Kotb *et. el.* (2001) sampled twenty-four sites in the CMA, and found that the number of hard coral species per site ranged considerably among sites (Figure 2).

Riegl and Luke (1997a) described at least 11 coral assemblage types from the Egypt Red Sea and defined them by the dominant coral genus or genera, exposure (windward / leeward) and topography. In the CMA, four assemblages types are widespread: windward *Acropora* assemblage, *Acropora* dominated patch reef assemblage, the leeward *Porites* assemblage and *Millepora* current assemblage. These assemblage types are described in below.

- Windward *Acropora* assemblage

This assemblage is found on windward of exposed reef edges and slopes. On the reef edge, *Acropora gemmifera* is the dominant coral. This species, with a sturdy growth form, is able to tolerate areas exposed to surge and extreme seawater temperatures. The reef slope is typically high in coral cover, and is dominated by the genus *Acropora*.

- *Acropora* dominated patch reef assemblage

Acropora also dominates this assemblage type, but faviids may also be abundant. Restricted on 'exposed well washed areas' (Riegl and Luke 1997a).

- Leeward *Porites* assemblage

As implied by its title, this assemblage is typically found on the leeward side of reefs (Photo 1). Dominated by large *Porites* colonies, commonly *Porites lutea*. The genera *Pavona*, *Hydnophora* and *Favia* may characterized the reef edge.

Photo 1 Leeward *Porites* Assemblage

- *Millepora* current assemblage

This assemblage is dominated by *Millepora dichotoma*, and is typically exposed to strong currents but not significant wave action.

Seagrass meadows

Seagrasses are flowering plants able to live permanently in the marine environment and are represented by about 50 species within 12 genera. Eleven species of seagrass are known from the Red Sea (Sheppard *et. el.* 1992). Many species are wide spread, but *Halophila decipiens* is only been recorded from the Gulf of Suez and *Holphila ovata* from Jeddah, Saudi Arabia (Jones *et. al.* 1987). Most species are restricted to unconsolidated soft bottom areas that are shallower than 10 m. However, *Halophila stipulacea* and *Thalassodendron ciliatum* (Photo 2) have been found in waters exceeding 40 m.

At least seven species of seagrass (Table 1) are widely disturbed throughout the coastal waters of the CMA. Fifteen sites sampled in the CMA during the GEF project contained seagrass (Figure 2). As is illustrated in Figure 2, percent cover of seagrass varied significant among sites, as well as within sites[11].

[11] At each site, seagrasses abundance was recorded separately for subtidal area (at 5 and 10 m) and for intertidal areas (the front and back reef) (GEF 1997). Note that the species were not described for each site.

Photo 2 Seagrasses *Halophila stipulacea* and *Thalassodendron ciliatum*

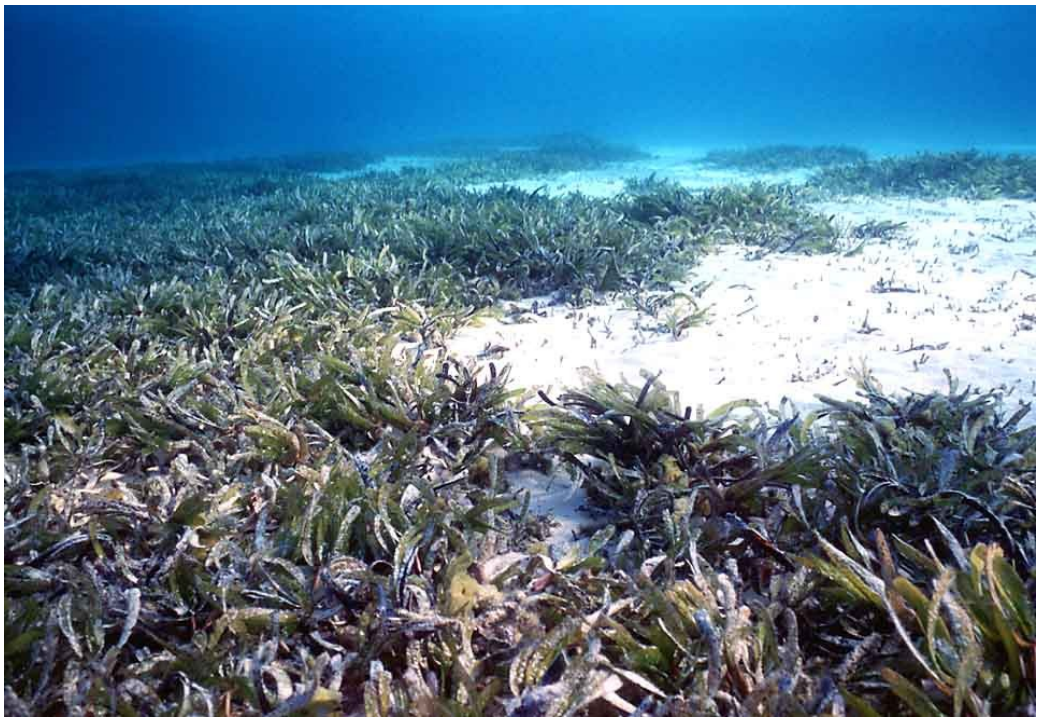


Table 1 Seagrass species reported from the CMA

Seagrass species	
Thalassia hemprichii	*Halophila stipulacea*
Thalassodendron ciliatum	*Halophila ovalis*
Halodule uninervis	*Syringodium isoetifolium*
Cymodocea rotundata	

Near Wadi Gemal, six species were observed within the small marsa adjacent to the Shams Alam Diving Centre (Dr Tony Rouphael, PSU, and Ali Sallam, EEAA, pers. obs. March 2003). The most widespread species appears to be *Halophila stipulacea*, which forms extensive monospecific meadows in waters between 6 and, at least, 45 m. Appendix A contains a recent report on the seagrasses of the WGHPA. Species of seagrass consumed by dugongs (*Dugong dugon*) in the Red Sea are: *Halophila stipulacea*, *Halodule uninervis*, *Thalassodendron ciliatum*, *Cymodocea rotundata* and *Syringodium isoetifolium* (Lipkin 1975).

Mangrove stands

Four species of mangroves have been reported from the Red Sea. Two species, *Avicennia marina* and *Rhizophora mucronata*, are known from Egypt. *Avicennia*

marina (Photo 3) is the more common. There are 28 mangrove stands[12] distributed along the Egypt Red Sea (Saenger 2002). Razek *et. el.* (1998a, 1998b) provided a description of the major mangrove stands and associated species in the CMA, while Saenger (2002) gave a more general description of all 28 mangrove stands found in Egypt.

Photo 3 Mangroves commonly found in Egypt

The CMA supports a significant proportion of the mangrove resources of Egypt. Nine mangrove stands (Table 2) and numerous isolated individual trees are recorded from the CMA (Figure 3). Included in this list is a stand of dwarf mangroves recently discovered by Dr. Mahmoud Hanafy, from a location 1 km north of the Shams Alam Resort. In addition, two stands are located on islands. Only *Avicennia marina* is found in the CMA. The closest population of *Rhizophora mucronata* is near Shalateen, over 100 km south of the CMA.

Table 2 Mangrove stands in the CMA

Location Name	Latitude and Longitude
Marsa Shakraa	25º 40’ 34º 35’
Shams Alam Resort	24º 40’ 35º 06’
Wadi Gemal	24º 40’ 35º 05’

[12] The Hamata mangroves are counted as one stand, although they form a discontinuous fringe along 12 km of coastline.

Location Name	Latitude and Longitude
Wadi Gemal Island	24º 40’ 35º 10’
Ras Baghdadi	24º 39’ 35º 06’
Hamata Mangroves	24º 18’ 35º 22’ – 24º 24’ 35º 15’
Shwareet Island	24º 21’ 35º 24’
Wadi Lahmi	24º 13’ 35º 26’
Quraat Hartway	24º 06’ 35º 29’

(Source: Saenger 2002; Dr. M. Hanafy, PSU)

Saenger (2002) observed that mangroves in Egypt are typically associated with coral fringing reefs, which provide protection from wind and waves. He also suggested that populations of *Avicennia marina* on the Egyptian Red Sea coast contain important genetic diversity not available in other populations on this species.

Intertidal pavement with algae

Intertidal pavement is a common habitat fringing the offshore islands and mainland coast. The dominant biota is algae, the most conspicuous being the browns, including *Turbinaria, Padina* and *Sargassum* and greens, such as *Halimeda*. Red algae (Rhodophyta) may also be abundant common in some areas. These marine plants play an important role in the functioning of marine ecosystems. Firstly, they are important primary producers. Secondly, some genera, such as *Halimeda,* contribute vast quantities of calcareous disks to the seafloor. Thirdly, coralline algae cement and consolidate the reef framework, and may provide important settlement locations for larvae of some marine organisms. About 500 species of benthic algae are known from the Red Sea. Razek *et. el.* (1998a, 1998b) described macro algae living near mangrove stands in the CMA. They found few species per site (typically less than 10) and reported red algae to be the most abundant macro algae.

Intertidal sand

Intertidal sand relates to soft sediments that are periodically exposed to air at low tide. The area of intertidal sand is small in the CMA and is typically restricted to sheltered areas along the mainland coast or on the leeward side of island fringing reefs where sediments can accumulate. According to Jones *et. el.* (1987) sediment in this habitat is usually poorly sorted due to the low tidal amplitude and the protection received from fringing reefs due to wave action. Jones *et. el.* (1987) also provides a detailed summary of the organisms of this habitat.

Subtidal sand

Subtidal sand is one of the largest habitats in terms of spatial extent. Like, intertidal sand, it supports numerous species of invertebrates that live on or beneath the sediments. These organisms are described in following sections. This habitat can be

subdivided into shelf and slope sands, but no studies have been done to characterise the subtidal sediment fauna of this region of Egypt, or how their abundance and distribution is influenced by water depth and its correlates.

Pelagic

This habitat includes the water column and ranges in depth from the surface to depths exceeding 1000 m near the CMA's eastern boundary. Weikert (1982) classified the central Red Sea water column into three zones based on zooplankton activity: epipelagic (0-100 m), mesopelagic (100-750 m) and bathypelagic (>750 m). It remains unclear whether these zones can be extrapolated to waters of the CMA because no studies have been done to describe the composition and abundance of plankton found in deep waters off the CMA.

3.2.2 Other marine flora and fauna

Zoo/phytoplankton

Sheppard *et. el.* (1992) provides a comprehensive, albeit dated, review of the plankton of the Red Sea. Razek *et. el.* (1998a, 1998b) gives a more recent description of the spatial distribution and community composition of phytoplankton adjacent to mangrove stands in the CMA. They found that phytoplankton was composed mainly of benthic diatoms. In contrast, Beltagi (1998) reported that water column phytoplankton of the northern Red Sea was mainly represented by coccolithophorids and dinoflagellates.

Khalil and El-Rahman (1997) recorded 62 species of zooplankton from surface waters off the Egyptian Sinai coast. Copepods were the numerically most abundant taxa, followed by meroplanktonic larvae. They noted that zooplankton abundance, in terms of number of individuals, peaked in winter.

Invertebrates (other than corals)

Tropical marine and coastal habitats support numerous species of sponges, jellyfish, crustaceans, molluscs, bryozoans and echinoderms. Over 2,441 species of molluscs, crustaceans and echinoderms, representing 279 families have been recorded from the Red Sea (JICA 2000). Some of these organisms, such as holothurians, play a critical role in nutrient recycling (Uthicke 2001), while others, such as sea urchins, can influence the distribution of marine habitats.

Seventy-six species of molluscs and 34 species of echinoderms were recorded during the GEF Project (GEF 1997). Of particularly significance is the occurrence of marine species in 'land locked'[13] coastal crevices near Marsa Ghaleb. Species found in the

[13] Although there is no surface water exchange between the crevices and the Red Sea, it appears that subsurface waters are linked. However, nothing is known of the flushing rate of waters in the crevices.

crevices include tunicates, the *Cassiopeia* jellyfish and the shrimp *Periclimenes pholeter* (Debelius 2000). Although the crevices are not located within the CMA, they require management to ensure human activities do no threaten these animals. Because, the crevices are within a short walk of the visitor centre at Marsa Ghaleb, they are at risk from being disturbed by human activity including diving, wind blown solid waste, ground water transported contaminants.

The reefs of the CMA support high densities of framework cavities that are likely to sustain high abundances of cavity-dwelling (coelobite) filter feeders. Richter *et. al.* (2001) suggested that reef coelobites are important in the trophodynamics of coral reefs.

Fishes

The Red Sea fish fauna has been extensively reviewed by Ormond *et. el.* (1984), Ormond and Edwards (1987) and Sheppard *et. el.* (1992). About 1000 species are known from the Red Sea (Sheppard *et. el.* 1992). Allen (in press) identified the Red Sea as the fourth most important global coral-reef fish hotspot in terms of the percentage of endemic species. His estimate was based on 900 species from the most specious families, of which 114 species (12.7%) are endemic to the Red Sea.

Two hundred and sixty-one species of inshore fishes, representing 89 genera, have been observed between Jernsa and Shalateen (GEF 1998a). Of these, 141 were found in the CMA (Photo 4).

Photo 4 Fish species of the Egyptian Red Sea

Marine Turtles

Five species of marine turtles have been recorded from the Red Sea: hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*), olive ridely (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*) and leathery turtle (*Dermochelys coriacea*). *E. imbricata*, and *C. mydas* are known to nest in the Red Sea, both of which have been recorded nesting in the CMA (Figure 4).

Photo 5 Evidence of Green Turtle Nesting at Umm Abass

In the CMA, green turtles are reported to nest on the mainland at Umm Abass (Photo 5) and Ras Baghdadi, and on Wadi Gemal Island and Siyul Island, in the Qulan Archipelago (Ali Salam, EEAA Hurghada, pers. comm. March 2003). Dr M Hanafy has also recorded five old nests approximately one km north of Sharms Alam Resort (pers. comm. April 2003). According to Ali Salam, EEAA Hurghada, green turtles nest in Egypt from May to November (pers. comm. April 2003). The distribution of hawksbill nesting locations in the CMA is less clear. Dr Sherif Baha El Din, of EEAA, believes that this species may nest on Wadi Gemal Island (pers. comm. January 2003), and Ali Salam, EEAA Hurgahda, mentioned that a small number nest on Ras Baghdadi (pers. comm. March 2003). Frazer *et. el.* (1987) reported that hawksbill nested from April to July in Egypt. Figure 4 shows the known major turtle nesting beaches in the CMA.

Dugongs

The dugong (*Dugong dugon*)[14] is widely distributed in the Red Sea (see cited literature in Preen 1989), but densities are not homogeneous throughout its range. For example, the most important dugong populations in Saudi Arabian Red Sea waters are concentrated in three areas with a mean density of 0.22 ± 0.04 SE dugong per km². This density is comparable with eastern Australia, where dugongs are still common.

The distribution and abundance of dugong in Egyptian waters has not been assessed in detail. Gohar (1958) collected specimens from near Hurghada. Riegl and Luke (1997a) reported that dugongs regularly occur in areas south of Ras Banas, and isolated populations existed at Safaga Bay, Umm Redj and Marsa Embarak. Dugongs are also commonly observed in waters near Wadi Gemal (Kirsten Ehlert, Manager, Shams Alam Diving Centre, pers comm. December 2002). In March 2003, Dr Tony Rouphael, PSU, and Ali Salam, EEAA, observed a dugong swimming in shallow waters opposite the Shams Alam Resort near Wadi Gemal. The area where the dugong was swimming had seagrass meadows composed of *Syringodium* and *Halodule*, and large monospecific meadows of *Halophila stipulacea*. The most recent dugong sightings were a juvenile (≈1.5 m in length) swimming close to the fringing reef adjacent to Shams Alam Resort and an adult (≈ 3 m in length) near Ras Baghdadi (Kirsten Ehlert, Manager, Shams Alam Diving Centre, pers. comm. April 2003).

[14] This species is listed as vulnerable to extinction at a global scale by the IUCN.

Mohammed Abdel Gheny, EEAA Hurghada, maintains a register of dugong sightings in Egyptian Red Sea waters. Recent sightings of this species in the CMA are shown in Figure 4. Also shown is the location of dugong feeding trails. Feeding trails, created when dugongs feed on seagrass rhizomes, were observed in *Halodule uninervis*/*Halophila ovalis* meadows at Umm Abass (Photo 6) and Ras Baghdadi (Dr Tony Rouphael, pers. observ. April 2003). According to Preen (1993) *Halodule* and *Halophila* are the preferred food because of their relatively high nutritional value.

Photo 6 Duogong Feeding Trail

Cetaceans

Gladstone and Fisher (2000) listed thirteen species of cetacea from the Red Sea. These include the common dolphin (*Delphinus delphis*), bottlenosed dolphin (*Tursiops truncatus*) and pilot whale (*Globicephala* spp.). The Bryde's whale (*Balaenoptera ednei*) has been reported from the Farasan Islands off southern Saudi Arabia. A fourteenth species, the humpback whale (*Megaptera novaeangliae*), was photographed off Ras Mohamed, Egypt in the 1990s (Debelius 1998).

The number of cetacean species and their status in the CMA remains unknown. The spinner dolphin (*Stenella longirostris)* appears to be common in many areas of the CMA. Four subspecies of *Stenella longirostris* have been described worldwide (Perrin 2002). The subspecies status of the Red Sea population remains unknown, but is

currently retained under *Stenella longirostris longirostris*. This species is listed as 'conservation dependent' in the IUCN Red List.

Seabirds

Baha El Din (1999) and Baha El Din *et. al.* (2003) reported two important seabird nesting locations in the CMA: Wadi Gemal Island and the Qulan Archipelago (Figure 4). The species known to have nested on Wadi Gemal Island or on the Qulan islands are listed in Table 3.

Table 3 Important nesting locations and nesting species

Wadi Gemal Island	
Red-billed tropic bird	Sooty falcon
Green-backed heron	Hemprich's gull (sooty gull)
Reef heron	White-eyed gull
European spoonbill	Caspian tern
Osprey	White-cheeked tern
Crab plover (possibly nest on the Island)	
Qulan Islands	
Red-billed tropic bird	Sooty falcon
Green-backed heron	Hemprich's gull
Reef heron	White-eyed gull
European spoonbill	Caspian tern

(Source: Baha El Din 1999; Baha El Din *et. al.* 2003)

3.3 Social description

3.3.1 Cultural and social settings

The indigenous people of the area between the Nile River and the Red Sea are the Beja (also referred to as Bedouin), who are predominantly camel pastoralists (Horton 1987). However, one group of Beja, called the Ababda, is mainly fishermen. Horton (1987) suggested that the Beja are the direct descendants of the early pastoral groups that have been resident in the region from about the first centaury AD.

A detailed description of the Ababda settlement at Qulan Bay has recently been prepared (anonym. 2003). Composed of 16 nucleus families, the settlement was established about 40 years ago. The settlement supports about 52 people, most of who participate in the fishing industry. Sheep and goats are an important component of the local economy. Because of its small size, the settlement has not health or educational facilities.

3.3.2 Archaeology

Sidebotham (2003) provided a succinct summary of the archaeological sites in WGHPA. He recorded 38 sites ranging in date from Ptolemaic to Islamic. The sites include road stations, some of which are fortified wells, highways and mines. His report also contains recommendations to protect these sites from visitors. There are no published accounts of marine archaeological sites in the CMA.

3.3.3 Socio - economic activities

Urban and industrial development

Figure 5 illustrates the population and industrial centers in and adjacent to the CMA. Marsa Alam (Photo 7) has approximately 1500 residents (Gomma 2001) making it the largest centre of human population adjacent to the CMA**.** The residents work in the mining and fishing industries and, more recently, tourism. However, there are no resorts in the city Marsa Alam. Hamata, situated about 100 km south of Marsa Alam, has the second largest human population in the region. According to the city administrator, Mr Nassar El-din Murad, Hamata has a population of 250-300, most of whom are Ababda (pers. com. December 2002). Many of the Ababda participate in commercial or semi-subsistence fishing.

Photo 7 Town of Marsa Alam

Abu Ghuson is a harbor town located 80 km south of Marsa Alam. Mr Mahmoud M. Aly, the Harbor manager, reported that the current population is 150 and most of who service the Harbor and quarries in the adjacent hinterland (pers. comm. December 2002). Smaller population centres (<100 people) adjacent to the CMA include Marsa Ghaleb Harbor and at least five permanent Ababda villages (Figure 5). There are also

numerous small coastguard outposts along the coast. About 40 km north of the CMA is the historical city of El Quseir, which has about 22,000 people who work in the fishing, mining and livestock industry (GEF 1998b). Port Bernice is situated south of the southern boundary of the CMA. Approximately 100 km south of Port Bernice is the town of Shalateen, which has a population of about 1000 people.

Coastal tourism development

The TDA is targeting the mainland opposite the CMA as a high priority area for coastal development. Since its inception in 1989, the TDA has already allocated large areas adjacent to the CMA for resort development (Photo 8). Developers have been quick to take advantage of this opportunity and have, as of June 2003, already opened or commenced building 29 resorts or lodges between Ras Toronbi and Marsa Alam (Figure 5). South of Marsa Alam, resorts are more dispersed. About 12 resorts have been built or are under construction. The most southerly resort is situated at Wadi Lahmi Bay, approximately 120 km south of Marsa Alam.

Photo 8 Resort Development Adjacent to the CMA

Importantly, Marsa Alam, including coastal lands 14 km north and south of the town, is under the jurisdiction of the Red Sea Governorate. Therefore, urban and tourism planning in the Marsa Alam region is controlled by the Red Sea Governorate and, thus, is independent of the TDA. Various population growth scenarios indicate that the population of the Marsa Alam region in 2025 could range anywhere from 4000 to 32,000 (ICP 2000/2001; cited in Gomaa 2001).

Harbors[15]

There are four Harbors in the CMA: Abu Ghuson; Marsa Alam, Hamata and Marsa Ghaleb (Figure 5). Abu Ghuson is the only Harbor that caters for bulk carrier vessels. According to Mr Mahmoud M Aly, the Harbor manager, about 25-bulk carriers dock and load illmenite and quartz per annum (pers. comm. December 2002). Loading of phosphate stopped in 2000. Abu Ghuson Harbor consists of a concrete breakwater built on the northern reef flat of a marsa. This breakwater shelters vessels from the prevailing northwest winds. Safari or fishing boats may occasionally moor in the Harbor.

The Harbor at Marsa Alam caters principally for safari and day boats. It is a natural 'Harbor' within a fringing reef. It is large enough to shelter 25 day/safari-sized boats at the same time (Dr Tony Rouphael, pers. observ. April 2003). Tourists are transferred to vessels via tenders. There are no on-site boating facilities, except a small causeway that allows road access to deep water off the reef edge. Water and fuel can be trucked in from the town. A smaller Harbor, which caters for fishing boats, is located at the southern edge of Marsa Alam.

The Harbor at Hamata caters principally for safari and day boats. The Harbor consists of a solid, concrete causeway, approximately 3 m wide, which crosses the 300 m wide reef flat. The causeway allows trucks to supply water and fuel to vessels moored close to the reef flat edge.

According to Dr. Mohamed M. Abou Zeid, the Red Sea Governorate is proposing to dredge Marsa Alam Harbor to permit larger vessels (pers. comm. February 2003). Similarly, the Hamata Harbor causeway will be repaired because it is slowly eroding and subsiding into the reef flat. Dr. Abou Zeid reported that sewage disposal facilities are proposed for both Harbors, which will allow vessels to dispose of their waste on land.

A Harbor has recently been constructed at Marsa Ghaleb (Photo 9), approximately 50 km north of Marsa Alam. It is an inland Harbor in that heavy machinery was used to excavate a large basin (20,000 m²) on the mainland, which was eventually flooded to a depth of 6 m. Like, Marsa Alam, it caters principally for tourist vessels. As yet, very few vessels use the facility, apparently because of its expense. Fuel can be purchased at the Harbor and, for a fee, solid waste can be collected and disposed. According to Captain Sherif Fawzy, the manager of the Marsa Alam Harbor, the current Harbor represents Stage 1 of a six-stage project (pers. comm. Dec. 2002). He said that the Harbor would eventually be expanded and doubled in size. Expansion will include widening the Harbor but it will not be deepened. A description of the Harbor at Marsa Ghaleb, and the proposed expansion can be found at: www.portGhaleb.com

Photo 9 Marsa Ghaleb Harbor

[15] The terms Harbor, marina and port appear to be used interchangeably in the region. For consistency, the term Harbor is used for Abu Ghuson, Marsa Alam and Hamata.

Shipping and boating

Three categories of vessels operate in the CMA: bulk carriers, fishing, tourist and leisure vessels. About 25 bulk carriers use the Abu Ghuson Harbor per annum. These are relatively small bulk carriers with maximum net loading capacity of 10,000 tonnes. The shallow Harbor prohibits larger vessels.

Barrania and Ibrahim (2003) reported that 71 fishing vessel, from seven landing sites, operating in the CMA. The vessels include: 'deck boats' ranging in size from 10-15 m with inboard motors; and small deck boats ranging in size from 6-7 m with outboard motors or with sails and oars.

According to the Maritime Inspection Bureau (MIB) in Hurghada, there are 2599 tourist, leisure, fishing and other small coastal vessels operating in the Red Sea[16]. Approximately 35% (910) are tourist vessels. Unfortunately, because the MIB does not record where vessels are based or where they can operate, it is impossible to accurately determine the number of vessels active in the CMA. However, it is a requirement of vessel operators to register with the local Coastguard each time the vessel leaves a Harbor. At the time of writing, vessel activity based on Coastguard records was not available.

The two most common forms of tourist vessels operating in the CMA are safari boats and day boats (Photo 10). Safari boats carry tourists on extended trips (> 6 days), while day boats return to their home harbor each day. Day boats typically do not range beyond 30 km of their Harbor. Not surprisingly, day boats are smaller (< 25 m) than safari boats, which require bunks and considerable storage space.

The actual number of safari boats operating in the CMA and or based in Marsa Alam and Hamata remains unknown. According to Mr Amra Ali, HEPCA, 68 and 10 safari boats operate out of Marsa Alam and Hamata respectively (per comm. March 2002). General Moustafa Basiouny, the mayor of Marsa Alam, reported that 20 safari boats are permanently based at Marsa Alam (pers. comm. December 2002). Kohn (2000) stated that 38 safari boats operated between Marsa Alam to Sataya in the far south.

[16] Maritime Inspection Bureau April 2003.

Photo 10 Day Boats and Safari Boats

The spatial and temporal patterns of tourist boat activity in the CMA are not clear. A preliminary survey undertaken in February 2003 by EEAA rangers provides some insight. Day boats operating out of Hamata range north to Qulan Archipelago and south to Dolphin Reef. The most commonly visited locations are Siyul Island, Abu Galawa and Dolphin Reef (Mohamed Galal and Mohamed Besser, EEAA Marsa Alam, April 2003). In Marsa Alam, day boats range north to Elphinstone Reef and south to Dolphin House. Safari boats based in Marsa Alam and Hamata range as far south as Saint John's Reef east of Shalateen. Other locations visited during these trips include Mikauwa/Horseshoe Reef, Dolphin Reef and Wadi Gemal Island.

SCUBA diving and snorkeling

Marine-based tourism is an important source of international revenue for countries bordering the northern Red Sea. For example, over 400,000 tourists visit Egypt's Ras Mohamed National Park each year (Ormond *et. al.* 1997). The main attractions of the northern Red Sea are the warm turquoise waters and the extensive coral reefs that fringe its coastline.

Two of the most popular forms of marine-based tourism are SCUBA diving and snorkeling. Herman (2003), based on numerous sources, provided estimates of the number of dive and snorkel trips for three regions of Egypt (Table 4). Of particular interest, he reported that from 2000 to 2001, Marsa Alam witnessed a 2014% increase in diving days (Table 5).

Table 4 Dive and snorkel trips (estimate) on the Egyptian Red Sea

Variable	Sharm El Sheikh	Hurghada	Marsa Alam	Egypt - total
Total number of dives	1,306,985	727,083	556,036	4,164,171
Total number of snorkel trips	871,323	654,375	74,851	3,046,446

(source: Herman 2003 and cited literature)

Table 5 Diving days in 2000 and 2001 (estimate) on the Egyptian Red Sea

Variable	Hurgahda	Marsa Alam	Rest of Red Sea	Egypt - total
Total 2000	440,139	4,188	166,421	610,748
Total 2001	345,462	88,549	118,132	552,143
Change	-22%	2014%	-30%	-10%

(source: Herman 2003 and cited literature)

Dive sites are not evenly distributed throughout the CMA but are concentrated in the main shoals. For example Ocean-Pro, Lahmi Bay, take divers to 23 sites in the Fury Shoals and the Sharms Alam Dive Center provides access to 36 dives just in the Wadi Gemal Area[17]. Marsas are important diving sites on the mainland because they provide safe access to deep water (Photo 11). The intensity of diving activity in the CMA remains unknown.

Photo 11 Divers at a Marsa

Other tourism activities

Other popular marine based activities in the CMA are reef walking and swimming. These activities are undertaken at the mainland dive sites listed above as well as opposite coastal resorts. The frequency and intensity of these activities in the CMA remains unknown.

Offshore petroleum activity

Much of the CMA is included in petroleum exploration concession areas (Figure 7). The concessions belong to the National Petroleum Company and the Multi Company. At least one exploratory well has been drilled in the waters of the CMA, but oil was not detected (Coleman 1993, Table 8.1, page 140). There are no producing wells in the CMA.

[17] These numbers came from dive site maps provided by these companies (March 2003).

Fishing

Barrania and Ibrahim (2003) provide a comprehensive description of the status of fisheries in the CMA. Two groups target fisheries resources in the CMA: local fishermen (Ababda) and migratory fishermen from other governorates. Traditional local fishermen are increasingly leaving the industry for more lucrative opportunities in the dive and hotel industry. The principal fishing methods used by the traditional fishermen are handlines, gill nets and trammel nets. The new settler fishermen from the Fayoum Governorate, who are replacing the traditional fishermen, have less knowledge about the local ecology and sustainable fishing practices. For example, the settler fishermen use illegal gill nets called 'sabeeb', which have smaller mesh size than that stipulated by the law. Figure 8 shows the distribution of fishing activity in the CMA.

There are seven fish landing sites in the CMA: Marsa Alam old jetty (20 boats); Marsa Alam Harbor (20 boats); Kils 23 South Marsa Alam (2 boats); Sharm El Luli (11 boats); Qulan Village (4 boats); Hamata Harbor (10 boats) and Sataieh (4 boats) (Figure 8). The total tonnage taken from the Marsa Alam to Ras Banas area was estimated at 500 for 2002. The dominant catch in this area include mullet; mojarras and parrotfishes.

A recent report has described the fishing activities of the Ababda from the Qulan village (Anonym. 2003). Fishing is done from boats or from the shore using nets. The village has four boats, one of which is motorized. All the boats are registered at El Quseir and the fishermen are members of the El Quseir fishing cooperative. The Ababda reported that fishing resources had diminished and that they needed to go further away to maintain catches. The fishing season is in summer and last for about 6 months. At the peak of the fishing season, the catch can range from 100 to 150 kg per week per boat. The report did not indicate the target species.

4. Management Issues

This section identifies and reviews current and emerging management issues relating to the CMA. It identifies threats to key values of the CMA; where the threats are occurring and originating; and what are the observed and potential ecological consequences of these threats. For the purpose of this Plan, threats to the biological and social values are confined to existing threats and threats likely to occur during the life of this Plan and manageable within the context of the CMA. By definition this excludes such threats as the world-wide warming phenomenon and most other forms of natural disturbance. Agents of natural disturbance that occur periodically in the CMA include flooding, disease and crown-of-thorns starfish. These are not addressed in this Plan because the management focus is to ameliorate the effects of humans on the natural environment.

4.1 Current Management Issues

The current management issues in the CMA fall into six broad categories:

- Habitat destruction
- Exploitation of living marine resources
- Threatened species
- Ship-originated pollution
- Land-originated pollution, and
- Indigenous people

We have used the above titles rather than, for example, coastal development, fisheries, or tourist activities because all these activities can, potentially lead to habitat destruction. Thus, it is easier to address issues relating to habitat destruction in the same section. Another reason is that ‘coastal development’ is not necessary a management concern if it is planned and managed appropriately. Indigenous people are included here because they rely to certain degrees on the natural resource of the CMA and should be considered in the management of the area. Importantly, modernizing of their fishing and grazing practices may also compromise the biological values of the CMA.

4.1.1 Habitat destruction

Habitats currently at most risk from direct human disturbance are coral reefs and mangroves. Anchors, anchor chains, mooring cables/wires and SCUBA divers can break corals, however damage is typically localised to areas where tourist boats can safely moor such as leeward side of reefs and marsas. Seagrasses are also vulnerable to disturbance by anchors and anchors chains. Benthic marine organisms in marsas are particularly susceptible to human impacts because they attract high levels of human use. Marsas provide divers and snorkelers with easy access to deep water, and attract vessels because of their sheltered waters. Intertidal reefs are threatened by illegal or legal building activity, the later associated with Harbor construction. Camel grazing and wood harvesting threaten mangroves.

Anchoring

Most tourist vessels operating in the CMA must, at some time, remain stationery near reefs or other features that tourists wish to view. Anchoring or mooring are two ways that vessel remain temporarily fixed at a given location. Unfortunately, anchors and anchor chains are potential sources of coral reef damage. Anchors can break, crush or push over coral colonies. Anchors and their chains can crush, severe and scour other sessile benthic organisms such as soft corals and seagrasses.

Riegl and Luke (1997b) listed 20 locations where vessels anchored or moored in the CMA (Table 6). Since this publication most of the locations listed by Riegl and Luke (1997b) have moorings. All reefs where mooring buoys have been installed in the CMA are shown in Figure 9. In addition, there may be other areas in the CMA where vessels continue to anchor or cable moor because of the absence of buoy moorings. The rates of vessel visitation given Riegl and Luke (1997b) have almost certainly increased because, since 2001, safari boats have been operating out of Marsa Alam and Hamata, and many new resorts have there own day boats.

Table 6 Known locations where vessels regularly anchor in the CMA

Location	Latitude / Longitude
Ras Toronbi	25 39.69 N 34 35.24 E
Marsa Ghaleb	25 31.95 N 34 38.56 E
Umm Rus	25 30.80 N 34 39.22 E
Shaabrur Abu Dabab	25 20.42 N 34 47.66 E
Abu Daba 5	25 19.52 N 34 47.92E
Abu Hamra (Elphinstone)	25 18.41 N 34 51.68 E
Shaab Samadai	24 59.04 N 35 00.19 E
Habili Samadai	24 58.84 N 35 00.08 E
Neckarie	24 56.74 N 34 59.05 E
Ghadeira Umm Halhalla	24 51.77 N 35 03.77 E

Location	Latitude / Longitude
Ghadeira Douani	24 50.30 N 35 01.94 E
Erg Ghadeira 1	24 50.03 N 35 04.33 E
Shaab Sharm	24 47.34 N (E not given)
Shaabrur Wadi Gemal	24 39.71 N 35 07.99 E
Erg Dynamite (Wadi Gemal)	24 38.37 N 35 10.88 E
Ras Honkorab	24 33.60 N 35 10.19 E
Ranga	24 24.78 N 35 15.45 E
Shaab Mahsur	24 14.48 N 35 39.10 E
Shaab Sattaia	24 10.00 N 35 40.75 E
Gota Marsa Alam	24 04.25 N 34 56.33 E

Jones (2002) provided a detailed description of the history of boat mooring installation in the Egyptian Red Sea. In 1992 managers of fifteen-dive centres in Hurghada established HEPCA. A primary goal of HEPCA was the installation of moorings at the most frequented coral reefs in order to stop coral damage attributable to boat anchors. Jones (2002) reported that, from 1992 to 1999, over 500 moorings were installed between Hurghada and Shalateen. However, by 1999 almost 80% of the moorings in the south were no longer operational. Unfortunately, in late 1999, USAID temporarily stopped funding HEPCA's mooring program, and installation and maintenance practically stopped.

In 2002, the Egyptian Environmental Policy Program – Policy Support Unit (EEPP-PSU) staff in Hurghada recognised the urgent need to install new moorings or replace damaged moorings on reefs south of El Quseir. In December 2002 the EEPP-PSU, in partnership with EEAA, HEPCA and the Red Sea Governorate, commenced the installation of moorings at several locations between El Quseir and Ras Banas, an area corresponding to the CMA. At the time of preparing this report 78 moorings, 76 pin and 2 mantas, have been installed, mainly in the Fury Shoals (Admiral Nader, PSU, pers. comm. February 2003). The 76 pin moorings were installed on both the reef flat 'reef-top pins' or the reef floor 'reef-floor pins'.

In areas without buoy moorings, many boat crews temporarily moor their vessels to reefs using steel cables (attached by rope to a vessel) that are looped around large coral colonies or through crevices in the reef. This method, hereafter 'cable mooring', is used because boat crews believe that it causes less physical damage to corals than anchoring. Whether this method of mooring is less damaging than anchoring remains debatable. Some stockholders, such as Ross McGrath, site manager of Red Sea Dive Safaris Wadi Lahmi Bay, claims that the method is extremely damaging to corals on the reef edge and upper reef slope (pers. comm. December 2002).

Reef flat development

The amount of damaged reef flat in the CMA is minimal compared with the damage done in Hurghada. Disturbance has been caused by the construction of breakwaters, artificial lagoons, jetties, shipwrecks and major reef excavation at Marsa Ghaleb. Figure 10 illustrates where the reef flat has been impacted in the CMA. EEAA enforcement has generally been rigorous, and infilling of reef flats is uncommon. Incidents of infilling include the breakwaters at Abu Ghuson Harbor and Hamata Harbor.

Construction of the Harbor at Marsa Ghaleb resulted in the destruction a large area of reef flat and slope at the Harbor entrance. In addition, suspended sediments may have disturbed coral communities down current of the Harbor. Disturbance of intertidal areas has also been caused by the illegal construction of 'lagoons' on reef flats adjacent to some hotels. In many areas of the CMA, the reef flats are wide (>500m) and do not have lagoons. This greatly limits access by tourists to deep water where they can swim or snorkel. Therefore, a few hotel owners have illegally constructed artificial lagoons on the near shore section of the reef flat. Artificial lagoons are excavated using heavy machinery, and can be up to 20 m long a 2 m deep. In addition to permanently damaging intertidal habitats on the reef flat, the new lagoons may become a chronic source of suspended sediments.

As reported earlier, the Red Sea Governorate is proposing to dredge the Marsa Alam Harbor. Not only will this have a direct impact on subtidal benthic organisms in the dredge zone, but the resulting sediment plumes may impact adjacent reef flats organisms. Another potential source of reef flat disturbance is infrastructure in wadis. A major flash flood would not only possess a threat to human life, but could result in large amounts of concrete and other construction material being deposited on the reef flat or reef slope.

Marine tourism activities

The environmental impacts of tourism fall in two broad categories. First there are impacts associated with tourism support facilities such as hotels, marinas, roads and airports. Poor environmental management of hotel and marina construction, for instance, has increased sedimentation on coral reef flats and increased turbidity of near-shore waters in Egypt and Jordan. These effects have contributed to widespread mortality of corals and other benthic organisms off Hurgadah, Egypt and Aqaba, Jordan. Second, there are impacts associated with the activities that tourists undertake during a visit, such as reef walking, boating, snorkeling and SCUBA diving. These activities can result in localized physical destruction of corals even under low levels of use.

SCUBA divers, snorkelers and reef walkers are a potential chronic source of disturbance to corals and other benthic organisms. The effects of diving, in particular, have been well described in Egypt (Hawkins and Roberts 1992, 1993, Jameson *et. al.* 1999) and other regions of the world. Divers, snorkelers and reef walkers can damage corals and other marine organisms through direct physical contact with their hands,

body, equipment and fins. Although, most divers make physical contact with the seafloor during their dive, only a small proportion of divers damage coral. Talge (1990) reported that 90 % of 206 Florida divers contacted the seafloor but only 2 % caused discernible damage. In Australia, Rouphael and Inglis (1995) reported that 70 % of 250 divers contacted the substratum, yet only 15 % damaged corals. Damage usually resulted from divers inadvertently kicking corals with their diving fins.

Most damage caused by individual SCUBA divers is relatively minor. A single fin kick can crush or sever the tips of branching corals or abrade corals, but is unlikely to kill a large coral colony. Corals have an ability to regenerate tissue over small injuries and recover quickly from the loss of apical branch tips. Meek (1982) and Kobayashi (1984), for example, reported broken tips of corals repairing within two months of injury. Nevertheless physical damage can kill small colonies (Loya 1976) and repeated physical injury can impair the regenerative capacity of corals potentially leading to colony mortality. There is some evidence that the cumulative effects of diving have modified the structure of fragile benthic assemblages (Garrabou *et al.* 1998, Hawkins *et al.* 1999).

Grazing

Camels feed on mangroves in the CMA. Some stands show evidence of significant grazing pressure such as ‘grazing lines’ on tall trees and cropped foliage on smaller trees. Dead adult mangrove trees were observed at the Hamata stand located close to the Red Sea Diving Safari Camp at Wadi Lahmi (Tony Rouphael, PSU-EEAA, per obs. December 2002). However, the cause of mortality remains unknown.

Saenger (2002) reported that Egypt’s Red Sea mangroves were under threat from land filling, deterioration of water quality due to the landward garbage dumping, hydrocarbons, altered hydrology, intense grazing and solid waste. He also concluded that litter is a problem at virtually all sites, and that overgrazing and wood cutting are of particular concern at more southerly stands.

The long-term effects of grazing and trampling of mangrove stands and other vegetation types remain unknown. Propagules are likely to be trampled by camels and soil compacted. Distinct camel and human tracks were clearly evident in mangrove stands and the *Zygophylum* communities near the Qulan Village.

Mangrove cutting

There is evidence that people are cutting and collecting mangrove wood. Coastguard personnel were recently observed collecting mangrove wood near Hamata (Sherif Baha El Din, PSU-EEAA, pers. obs. June 2002). The Ababda at the Qulan Village informed Ayman Mohamed Gomaa (EEAA Manager, December 2002) that Coastguard personnel collect branches of mangrove trees. The frequency and intensity of cutting by Coastguard personnel and other people remains unknown.

Boat groundings

According to Ayman Mohamed Gomaa, EEAA, about 20 boats per annum run-aground on reefs in the Egyptian Red Sea. These range in size from small wooden fishing vessels (<6 m) to bulk carriers.

Development of marsas

A marsa is a natural bay usually at the mouth of a wadi. It is an uncommon feature in the CMA. For example, between Marsa Alam and Wadi Lahmi there are only 8 marsas, including Sharm El Luli. Marsas have significant ecological and social value. Their sheltered waters provide ideal environments for *Halophila ovalis*/*Halodule uninervis* meadows, which appear restricted to shallow water (<10 m) in the CMA. Marsa may also support unique coral assemblages because wave exposure is a major factor influencing the abundance and distribution of scleractinian coral. DeVantier *et. al.* (2000) described four coral communities from Saudi Arabian Red Sea waters, of which one, characterized by the scleractinian corals *Montipora spumosa* and *Pavona decussata*, was restricted to marsas and other shelter areas. Marsas also provide divers, snorkelers and swimmers with easy and safe access to deep water.

Resort developers target marsas because they provide safe anchorage/mooring for day boats and are some of the few areas with sandy beaches. Resort construction and operation near marsas pose a serious threat to corals and seagrasses. Increased suspended sediment, associated with construction activity, and elevated nutrient loads, attributed to septic systems or direct sewage discharge from vessels, may stress these organisms, particular in semi enclosed water bodies where flushing is limited. Boats may also damage coral and seagrasses through grounding or anchoring. Further, anti-fouling paints on boats and oily ballast water may contaminate sediments and waters.

4.1.2 Exploitation of marine resources

The unmanaged harvesting of fish and invertebrates within the CMA could have long-term ramification on the marine ecosystem. Unfortunately, there is limited information of the status of fisheries in the area or information on the direct and indirect environmental effects of the fisheries.

Fishing

Ababda and itinerant commercial fishermen fish in the CMA using a variety of methods. The intensity of fishing effort and their effect on local populations of target and by-catch species remains unknown. However, fishermen at the Qulan Village reported that local fisheries resources had diminishes, and that they were forced to travel greater distances to seek new fishing grounds. Other studies have indicated that Bedouin fishermen can significant effect local fish stocks. Galal *et. el.* (2002) reported that fishing by Bedouins in Nabq Natural Protected Area, south Sinai, had led to a significant decrease in the abundance and mean length of some serranids and lethrinids. The long-term effects of human induced change in the composition of reef

fishes or modification of trophic structures remain unknown. Long-term studies suggest that the loss of herbivores can contribute to shifts in the composition of sessile benthic organisms.

Barrania and Ibrahim (2003) reported that new settler fishermen in the CMA have introduced gill nets named 'sabeeb' that have smaller mesh size than that legally permitted. They also use ring nets on corals that can lead to physical destruction of this habitats.

Riegl and Luke (1997b) reported evidence of wide spread use explosive fishing techniques in and adjacent to the CMA. Explosive fishing kills non-target species, including corals and other habitat-forming species. It remains unknown whether explosive fishing is still done in the CMA. EEAA rangers reported that very small number of fishermen may still use explosives in the region of Marsa Alam and that the practice is non-longer widespread (EEAA Rangers, Marsa Alam, pers. comm. 2002).

Invertebrate harvesting

Since about 1999 the trade and selling of marine curios, such as corals and shells, has been greatly curtailed in Hurghada, Safaga, El Quseir and Marsa Alam. This has been achieved through enforcement of laws restricting the harvesting of these products. However, large numbers of dead and broken *Lambis* shells in the CMA indicate it is still heavily harvested (Tony Rouphael, pers. comm. June 2002). The animal is harvested for its meat, but the scale of harvesting remains unknown. It also remains unknown whether the meat is sold commercially.

About fifty species of sea cucumbers (Holothuriidae) are known from the Red Sea. According to Dr Mahmoud Hanafy (PSU-PPSS, Hurghada), rampant poaching and over harvesting by licensed fishermen have lead to the commercial extinction of the most commercially valued species (pers. comm. January 2003). The status of all species in the CMA remains unknown. The long-term ecological consequence of reduced numbers of benthic feeding sea cucumbers from the region is difficult to predict. Uthicke (2001) described sea cucumbers as benthic recyclers and suggested that the presence of high densities of these animals can stimulate the production of the microphytobenthos. Recovery of decimated populations may take many decades, particular for species heavily reliant on asexual reproduction to maintain abundances (Dr. Uthicke, Australian Institute of Marine Science, pers. comm. February 2003). Further, he does not advocate relocation of holothurians to overexploited fishing rounds unless genetic studies show that the relocated specimens are of the same genetic stock.

4.1.3 Threatened species

This section relates to the disturbance of seabirds, marine turtles, cetaceans and dugongs.

Disturbance of nesting marine turtles and seabirds

Humans have the potential to disturb nesting marine turtles and seabirds. People walking or campfires may deter female turtles from nesting. Large pieces of solid waste, such as pallets or large lengths of timber, on nesting beaches may act as barriers to nesting turtles. Similarly, humans walking in or adjacent to an activity rookery may alter the behavior of adult birds to the detriment of the young. Introduced animals, such as rodents or cats, may prey on eggs, recently hatched birds or on adult birds.

The intensity and frequency of human visitation to islands in the CMA remains unknown. An old campfire and considerable amounts of household waste was observed on Mahabis Island, Qulan Archipelago. In the same area, fishermen have built small accommodation huts and tables for drying fish on Siyul Island. Wadi Lahmi Resort offers day trips to Qulan Archipelago, where visitors are permitted to explore islands such as Mahabis Island. Mrs Kirsten Ehlert, manager of the Wadi Gemal Dive Centre, reported that she infrequently takes birdwatchers to visit Wadi Gemal Island in spring and autumn (pers. comm. December 2002). She also suggested that human visitation to the island and the collection of bird eggs by fishermen had resulted in extensive mortality of eggs and young birds during the previous nesting season.

Marine mammal/tourist interactions

In the CMA, interactions between spinner dolphins (*Stenella longirostris longirostris*) and snorkelers occur at Dolphin House (Shaab Samadai) and Dolphin Reef (Shaab Sattaia). The frequency of boat visits to both reefs and the number of snorkelers interacting with the dolphins remains unknown. However, up to 18 vessels have been recorded at Dolphin House on the same day (Kirsten Ehlert, Wadi Gemal Dive Centre, pers. comm. April 2003). According to Ayman Mohamed Gomaa (pers comm. February 2003), the EEAA in cooperation with local diving operators have implemented a strategy to limit the disturbance of the resident dolphins at Dolphin House: the strategy includes capping the number of visiting boats to 12; prohibiting vessels from entering the lagoon and prohibiting snorkelers from touching the dolphins. The success of this strategy has not been assessed nor is there a permanent management presence at the reef to ensure compliance with the regulations. In addition, tourists have been reported diving or snorkeling with dugongs off Wadi Lahmi and Wadi Gemal. The effects of these interactions on individual dugongs remain unknown.

By-catch and boat strikes

Dugong and turtles are vulnerable to being caught and drowned in large mesh (150 mm and greater) fishing nets, and being hit by fast moving boats. The frequency of such occurrences in the CMA and in other areas of Egyptian Red Sea remains unknown. During their field survey along the Egyptian Red Sea in March 2003, Barrania and Ibrahim (2003) photographed on separate occasions marine turtles caught in fishing nets.

4.1.4 Ship-originated pollution

Lintner *et. el.* (1995, cited in PERSGA 2001) reported that 25,000 to 30,000 ships pass through the Red Sea annually. Evidence of illegal dumping of oily substances can be found throughout the CMA (Hassan 1998). This includes weathered crude oil on beaches and oil stained rocks. Gomma (2001) suggested that Marsa Ghaleb Harbor is a chronic source of spilt fuel for areas south of it. However, it remains unknown whether the source of spills is associated with the fuelling facility or with discharged ballast water. Captain Sherif Fawzy, manager of Marsa Ghaleb Harbor, suggests that the main source of petroleum hydrocarbons into the Harbor is associated with discharged generator cooling water. However, this is unlikely given that the cooling water typically does not make contact with oil or oily substances. Philip Jones, Manager of the Gouna Harbor north of Hurghada, suggested that discharge of oily bilge water is exasperated in Egyptian Red Sea waters because the wooden tourists vessels are not structurally sound, leak constantly and, thus, oily bilge water is frequently pumped into the sea (pers. comm. January 2003).

The Red Sea Govenor Decree No. 115 (2000) states that all boats staying out at sea (overnight) must have waste holding tanks and waste munching machines. However, there are no harbors in the CMA with facilities to receive and dispose of sewage. Consequently, regulations have been issued that vessels within Egyptian waters must not discharged within 5 km of the reef edge or the coastline (Abdalla Selim, EEAA, pers comm. February 2003)

Safari boats may also be a chronic source of solid waste, including plastics, to the marine environment. Most stakeholders in the CMA reported anecdotal evidence of safari boats discarding solid waste directly into the sea. Reasons for this include the smell of the rubbish and the space it takes up. Derraik (2002) reviewed the effects of plastic debris on marine species and concluded that a large number of marine species is known to be harmed and/or killed by plastic debris. Marine animals are mostly affected through entanglement in and ingestion of plastic litter. Other less known threats includes the use of plastic debris by “invaders” species and the absorption of polychlorinated biphenyls form ingested plastics (Derraik 2002).

4.1.5 Land-originated pollution

In this section sewage, industrial waste and general litter are treated separately. Figure 11 illustrates areas of known or potential pollution sources. It does not depict polluted sites because almost the entire coastline has evidence of plastic or oily material.

Sewage

There are no approved sewage outfalls in the CMA. New resorts are required to have treatment plants. Treated water is used for irrigation and the sludge is disposed of in

the desert, sometimes to be used as fertilizer. Septic systems are still commonly used and may contaminate groundwater aquifers or the adjacent reef flat environment. However, no data have been collected to test this prediction. Marsa Alam, Hamata and Abu Ghuson, the largest centres of population adjacent to the CMA, are still on septic systems. In addition, although resorts are required by law to have treatment plants and not to discharge sewage or treated water back into the sea, some hotels are still on septic systems.

Industrial waste

Industrial waste includes, dust associated with harbor loading facilities and construction activities, brine discharge from desalination plants, fuel spills in marinas and construction material. Phosphate dust from the Abu Ghuson Harbor is no longer a major input into the CMA as phosphate is no longer loaded there. As reported earlier, illmenite and quartz are the main cargo leaving the Harbor. Loading of these minerals results in relatively small quantities of dust settling on adjacent marine waters. Construction waste, such as drums, scrap metal and bricks, is common in Abu Ghuson Harbor (Hassan 1998).

The Marsa Alam Desalination Plant located north of the Marsa Ghaleb Harbor discharges about 1000 m³ of brine, from a diffuser, in about 22 m of water (Mr Ashraf Saadawy, Plant Manager, pers. comm. December 2002). Other hotels are legally permitted to inject the brine into wells (Jack Gisiger, RSSTI, pers. comm. February 2003). Hassan (1998) suggested that tin ore on the shoreline at Marsa Alam is a potential source of marine contamination.

General litter

Photo 12 Garbage along the Beach

Household garbage, particularly plastic bags and plastic bottles, is also common along much of the coastline the CMA (Photo 12). In addition, household garbage and construction material are common in most wadis. This material is likely to enter the sea or end up on the reef flat during major flooding events.

According Hossam Helmy, proprietor of Red Sea Diving Safari, the major source of general litter along the Egyptian Red Sea coast comes from the resort construction camps (pers. comm. May 2003). Typically, waste generated by the men living in these camps is dump in the nearest wadi. Another source of general litter on the coast is open municipal dumps. One

example is located north of Hamata, adjacent to a coastguard station. Garbage from this site was observed many hundreds of meters down wind (Dr. Tony Rouphael, pers. observ. December 2002).

4.1.6 Indigenous people

With shrinking Ababda land and opportunities for permanent work, most local indigenous populations in the CMA are tending towards more sedentary lifestyles. As a result, this has placed added pressure on natural resources, such as mangroves and fishes, which are exploited by the Ababda.

The Ababda need to be consulted during the implementation and eventual management of the CMA. Although some Ababda are employed as labourers at hotels, others, according to Ayman Mohamed Gomaa (EEAA) have expressed a desire not to participate in this industry, but would prefer to participate as community rangers (pers. comm. December 2002).

4.2 Potential future issues

4.2.1 Introduced marine species

In temperate marine systems, invasive species are well-documented causes of marine community disruption. Recent studies indicate that tropical seas are also susceptible to invasions from introduced species. For example Eldredge and others (Dr. L Eldredge, pers. comm. 2001) recorded 340 non-native marine and brackish water species from Hawaii. The majority of these species are through to have been introduced through hull fouling. Barile and Lapointe (2002) warn that invasive macro-algae species in the Mediterranean posses a potential threat to marine species in the Red Sea. There are three harbors in the CMA that regularly receive vessels from international waters. Species introduced to these harbors could conceivably spread into adjacent waters.

4.2.2 Major oil spill

The risk of a major pollution event due to an accidental oil spill in the CMA is high given the volume of commercial shipping that pass through the Red Sea. An oil spill in or adjacent to the CMA would not only have detrimental effects on water quality but could also have significant ecological impacts on birds and intertidal assemblages in the CMA. The EEAA is responsible for coordination of oil spills incident response and remediation (Boharn 1997). Whilst the management of shipping is outside the scope of this Plan, the preparation for an incident is not. Dr Mohamed Borhan, Director General of the Egyptian National Oil Spill Contingency Plan (NOSCP) suggested that the risk of environmental damage associated with a spill is high given the incomplete knowledge on the spatial distribution of sensitive habitats in the CMA and the current lack of spill control equipment (pers. comm. January 2003).

4.3 Synthesis of management issues

The principle aim of natural resource management is to maintain the ecological and social values while providing compatible subsistence, tourism and commercial use. To achieve this aim it is vital to undertake a risk assessment, which includes identifying existing and potential threats to key ecological and social values. CALM (2000) suggested that the level of risk posed by existing and potential threats to values should be assessed by considering the following factors:

- The temporal scale of the threat –threats that continue over a longer time frame are often of greater concern than short-lived threats
- The spatial scale of the threat – threats that affect a large area are often of greater concern than the localised threats
- The trophic level and conservation status of the species affected by the threat
- The likelihood of a threat occurring
- The consequence of the threat (the ecological and socio-economic implications and the manageability of the threat)

It is therefore necessary to make predictions on how key values will or are likely to be, affected by existing or future threats. However, predicting the effects of human activity on some ecological values is not easy because their ecological effects on the environment are not fully understood. Tables 7 and 8 summarize the current and potential threats to the ecological values of the CMA. The summary is based on the criteria described above. It provides guidance as to the priority management issues.

Table 7 Current human threats to the ecological values of the CMA

Issue	Temporal	Spatial	Trophic	Likelihood	Ecological Consequence	Management in Progress?	Priority
Habitat Destruction							
Anchoring / cable mooring	Chronic	Localized	Medium	Occurs	Major change in coral community structure. Anchors and chains can also scour seagrass meadows. Impacts localized to leeward sides of offshore reefs and in marsas. Can be managed with buoy moorings and zoning.	Yes Moorings are currently being installed at high use reefs in the CMA	Medium[18]
Reef flat development	Varies	Varies	Medium to High	Occurs[19]	Permanent, sometimes widespread modification of reef flat and displacement of associated organisms. Can be managed with rigorous and strict enforcement relating to the setback regulations.	Yes EEAA rangers inspect resorts to ensure legal compliance of the setback rules	Medium[20]

[18] This issue is given as medium, rather than high, priority because moorings are currently being installed at all high use reefs in the CMA.

[19] Disturbance of the reef flat is illegal, however illegal construction of artificial lagoons is a potential threats without rigorous enforcement. Disturbance of reef flats may also occur if permission is given for the construction or expansion of Harbors.

[20] This issue is given as medium, rather than high, priority because EEAA rangers have and continue to enforce the setback rules in this area. To date, disturbance of the reef flat in the CMA has been negligible.

Issue	Temporal	Spatial	Trophic	Likelihood	Ecological Consequence	Management in Progress?	Priority
Marine tourism activities	Chronic	Localized	Medium	Occurs	Depends on activity and location. Source of mechanical damage of corals and other benthic organisms. However, disturbance is typically localized to entry and exit points; trails; and close to moorings. Can be managed with education, zoning and enforcement.	No Some resorts and dive operators provide environmental awareness instructions	Medium
Grazing	Chronic	Widespread	High	Occurs	The most obvious effect is a reduction in foliage cover. Grazing or trampling does not appear to cause death of adult plants, but may limit recruitment due to the trampling or eating of young plants. Possible to limit disturbance if Ababda agree to reduce grazing pressure on selected stands.	No	Medium
Mangrove cutting	Unknown	Unknown	High	Occurs	The ecological consequences of harvesting are unknown. Potentially easily managed with Ababda and Coastguard co-operation.	No	Medium
Boat groundings	Highly infrequent	Localized	Medium	Occurs	Depends on the size of the vessel. Cause of mechanical damage to corals and potential permanent modification of the substratum. The direct impact is highly localized, but an associated fuel spill could affect a large area.	No	Low

Issue	Temporal	Spatial	Trophic	Likelihood	Ecological Consequence	Management in Progress?	Priority
Development of marsas	Chronic	Varies	High	Occurs	Development of marsas has the potential to affect marine organisms living in these uncommon coastal features. Development may result in increased levels of turbidity and contamination of waters and sediments. Development will also lead to increased boating and diving activity in and adjacent to the marsa.	No	High
Exploitation of Marine Resources							
Fishing	Chronic	Widespread	Low	Occurs	Depends on: gear type; the intensity and frequency of fishing; and the biology or ecology of the species caught. All modify fish assemblage structure to some degree. Trawlers can also modify the benthos. Ecological consequences difficult to predict, but possibly severe. May result in benthic habitat change. For example, the reduction of herbivores may give algae a competitive advantage over corals. Difficult to manage multi-species fisheries and difficult to assess the direct and indirect effects of fishing. Management will require a combination of fisheries regulations, no-take zones and enforcement.	No	High

Issue	Temporal	Spatial	Trophic	Likelihood	Ecological Consequence	Management in Progress?	Priority
Invertebrate harvesting	Chronic	Widespread	Low to high	Occurs	Holothurians (sea-cucumbers) are beneficial to the production of benthic microalgae because they produce ammonium and small quantities of phosphate as by-products. They are also contribute to the bioturbation of sediments. Populations of holothurians have been heavily exploited in much of the Egyptian Red Sea waters. Commercially important species are now uncommon or locally extinct.	No	High
Threatened species							
Disturbance of nesting turtles/seabirds	Unknown	Unknown	High	Occurs	International and nationally significant seabird and turtle nesting rookeries are found on Wadi Gemal Island and on islands in the Qulan Archipelago. These islands support nesting populations of the white-eye gulls, which are endemic to the Red Sea. The islands also support significant populations of the threatened sooty falcon and breeding populations of green and hawksbill turtles. Theoretically easy to manage by ensuring no or limited human access to islands. Management will require public consultation, regulations and enforcement.	No	High

Issue	Temporal	Spatial	Trophic	Likelihood	Ecological Consequence	Management in Progress?	Priority
Marine mammal / tourist interactions	Unknown	Unknown	Low	Occurs	Unknown.	YesA site plan has been prepared for Dolphin House	Low
By-catch and boat strikes	Unknown	Unknown	Low	Likely	A small increase in dugong mortality might have significant impact on local population.	No	High
Ship-originating pollution							
Non-local vessels[21]	Chronic	Widespread	High	Occurs	Unknown. Depends on the type, quantity and frequency of contaminants. The most common are petroleum hydrocarbons and plastics. The ecological impacts of routine ballast water discharge (as apposed to a major spill) and tar mats on coastal and marine organisms have not been adequately described. Discharge of ballast water is probably still a major source of oil pollution in the Red Sea despite the extensive laws restricting it (e.g. MARPOL and the London Convention). Evidence of oily waste in the CMA includes tar mats or tar balls along the coastline. Difficult to prevent, particularly for vessels discharging in international waters.	No	Medium

[21] Non-local vessels include bulk carriers using the international shipping lanes of the central Red Sea.

Issue	Temporal	Spatial	Trophic	Likelihood	Ecological Consequence	Management in Progress?	Priority
Local vessels	Chronic	Widespread	High	Occurs	Unknown, but the chronic discharge of oily bilge water is probably significant. Other contaminants include sewage, plastics, fishing nets and other garbage. Need the cooperation of vessel owners to effectively limit the discharge of contaminants from local vessels. Management will include public awareness and enforcement. However, ballast water and sewage receiving and storage facilities will be required at Harbors to reduce discharge of these contaminants into the CMA.	No	High
Land-originating pollution							
Sewage	Chronic	Localized	Low	Occurs	Unknown. Possible localized contamination of waters on reef flats or in marsas adjacent to towns or hotels using septic systems. Biological effects may include enhanced algae production and severe oxygen deficits in semi-enclosed waters like lagoons and marsas.	No	Low
Industrial waste	Chronic	Localized	Low	Occurs	Population and ecosystem levels effects unknown. Contamination of construction material is typically localized while plastics are widespread.	No	Medium
General litter	Chronic	Wide spread	Low	Occurs	As above	No	High

Table 8 Potential human threats to the ecological values of the CMA

Issue	Temporal	Spatial	Trophic	Likelihood	Ecological Consequence	Management in Progress	Priority
Introduced species							
	Varies	Varies	Varies	Unknown	May displace native species, leading to changes in species composition.	No	Medium
Major oil spill							
	Short to medium term	Widespread	High	Low	Potential catastrophic effects.	EEAA has prepared an Oil Spill Contingency Plan for the Egyptian Red Sea. However, there is no equipment in the CMA to combat a major spill	High

5. Management

5.1 Management objectives

Management objectives identify what the primary aims of management are. Achieving the management objectives will assist EEAA to meet the strategic goals of the CMA. In this Plan, some management objectives have been formulated to address specific threats to habitats and populations of organisms in the CMA. In many cases, the ecological significance of a threat, such as fishing, remains unclear and difficult to predict. In these cases the primary objective is to assess the significance of a threat.

In this Plan, management objectives (Table 9) are reasonable and measurable. Reasonable objectives are achievable in the context of an area's specific management challenge. In the case of the CMA, challenges include large area of marine waters, limited numbers of EEAA staff rangers based in the area, no patrolling vessel, unregulated tourism vessel activity and unmanaged fisheries.

Lastly, objectives need to be measurable in order to clearly assess whether they are being achieved. As Jones (2000) argues, there is dire need that performance of management for PAs should be able to be demonstrated through evidence of results rather than on the basis of educated best guess, 'gut feelings' or assurances of 'trust us we are the experts'.

Management objectives can be categorized as output and outcome based (Hockings *et. el.* 2000). Output based objectives relate to management action, such as the implementation of regular patrolling or baseline study. An output-based objective relates to the condition of the resource under protection, such as the abundance of living coral at a popular dive site. Both types of objectives are given in this report. This distinction is important in terms of the assessment of management effectiveness.

5.2 Management strategies

Management strategies describe how an objective will be achieved and are given in Table 9. The strategies described in this Plan are relatively simple, and once implemented, should minimize the threat to the values of the CMA. Strategies will involve a mixture of management tools including: marine protected areas, zoning, education and interpretation, surveillance and enforcement, research and associated

monitoring and public participation. These are described in more detail in Section 12. Justifications of individual strategies are given as footnotes beneath the Tables. In this Plan, management strategies are proposed as short or medium term. Short-term strategies have priority and should be implemented during year 1 and 2 of this 5-year Plan. Medium-term strategies are of less priority, but should be started within 5 years.

5.3 Management effectiveness

In this Plan, importance is given to evaluate whether the management objectives have been achieved. The integration of evaluation programs into management plans offers a number of significant benefits for natural resource management. Jones (2000) argued that the ability to demonstrate the results or outcomes of management has the following advantages:

- Providing feedback to management about the extent to which previous actions are achieving management objectives
- Providing the opportunity to learn from past management experience and so progressively improve management performance
- Providing a more informed basis from which to make ongoing management decisions and for allocating and prioritizing management effort and resources
- Providing the necessary link to public accountability and to those funding management by demonstrating the outcomes for expenditure on protected area management

In this Plan a 6-step assessment approach is proposed:

1. Define management objectives – ensure they are tangible and measurable
2. Define appropriate indicators (i.e. variables) that can be measured to provide information about the extent to which management objectives are being achieved (see below)
3. Monitor indicators using sound scientific principles
4. Periodically assess results
5. Report findings
6. Adjust management if necessary

Of these, Step 2 and 3 are probably the most difficult to achieve and are explained in more detail below.

5.3.1 Indicators

Indicators in this Plan have been assigned for both the output and outcome based objectives (see Section 6.1 for definitions). Indicators are used to provide information about the extent to which each objective is being achieved. Indicators are chosen for three reasons: they directly or indirectly reflect the status of an attribute (which is commonly a conceptual entity that cannot be measured directly); they provide information about inputs or factors affecting a system; or they elucidate the links between inputs (e.g. number of snorkelers) and change (impacts).

Some desirable properties of indicators are:

- They are readily measurable
- They respond quickly and unambiguously to inputs
- They are distributed over a spatial scale that includes areas that will not be affected by development/activities
- They have been studied previously

5.3.2 Monitoring

A simple definition of monitoring is repeated sampling over time with adequate replication to detect variation over different temporal and spatial scales. Importantly, this Plan does not advocate the standard 'gunshot' approach to monitoring in which sites and indicators are arbitrary selected. Rather, monitoring should be driven by specific questions, typically to test predictions relating to management intervention. It is beyond the scope of this Plan to describe in detail a monitoring program for the CMA, but some important principles are mentioned here:

- An effect (e.g. change resulting from protection or other type of impact) can only be demonstrated with controls. This is why the establishment of scientific-reference and no-take zones are strongly recommended in this Plan.
- Every level of sampling should be replicated
- Need to consider short temporal and small spatial scales, and
- The methods used to analyze data should be determined at the design stage

Key steps in the design and implementation of a monitoring program are shown here based on the recommendations by Keogh and King (1991).

1. Define the 'indicators' to be measured.
2. Pilot studies to determine variation between sites.
3. Sample size determine, power analysis.
4. Choice of sampling units.

5. Initial choice of indicators.
6. Who should do the monitoring.
7. How often and for how long should monitoring be done?
8. Final monitoring program.

Given the complexity of rigorous scientific monitoring, it is desirable that qualified marine scientists carry out the monitoring programs. At the very least, qualified scientists should design the program, and undertake the analysis and interpretation.

5.3.3. Description of Tables 9 and 10.

Table 9 lists the management issue, management objectives and short and medium term strategies. Potential indicators of management success and the method of data collection for each management objective are shown in Table 10.

Table 9 CMA management objectives and strategies

Issue & Objectives	Strategy
CURRENT ISSUES	
Habitat Destruction	
1) Boating / anchoring	
Reduce the amount of coral damage caused by anchors, anchor chains and cable mooring	**Short-term**
	EEAA install moorings at frequently used reefs (in progress)
	EEAA implement mooring buoy strategy for the CMA[22]
	EEAA implement zoning scheme - See Zoning Section 8
	Medium-term
	EEAA rangers undertake boat patrols, at random periods, to assess compliance of regulations pertaining to mooring use and no-anchoring[23]
	EEAA, in consultation with boat operators and the Coastguard, implement a strategy to regulate the number of vessels permitted to visit popular dive locations per day within the CMA[24]
	EEAA undertake study to assess the environmental effects of cable-mooring[25]
2) Coastal development	

[22] PSU Hurghada has submitted a comprehensive mooring strategy for the region. The strategy addresses issues such as mooring maintenance, mooring/anchoring regulations; and best-practice mooring/anchoring.

[23] It is important that tourists boats use the buoy moorings, rather than continue to cable moor, and that the moorings are used appropriately. Patrols by EEAA rangers or community rangers will be required to ensure compliance.

[24] At some popular reefs there is insufficient number of moorings to cater for demand. Therefore, boats must either tie up to moored vessels, which may damage the mooring, or they will cable moor directly to the reef. Controlling vessel numbers at popular reefs will be difficult, at least in the short term, because many vessels operating in the CMA are based in Hurghada and Safaga. However, it may be achievable with Coastguard assistance, because day and safari vessel operators must provide the Coastguard with their trip itinerary.

[25] It remains inconclusive whether cable mooring is or less damaging than anchoring or is extremely damaging. Stakeholder opinion is mixed.

Issue & Objectives	Strategy
Reduce disturbance of reef flat habitats by illegal urban, tourism or industrial construction	**Short-term** EEAA continue to enforce setback regulations according to Law 4 (1994) EEAA establish and maintain a register of locations in the CMA where reef flats have been damaged by infilling or excavation for lagoons (in progress) EEAA rangers continue undertake periodic surveys of reef flats adjacent to all resorts (including those under construction) to assess that illegal disturbance has not occurred EEAA staff in Marsa Alam and El Quseir participate in the assessment of EIAs for proposed developments in and adjacent to the CMA[26] **Medium-term** EEAA undertake a Strategic Environmental Assessment (SEA) of the proposed tourism development concessions within the WGHPA[27]
3) Marine tourism activities	
Reduce coral damage caused by SCUBA divers, snorkelers and reef walkers	**Short-term** EEAA, in consultation with the Red Sea Diving Association and HEPCA, develop best-practice environmental guidelines to SCUBA diving, snorkeling, reef walking and boating for free distribution to all Egyptian marine based-tourists operators EEAA implement zoning scheme - See Zoning Section 8 EEAA establish baseline and monitoring program to assess the status of benthic assemblages in heavily used marsas in the CMA[28]

[26] The TDA and EEAA Cario currently assess EIAs for proposal along the coast in TDA lands, while the Red Sea Governorate and EEAA Cairo assess EIS proposed for Red Sea Governorate lands. Rangers in Marsa Alam and El Quseir complain that EIAs are being approved without due consideration of the location. For example, developments in wadis have been approved in the past. Further, rangers have suggested that setback rules are not being applied consistently as some structures are being constructed, on flat areas, well within the 200 m setback.

[27] A SEA is recommended here because any assessment needs to take into consideration the synergistic, cumulative and off-site effects associated with the two TDA concession areas in the WGHPA. EIAs on individual developments in the two concession areas will be inadequate.

Issue & Objectives	Strategy
4) Grazing	
Assess the impact of camel activity (trampling and grazing) on mangrove stands	**Short-term** EEAA undertake quantitative baseline study on mangrove stand structure at grazed and ungrazed stands (in progress)[29] **Medium-term** EEAA undertake study to assess the effects of camel grazing and trampling on mangrove stands in the CMA[30]
5) Mangrove cutting	
Reduce the cutting mangroves	**Short-term** EEAA inform senior Coastguard personnel of the environmental importance and legal status of mangroves in Egypt, and that it is illegal to cut mangroves[31] EEAA rangers meet with Coastguard personnel based near mangroves to remind them of the legal status of mangroves **Medium-term** EEAA undertake study to describe the type and intensity of Ababda use of mangroves[32]

[28] Marsas are uncommon features in the CMA and may contain species or assemblages that are rare or absent in other marine environments along the Red Sea coast of Egypt. Marsas are some of the most frequently used areas in the CMA because they provide access for divers and snorkelers to deep water and provide safe mooring areas for tourist vessels.

[29] Grazing of camels and other livestock has modified the structure of mangrove stands in the CMA. The ecological significance of this grazing pressure remains unknown. Until the effects of grazing have been adequately described it is desirable to monitor the status of these stands and do not deteriorate further. Dr Abdelarazik, Alexandria University, has been contracted to establish a baseline on the structure and condition of select mangrove stands in the CMA.

[30] The effect of livestock grazing and trampling on the recruitment of mangroves or on the long-term viability of the stands remains unknown and should be assessed.

[31] Support from senior Coastguard staff will be essential to stop or reduce the illegal cutting of mangroves by coastguard personnel

[32] The Ababda also use mangrove for firewood and other products. The ecological effects of Ababda mangrove harvesting need to be assessed.

Issue & Objectives	Strategy
6) Boat groundings	
Reduce the number of boat groundings	**Short-term**
	EEAA review navigational requirements and aids for all vessels operating in the CMA
7) Development of marsas	
Stop development of marsas	**Short-term**
	EEAA advise TDA and Red Sea Governorate to ban all development of resorts and other human habitation in and adjacent to marsas in the CMA that are currently free of development
	EEAA ban all development of resorts and other human habitation in and adjacent to marsas in the PA that are currently free of development
Exploitation of Marine Resources	
1) Fishing	**Short-term**
Assess and limit the impact of fishing on populations of marine species and habitats in the CMA	EEAA/MoA implement a fisheries management strategy for the CMA that will include no-take zones (in progress)[33]
	EEAA implement zoning scheme - See Zoning Section 8
2) Invertebrate harvesting	
Assess and limit the impact of invertebrate harvesting on populations of marine species and habitats in the CMA	**Short-term**
	EEAA/MoA implement a fisheries management strategy for the CMA that will include no-take zones (in progress)
	EEAA implement zoning scheme - See Zoning Section 8
Threatened species	

[33] Dr A. Barrania and Dr A. Ibrahim have recently submitted to PSU Hurghada a fisheries management strategy for the CMA (Barrania and Ibrahim 2003). EEAA and the MoA should review this, and the appropriate recommendations implemented.

Issue & Objectives	Strategy
1) Disturbance of nesting marine turtles and seabird	
Assess and limit the impact of human activity on nesting populations of seabirds and marine turtles in the CMA	**Short-term** EEAA develop guidelines for tourists, fishermen and others visiting Wadi Gemal Island and the islands of the Qulan Archipelago EEAA implement zoning scheme - See Zoning Section 8 and Site Plans - Section 9.
2) Marine mammal / tourist interactions	
Assess and limit the impact of human activity on spinner dolphins at Dolphin House	**Short-term** EEAA, in cooperation with local tourist operators, review the current management strategy to managed Dolphin House (in progress)[34] EEAA monitor the population of spinner dolphins that frequent the lagoon of Dolphin House EEAA develop policy relating to interactions between divers/snorkelers and dugong[35]
3) By-catch and boat strikes	**Short-term**
Assess and limit the impact of human activity on dugongs and marine turtles in the CMA	EEAA identify critical habitat for dugongs and marine turtles in the CMA EEAA develop strategy to minimize disturbance and mortality of dugongs and marine turtles in the CMA (in progress)[36] EEAA implement zoning scheme - See Zoning Section 8
Ship-originated pollution	
Stop discharge of waste into the sea from vessels	**Short-term**

[34] The EEAA is currently reviewing the Dolphin House Management Plan (Ayman Mohamed Gomaa, pers. com. February 2003).

[35] Given the presumably small number of dugong in the CMA, it is desirable to prohibit all deliberate interactions.

[36] A useful model for this strategy is *Dugong, Boats, Dolphins and Turtles in the Townsville-Cardwell Region and Recommendations for a Boat Traffic Management Plan for the Hinchinbrook Dugong Protection Area*: Research Publication No. 67 at: www.gbrmpa.gov.au. Dr Mahmoud Hanafy, PSU Hurghada, is currently preparing a strategy to protect and conserve dugongs and marine turtles in the Egyptian Red Sea.

Issue & Objectives	Strategy
	EEAA consult with key stakeholders to develop mutually agreed strategy to reduce the discharge of waste from tourists and fishing vessels[37]
	EEAA consult with the Red Sea Governorate to ensure existing and future harbors receive liquid and solid waste disposal facilities
Land-originated pollution	
1) Sewage	
Assess the impact of septic systems on inshore benthic organisms	**Short-term**
	EEAA undertake study to assess if septic systems at Marsa Alam and Hamata are contaminating adjacent coastal waters
	EEAA monitor new resorts to ensure the developers comply with their licenses governing the treatment and disposal of sewage
2) Industrial waste	
Stop industrial waste entering the CMA	**Short-term**
	EEAA, in accordance with Law 4 (1994), undertake EIAs of proposed industrial development in and adjacent to the CMA
	Medium-term
	EEAA consult with the Red Sea Governorate to develop and implement a Solid Waste Management Plan (in progress)[38]
3) General litter	

[37] Decree No. 54 (2000) was passed by the Red Sea Governorate in order to prevent vessels from taking onboard plastic bags. This was meant to stop the discharge of plastic into the Red Sea. With no practical alternative to plastic bags as storage containers for waste most operators have retained the practice. Unfortunately, because operators are concerned they will be prosecuted if they return to Harbor with plastic bags (albeit full of waste) many throw the bags overboard before returning to Harbor.

[38] Solid waste disposal is the responsibility of the Red Sea Governorate for both Governorate and TDA lands. RSSTI has prepared best practice guidelines for resorts and hotels to dispose of their solid waste (Ihab Shaalan, RSSTI, pers. comm. May 2003).

Issue & Objectives	Strategy
Stop general litter entering the CMA	**Short-term** EEAA consult with the Red Sea Governorate and TDA to ensure all construction sites have waste disposal facilities **Medium-term** EEAA consult with the Red Sea Governorate to develop and implement a Solid Waste Management Plan
Indigenous people	
Ensure Abadada participation in management decisions	**Short-term** EEAA inform Ababda communities about the proposals given in this Plan that may effect their activities **Medium-term** EEAA employ Ababda as community rangers[39]
POTENTIAL FUTURE ISSUES	
Introduced marine species	
Assess if introduce species have become established in the harbors and describe the extent of introductions	**Medium-term** EEAA undertake biological survey of the harbors at Abu Ghuson, Marasa Alam and Hamata to describe the occurrence of introduced marine species
Major oil spill	
Limit the ecological and social impact of an oil spill on the CMA	**Short-term** EEAA Hurghada provide EEAA NOSCP GIS Office with maps of mangroves and other sensitive habitats in the CMA.

[39] This should follow the model successfully employed in the Elba PA

Issue & Objectives	Strategy
	EEAA develop a contingency plan to combat an oil spill in the CMA
	Medium-term
	EEAA establish a rapid oil spill response storehouse at El Quesir or Marsa Alam which will hold suitable equipment to combat a 3 tier size spill[40]

Table 10 CMA management objectives, indicators of success, and methods of data collection

Issue & Objectives	Indicators	Method of Data Collection
Habitat Destruction		
Boating / anchoring		
Reduce the amount of coral damage caused by anchors, anchor chain and cable mooring	Number of moorings	Monitoring study – variables measured concurrently at anchoring/mooring locations and reference locations
	Number of infringements relating to mooring use	
	Number of vessels anchoring or cable mooring	
	Proportion of damaged coral colonies	Field patrols of mooring locations to record vessel anchoring or cable mooring
	Density of coral colonies	
	Percent cover of living coral and coral rubble	
	Growth form composition	
Coastal development		
Reduce disturbance of reef flat habitats by illegal urban,	Number of illegal reef flat impacts (i.e	Field patrols and random surveys of reef flats

[40] Dr Borhan, EEAA NOSCP Unit, has said that this is prohibitively expensive at the moment. A modern oil spill contingency depot was established at Sharm El Shiekh with funding from a major oil company.

Issue & Objectives	Indicators	Method of Data Collection
tourism or industrial construction	number of artificial lagoons, breakwaters etc)	opposites resorts, particularly resorts under construction
	Number of infringements (.i.e number of prosecutions relating to reef flat disturbance)	
Marine tourism activities		
Reduce coral damage caused by SCUBA divers, snorkelers and reef walkers	Implementation of best practice guidelines	Monitoring study – variables measured concurrently at diving locations and reference locations
	Number of monitoring programs designed to assess the impact of divers and snorkelers in the PA	
	Proportion of damaged coral colonies	
	Density of coral injuries	
	Percent cover of living coral and coral rubble	
	Growth form composition	
Grazing		
Assess the impact of camel activity (trampling and grazing) on mangrove stands	Number of studies relating to this issue	
Mangrove cutting		
Reduce the cutting of mangroves	Proportion of mangroves with severed branches	Monitoring study
	Number of infringements (.i.e number of prosecutions relating to coastguard observed cutting mangroves)	Field patrols
Boat groundings		
Reduce the number of boat groundings	Number of boat groundings per annum	

Issue & Objectives	Indicators	Method of Data Collection
Development of marsas		
Stop development of marsas	Proportion of undeveloped marsas in the CMA	
Exploitation of marine resources		
Fishing		
Assess and limit the impact of fishing on populations of marine species and habitats in the CMA	Implementation of fisheries management strategy Mean fish length, biomass etc. Species composition	Monitoring study – variables measured concurrently at no-take zones and adjacent fishing grounds
Invertebrate harvesting		
Assess and limit the impact of invertebrate harvesting on populations of marine species and habitats in the CMA	Implementation of fisheries management strategy Mean invertebrate length, biomass etc. Species composition	Monitoring study – variables measured concurrently at no-take zones and adjacent fishing grounds
Threatened species[41]		
Disturbance of marine turtles and nesting seabirds		
Assess and limit the impact of human activity on nesting populations of seabirds and marine turtles in the CMA	Number of nesting turtles and nesting seabirds at important nesting locations Number of infringement (i.e. number of prosecutions relating to people landing on nesting islands that have restricted access	Monitoring study

[41] Monitoring trends in populations of marine turtles, seabirds and marine mammals is difficult because of the cost to conduct a comprehensive survey and the considerable interannual and within year variability of population numbers.

Issue & Objectives	Indicators	Method of Data Collection
Marine mammal / tourist interactions		
Assess and limit the impact of human activity on spinner dolphins at Dolphin House	Number of spinner dolphins at Dolphin House	Monitoring study
	Number of infringements relating to the disturbance of dolphins	
By catch and boat strikes		
Assess and limit the impact of human activity on dugongs and marine turtles in the CMA	Number of dead turtles and dugongs showing evidence of net entanglement or physical damage	
Ship-originated pollution		
Stop discharge of waste into the sea from vessels	Density of plastic and other litter on selected beaches in the CMA	Monitoring study
Land-originated pollution		
Sewage		
Assess the impact of septic systems on inshore benthic organisms	To be developed	Field study
Industrial waste		
Stop industrial waste entering the CMA	Density of industrial waste in the waters adjacent to the main towns and in the main harbors.	Monitoring study
General litter		
Stop general waste entering the CMA	Density of plastic and other litter in wadis in the CMA	Monitoring study
Indigenous people		
Ensure Ababda participation in management decisions	The number of meetings with Ababda leaders	

Issue & Objectives	Indicators	Method of Data Collection
	The number of complaints from Ababda relating to management issues	

6. Management Tools and General Recommendations

A variety of tools will be adopted to achieve the management objectives of the CMA. Three of these – Zoning, Site Plans and Mooring Strategy – are covered individually in Sections 7, 8 and 9, respectively.

6.1 Protected Areas

The establishment of protected areas will be an integral component of the CMA. In Egypt, marine and terrestrial PAs can be declared under Law 104. In March 2003, a large area of the CMA (about 40% of the marine component) was declared the WGHPA. This PA forms the core area of the CMA. Other existing PAs in and adjacent to the CMA include all mangrove stands. Formal gazettal of a PA by the Egyptian Government has the advantage of giving EEAA a legal basis to protect species and habitats. The gazettal of a PA can also facilitate the establishment of a permanent management presence, as is being done now at the northern entrance of WGHPA.

Increasing the terrestrial component of the CMA through the establishment of PAs will be difficult because that the TDA has sold much of the coastal land between El Quseir and Wadi Lahmi Resort. Indeed, two large coastal areas inside the WGHPA have been conceded to the TDA for tourism development. The only remaining large area of undeveloped land not under the control of the TDA or the Red Sea Governorate is Ras Banas. Ras Banas is currently under the jurisdiction of the Egyptian Military, which has so far indirectly contributed the protection of the biological values of this area. Because Ras Banas may eventually be opened for tourism development, it is desirable that the EEAA map biological values on Ras Banas and identify areas suitable for PA status.

6.1.1 Recommendation

- EEAA describe significant biological values on Ras Banas and propose a PA to protect representative habitats

6.2 Stakeholder participation and interaction

Developing stakeholder support for the CMA is critical to the effective implementation of this Plan. Stakeholders in this region include the Egyptian Government, Red Sea Governorate, EEAA, TDA, Egyptian Coastguard, Ministry of Agriculture (Fisheries) Ministry of Petroleum, Ministry of Defence, Southern Red Sea Diving Association, resort managers and owners, shopkeepers, local fishermen, visiting fishermen and recreationists. The level of public compliance in relation to management controls in the CMA will be related directly to the level of understanding of the values of the CMA and the reasons for regulations of activities. Education programs will need to initially raise awareness of the CMA and new restrictions on fishing and tourist activities as a result of the implementation of zoning and other management strategies.

One way to achieve and maintain stakeholder participation in the management of the CMA is the establishment of a council made up of senior staff from the EEAA, Red Sea Governorate, TDA and members from other key stakeholders. The role of the Council will provide a forum for stakeholders to review new and existing management action or to allow members to express grievances. Importantly, EEAA will retain veto powers over new and existing management recommendations pertaining to the WGHPA.

6.2.1 Recommendation

- EEAA establish CMA Council made up of key stakeholders, which will meet every 12 months to discuss management issues pertaining to the CMA. The CMA Council will be chaired by the EEAA, which will retain overall veto of actions pertaining to all PAs and protected species in the CMA.
- EEAA ensure representation at the monthly meetings of the Southern Red Sea Diving Association.

6.3 Environmental Regulations

Based on the requirements expressed in Law 102 (1983), a comprehensive set of regulations has been prepared for Ras Mohamed National Park, Nabq Managed Resource Protected Area and Abu Galum Managed Resource Protected Area. This set, plus regulations developed for the Hurghada offshore islands PA, should form the basis for regulations pertaining to the WGHPA. These regulations will provide clear guidance to stakeholders and visitors on allowed and prohibited actions with the PA.

6.3.1 Recommendation

- EEAA prepare regulations for the WGHPA
- EEAA distribute regulations to key stakeholders operating in or adjacent to the PA.

6.4 Law Enforcement

This Plan details a range of strategies and regulations relating to the control of particular human activities. The effectiveness of these actions will be dependent on the extent to which the users of the CMA abide by these restrictions. The education program is critical to achieving a high level of compliance as in most cases users will abide with controls where they are clearly aware of what they are and why they have been implemented. There will, however, always be a need to monitor the level of compliance and, where users continue to undertake illegal activities, take action to stop inappropriate behaviour.

6.4.1 Recommendations

- The EEAA establish a permanent ranger presence near Shams Alam Resort and Hamata with the capacity to undertake offshore patrolling[42].

6.5 Coastguard Participation

The CMA covers a vast area of Egyptian Red Sea waters and the cost of establishing a large staff of EEAA rangers, and associated infrastructure, will be prohibitively expensive in the short-term. Therefore it is will be essential for the EEAA to facilitate cross authorisation with the Egyptian Coastguard to ensure that regulations pertaining to the management of the CMA and WGHPA are enforced. According to Kirsten Elhert, Wadi Gemal Diving Centre Manager, coastguard staff have been instrumental in apprehending cucumber and finfish poachers in the WGHPA (pers. comm. June 2003).

6.5.1 Recommendations

- EEAA consult with the Egyptian Coastguard to facilitate Coastguard involvement in the enforcement of regulations pertaining to the management of the CMA and WGHPA.

[42] At the time of preparing this Plan, an EEAA office was being established at Shams Alam Resort, which is at the northern boundary of the terrestrial component of the WGHPA.

6.6 Community and Volunteer Rangers

The CMA is a vast area and the cost of establishing a large staff of EEAA rangers, and associated infrastructure, will be prohibitively expensive in the short too medium term. Therefore, it will be desirable for the EEAA to develop a community and volunteer ranger program to help enforce the regulations. Here the term community ranger relates to an individuals paid by the EEAA to support professional EEAA rangers. Community rangers have been successfully used in the Elba PA (Mohamed Ghad, EEAA, pers. comm. January 2003).

There is potential to use volunteer rangers in the CMA. The term volunteer ranger relates to individuals who are given powers to enforce site-specific regulations, but are not paid by EEAA. An example would be dive staff who are given limited powers to uphold regulations pertaining to tourists activities at Dolphin House. Volunteer rangers could be given identification cards and digital cameras to record infringements for future prosecution.

6.6.1 Recommendations

- EEAA train and employ Ababda as community rangers to patrol the WGHPA
- EEAA conduct a trial program to assess the effectiveness of volunteer rangers associated with one or two diving operations

6.7 Public Awareness

Other important and ongoing education programs will be required to minimize human impacts on the ecological values and a range of education and interpretation infrastructure (e.g. walking trails and interpretative centre) should be considered where and when appropriate.

6.7.1 Recommendations

- EEAA prepare high quality tourist brochures and fact sheets relating to the CMA. The brochures should include: a summary of the biological and social values CMA; boundary maps and a brief description of the regulations[43].
- EEAA prepare boundary and interpretation signage for the CMA

[43] A useful model is the colour brochure by EEAA for the Ras Mohammed National Park Sector

6.8 EIA[44]

Law 4 (1994) requires the licensing authorities - so called "Competent Administrative Authorities" (CAAs) to undertake an assessment of any project having a potential adverse impact on the environment. The law mandates EEAA, in coordination with the CAAs, to set the concept and guidelines for the EIA process and requires the CAA to submit the EIA to EEAA for review and approval.

According to the guidelines for Egyptian EIA issued by EEAA under requirement of Law 4 (1994), developers prepare and submit EIA documentation to the CAA before the start of any construction work. Projects are classified into three categories based on their anticipated impact on the environment. In addition, any project to be located within the 200 m zone from the coastline (the setback) requires a full EIA.

Recently, staff from PSU provided a comprehensive review of Egypt's EIA process (Chemonics 2002). Some of the primary concerns were the low quality of the submitted EIAs and lack of trained staff to write the reports. Another limitation of the EIA process is that it does not take into consideration the cumulative and synergistic effects of multiple developments. For example a single hotel may have negligible environmental effects, but five hotels in the same vicinity may have significant environmental consequences. According to Dr. Mahmoud Hanafy, the TDA is proposing that over 20 resorts be permitted in the development concession zones within WGHPA (pers. comm. April 2003). Such a proposal needs to be assessed in its entirety, not on a resort-by-resort basis. Further, the assessment must include not only the direct effects, such as disturbance to the construction site, but also the indirect effects, such as increased use of adjacent waters by boaters and recreationists.

6.8.1 Recommendations

- See Table 7, Coastal development

6.9 GIS

Mapping is an essential tool of conservation management. The EEAA/PSU GIS Unit based in Hurghada has advanced capabilities to produced and store maps. It has Landsat TM coverage of the entire Egyptian Red Sea and has recently acquired Quickbird imagery of the coastline and islands within the WGHPA. The unit is n the most advanced of its kind on the Egyptian Red Sea.

6.9.1 Recommendations

[44] This summary on the Egyptian EIA process is taken from*: Gulf of Aqaba Environmental Action Plan* (1998)

- EEAA continue to fund the GIS Unit in Hurghada
- EEAA purchase Quickbird imagery for the entire CMA coastline, including offshore features.

6.10 Species Action Plans

The dugong, green turtle and hawksbill turtle are three threatened species occurring in the CMA. They are currently threatened by habitat disturbance and mortality of individuals through by-catch and boat strikes. EEAA is responsible for identifying threats and coordinating and facilitating programs for threatened species. Species action plans will need to be developed for these species. These plans will work to protect these species by:

- Identifying threats to their survival
- Describing appropriate management actions to mitigate these threats

6.10.1 Recommendation

- EEAA prepare management action plans for threatened species in the CMA

7. Zoning

7.1 Introduction

An important mechanism to achieve the objectives of the CMA is a zoning scheme. A zoning scheme is used to separate conflicting uses and to provide for specific activities such as scientific research, recreation, tourism or fishing. For example, recreation zones, Category II of the IUCN PA Categories, are reserved primarily for recreational activities, such as swimming, snorkeling and diving. Zoning schemes have been used to varying levels of success by marine park managers in Egypt, the United States and Australia. Three types of zones are currently used in Ras Mohammed PA: general use; closed areas; and scientific reserves. Currently, no formal zoning is given to the Hurghada Islands PA[45], however most islands have restricted access. Sherif Baha El Din, EEAA Hurghada, has recently proposed a zoning scheme for WGHPA (Table 11). This scheme includes eight zones ranging from a strict natural zone, where no activities are permitted, to a general use zone, where almost all activities are allowed.

Table 11 Proposed zoning scheme for the WGHPA

Name of zone	Permissible impact level	Example of activities
Strict natural zone	Zero impact	Scientific research
Premium wilderness zone	Low impact	Ecotourism
No-take zone		
Recreational zone	Moderate impact	Passive recreation
Archaeological protection zone		
Traditional use zone		
General use zone	High impact	Development
Adjacent area (buffer zone)		Mining
		Oil exploitation
		Cultivation
		Navigation

The Florida Keys National Marine Sanctuary has five zones including: wildlife management areas and special-use areas. The Great Barrier Marine Park (GBRMP)

[45] The Hurghada PA refers to the islands and surroundings waters

has a more complex system with seven zones. Recently, however, the Great Barrier Reef Marine Park Authority has undertaken a major revision of its zoning scheme. An important finding of the review was that most habitats in the GBRMP were not adequately represented in no-take zones.

A no-take zone is an area where harvesting of marine resources is strictly prohibited, but passive tourist activities and scientific research may be permitted. The benefits of no-take zones are well documented by numerous researchers (Allison *et. el.* 1998, Bohnsack 1998 and Dayton *et. el*. 2000) and cited literature) and include:

- Protecting sensitive habitats from destructive fishing methods
- Providing refuge for intensively harvested species (target and by-catch species)
- Enhancing production of target species outside the no-take zone.
- Serving as a demonstration area to the extent of human impacts in coastal environments.
- Providing a valuable eco-tourism resource.

Importantly, no-take zones typically permit non-extractive types of recreational and tourism activities, which managers have considered environmentally benign. However, Alevizon (2003) correctly points out that some recreational activities, such as diving and snorkeling, can disturb benthic communities. For this reasons he advocates the need for 'fully-protected' zones that exclude all human activity except non-destructive scientific research. To remain consistent with EEAA's proposed terminology, hereafter, this type of zone is referred to as a strict natural zone (see Table 11).

7.2 Indicative WGHPA Zoning Scheme

At the timing of preparing this Plan there was insufficient information to provide a comprehensive zoning scheme for the whole CMA. The reasons for this are:

- Insufficient understanding of the distribution of marine organisms and assemblages in the CMA, particularly in relationship to offshore islands and reefs
- Insufficient time to undertake comprehensive consultation with key stakeholders, especially in regards to the designation of scientific-reference zones

Nevertheless, there is a reasonable understanding of the significant tourists sites (Harrigan 2000), areas of important conservation values and primary fishing grounds to assign a preliminary zoning scheme to the marine waters of WGHPA. A simple zoning scheme is proposed for waters within the PA. This will consist of four types of zone: strict natural, no-take, recreational and general use zones. Figure 11 shows the

spatial arrangement of the zones within the PA, and Table 12 illustrates what activities are permitted within each zone.

Table 12 Uses permitted in each zone of the marine component of the WGHPA

Activity	Strict natural	No-take	Recreational	General use
SUBSISTENCE FISHING	No	No	Yes	Yes
RECREATIONAL FISHING				
Hand lining / drop lines from shore	No	No	No	Yes
Hand lining / drop lines from boat	No	No	No	Yes
Net fishing from shore	No	No	No	Yes
Net fishing from boat	No	No	No	Yes
Trap fishing	No	No	No	No
Collecting invertebrates	No	No	No	No
Spearfishing	No	No	No	No
COMMERCIAL FISHING				
Hand lining / drop lines	No	No	No	License (MoA)
Net fishing from shore	No	No	No	License (MoA)
Net fishing from boat	No	No	No	License (MoA)
Trap fishing	No	No	No	No
Trawling	No	No	No	No
Aquarium fish collecting	No	No	No	License (MoA)
Spearfishing	No	No	No	No
OTHER COMMERCIAL				
Aquaculture	No	No	No	Assess
Mineral exploration / development	No	No	No	No
Charter vessels – fishing	No	No	Assess	Assess
Charter vessels – other	No	License (EEAA)	License (EEAA)	License (EEAA)
Eco-tourism activities	No	License (EEAA)	License (EEAA)	License (EEAA)
OTHER RECREATIONAL				
Boating	No	Yes	Yes	Yes
Surface water sports	No	Yes	Yes	Yes
SCUBA diving	No	Yes	Yes	Yes
Snorkeling	No	Yes	Yes	Yes

Activity	Strict natural	No-take	Recreational	General use
Reef walking	No	Yes	Yes	Yes
OTHER ACTIVITIES				
Groyne, jetties, moorings etc	No	Assess	Assess	Assess
Research	Assess	Assess	Assess	Assess

License (MoA) Based on our current understanding these activities are considered compatible but require a license from the Ministry of Agriculture (MoA).

License (EEAA) These activities may or may not be compatible. These activities require a license form the EEAA. The EEAA will assess the suitability of each application in liaison with relevant bodies.

Assess EEAA undertake assessment on individual proposals

Justification for the placement of zones, except general use, is given below.

Strict natural zone

Nine strict natural zones are proposed for marine waters in the PA. Locations, special features and primary objectives are given in Table 13.

Table 13 Proposed strict natural zones in WGHPA

Strict natural zone	Location description	Special features	Primary objectives
Un-named reefs near the northern boundary of the PA	All waters within 500 m of the reef edge	Coral reefs	Serve as a demonstration area to the extent of human impacts (including diving) on adjacent reefs
Sha'ab Dahara sand island	All land inclusive of the intertidal area	Seabird nesting	Protect nesting seabirds
Ras Baghdadi	Beaches above the upper strand line	Turtle nesting	Protect nesting beaches
Wadi Gemal Island[46]	All land inclusive of the intertidal area	Turtle nesting Seabird nesting	Protect nesting marine turtles and seabirds
Umm Abbass	Waters within 1 km of the beach and fringing reef / including beach	Turtle nesting Dugong feeding area Large seagrass meadows	Protected nesting marine turtles Protected dugong
Siyul Island	All land inclusive of the intertidal area	Turtle nesting Seabird nesting	Protect nesting marine turtles and seabirds
Shawarit Island	All land inclusive of the intertidal area	Turtle nesting Seabird nesting	Protect nesting marine turtles and seabirds

[46] Assigning Wadi Gemal Island a strict-natural zone is an interim measure. Part of the island may eventually be zoned recreational to allow supervised visitation to the island by tourists.

Strict natural zone	Location description	Special features	Primary objectives
Umm Ladid Island	All land inclusive of the intertidal area	Turtle nesting Seabird nesting	Protect nesting marine turtles and seabirds
North Lahmi Reef in the northern Fury Shoals	All waters within 500 m of the reef edge	Coral reefs and associated species	Serve as a demonstration area to the extent of human impacts (including diving) on adjacent reefs

No-take zone

Three no-take zones are proposed for marine waters in the PA. Locations, special features and primary objectives are given in Table 14.

Table 14 Proposed no-take zones in WGHPA

No-take zones	Location description	Special features	Primary objectives
Wadi Gemal Island	All inshore and offshore waters between Shams Alam Resort and Sharm El Luli	Contains examples of all most marine habitats Contains important mainland and island turtle nesting areas Known dugong feeding area	Provide refuge for harvested species. Serve as a demonstration area to the extent of human impacts (including fishing) in adjacent waters.
Siyul Island	Waters within 1 km of the island's fringing reef	Contains representative examples of most marine habitats in the Qulan Archipelago.	As above
Northern Fury Shoals including Lahmi and Maksour Reefs	Waters surrounding all reefs of the northern Fury Shoals	Contains representative examples of most marine habitats in the Fury Shoals	As above

Recreational zone

Three recreational zones are proposed for marine waters in the PA. Locations, special features and primary objectives are given in Table 15. Access to some of these recreational zones will have special conditions attached to ensure limited disturbance of important biological values.

Traditional Use Zone

The mangroves adjacent to the Qulan village will be zoned traditional use zone. All other stands will be zoned premium wilderness.

Table 15 Proposed recreational zones in WGHPA

Recreational zone	Location description	Special features	Primary objectives
Sharm El Faqeiry	All waters and intertidal areas in the Sharm	Undeveloped sharm used by recreational divers Safe swimming area	Maintain in near natural state Recreational use
Sharm El Luli	All waters and intertidal areas in the Sharm	Undeveloped sharm used by recreational divers Safe swimming area	Maintain in near natural state Recreational use
Mahabis Island	Southern most island in the Qulan Archipelago	Island with beach and safe swimming area. Easily accessible by boat.	Provide tourists with an opportunity to explore a Red Sea island

General Use Zone

All marine waters and coastal areas not included in strict natural, not-take, recreational, traditional use or the premium wilderness zones will be zoned general use.

8. Site Plans

Given the size of the CMA, it is impractical to provide detailed management prescriptions for the whole area. Therefore, site specific planning is required for sites of significant biological value or sensitivity and are, or will be, subject to high human visitation. An example would be a seabird rookery or turtle-nesting beach subject to high tourist use. Site plans aim to find a balance between tourists, commercial and Ababda access consistent with the protection of biological values. Site plans are management tools, but are treated separately because they represent an amalgamation of other management tools. That is, site plans include detailed maps, zones and regulations pertinent to its specific area. A site plan is a working document used by on-site staff. It is also a dynamic document in that it should be frequently reviewed and updated.

Regulations contained in site plans will take precedence over the regulations pertaining to the proposed zoning scheme (Section 8). For example, it is proposed that Wadi Gemal Island be zoned strict natural, where only scientists will be permitted to visit. However, a future site plan for the Island may allow supervised tourist visitation.

Table 16 list locations that will require site plans. The provisional Ras Baghdadi Site Plan is given in Appendix B**.** This site plan include seven sections: background; site planning objectives; site location (including map); status of resources; conservation issues or threats; site management strategies and proposed action; and annexes.

Table 16 Locations in the CMA requiring site plans because of their high conservation value and threats from human activity

Location	Values	Threats
Ras Baghdadi	Turtle nesting beach	Egg harvesting
	Dugong and turtle feeding area	Tourist visitation
	Seagrass meadows	Net fishing
		Boating
Umm Abass	Turtle nesting beach	Egg harvesting
	Dugong and turtle feeding area	Tourist visitation
	Seagrass meadows	Net fishing
		Boating
Wadi Gemal	Unique vegetation community	Livestock grazing and

Location	Values	Threats
'wetland'		trampling
Wadi Gemal Island	Turtle and seabird nesting area	Egg harvesting
		Tourist visitation
Qulan Archipelago	Turtle and seabird nesting area	Egg harvesting
		Tourist visitation
Sharm El Luli	Spatially restricted marine assemblages	Boat activity
		Pollution
	Seagrass meadow	Tourist visitation

8.1. Recommendation

- EEAA prepare and implement site plans for Ras Baghdadi, Umm Abass, The Wadi Gemal wetland, Wadi Gemal Island, Qulan Archipelago and Sharm El Luli.

9. Mooring Strategy

Moorings come in a variety of designs, but consist of three main parts; a heavy weight or fixed point on the seafloor; a rope or wire linking the heavy weight to a surface buoy; and a surface line attached to the buoy. The latter is attached temporary to a vessel when in use.

Moorings are desirable in the CMA for two main reasons:

1. They provide extra security and convenience for vessels visiting the CMA.
2. They protect corals and other organisms by eliminating the need to anchor.

A comprehensive Mooring Buoy Strategy has recently been prepared by PSU. The preparation of a Red Sea *Mooring Buoy Strategy* allows a timely revisit of past experience in building and operating the system, as well as an update on its present status. This knowledge, combined with the future needs for moorings over the next 5-years, gives the EEAA and stakeholders a roadmap to follow in improving its operational reliability—and sustainability—while developing the system further.

As an adjunct to the preparation of the *Strategy*, a practical *Mooring Buoy Pilot Program* has been recently implemented to conduct mooring maintenance, make new installations and test out some new approaches. Within the framework of the EEAA-USAID Red Sea support programme, both the *Strategy* and *Pilot Program* comprise part of *EEAA's Southern Conservation Management Plan*.

10. Building Capacity

This Section provides an overview of the EEAA resources currently in the CMA, and recommends future management resources and likely costs. Figure 12 illustrates the current and proposed EEAA resources adjacent to the CMA.

10.1 Personnel, Offices, and Accommodation

There is currently one EEAA office adjacent to the CMA - Marsa Alam. The Marsa Alam rangers patrol the region between Marsa Alam and the Elba Protectorate. El Quseir lies approximately 40 km north of the CMA and is considered here because its rangers patrol the CMA coastline to Marsa Ghaleb. Five rangers are permanently based at the El Quseir and four at Marsa Alam. The El Quesir rangers patrol the coastline from north of El Quseir to Marsa Alam. In addition, the operator of Marsa Ghaleb Harbor has provided EEAA with a one-person office, but is not currently used. Note that funding has been budgeted by EEAA to build a mutli-office complex at Marsa Alam, which will form the headquarters of EEAA activities in the south.

At the time of writing the EEAA, with assistance from the PSU, was establishing an office near the Shams Alam Resort, which is situated at the northern boundary of the WGHPA. A portable office (portacabin) will be purchased and located near the Resort. The Resort will provide electricity and water for the office. It is anticipated that the portacabin will provide accommodation and office space for two to three rangers. In future, additional portacabins will be used to establish an office at the WGHPA's southern boundary, near Hamata, and one at its western boundary, possibly near Sheikh Shazly.

10.2 Office and Field Equipment

The El Quseir and Marsa Alam offices are equipped with computers, printers and faxes. Similar equipment will be required for the new office at Shams Alam and the proposed offices at Hamata and Sheikh Shazly.

10.3 Communications

There are no telephone cables beyond Marsa Alam and mobile telephone reception ends here. Hence reliable communications in the CMA will be via satellite phones, two of which have been recently purchased by the PSU and are held at the EEAA Hughada office. Offshore communications will be via marine radio, with base stations operating from Marsa Alam, Shams Alam and Hamata. Local field communication will be via walky-talkies.

10.4 Vehicle Transport and Heavy Equipment

The El Quseir and Marsa Alam offices each have a single four-wheel drive. At least one four-wheel drive vehicle will be required for the proposed Shams Alam, Hamata and Sheikh Shazly offices.

10.5 Vessel

Patrolling marine waters of the CMA will be essential for the EEAA to achieve its management objectives. It will allow rangers to enforce regulations pertaining to use of moorings and to ensure compliance of zoning rules. Currently there are no EEAA patrol vessels in the CMA, however one from Hurghada will soon be based at the marsa adjacent to the Shams Alam Resort. This will give rangers patrol coverage over Wadi Gemal Island, Ras Baghdadi and Ras Honkorab. A second vessel will be based at or near Hamata Harbor to give rangers patrol coverage over the Qulan Archipelago and the Fury Shoals. Additional support will be provided to the rangers on daily boats traveling to specific reefs.

10.6 Indicative Budget for the CMA

An indicative budget for projected EEAA needs in the CMA area over a 4-year period is given in this Section (Table 17). The budget is based on the following assumptions:

- Projected expenses are tied to the number of operational rangers.
- Budget estimates are based on historical expenditure patterns in the North Zone (i.e. Hurghada / Safaga area) as described by Colby (2003).
- The number of rangers stationed in the south follows the estimates given by Colby (2003) Table 2.41 page 18.
- That the medium-scenario budget is financially more realistically than the low and high scenario budgets proposed by Colby (2003).

The budget is dived over four years (2004-2007) and into three main categories: recurrent operations; capital investment; training and communications. The relevant subcategories are given as footnotes below Table 16. The projected staffing numbers

for the budget period are: 34 – 2003; 48 – 2004; 62 – 2005; and 76 –2006. The main expenses for recurrent operations are salaries followed by operation/maintenance costs. Boats, support facilities and vehicles are the main capital investment expenses. Public awareness programs take the lion's share of the budget in the training and communication category.

Table 17 Future CMA Budget, Medium Case Scenario (after Colby, 2003)

GoE fiscal years	FY03-04	FY04-05	FY05-06	FY06-07	GoE fiscal Year	Total 03-07
Total number of staff south	34	48	62	76	South staff (Marsa Alam/Hamata)	
Recurrent Operations[47]	$376,436	$447,442	$472,040	$543,146	Recurrent operations	$1,839,064
Capital investment inc. shpg.[48]	$252,543	$441,448	$582,667	$620,293	Capital investment	$1,896,951
Training and communications[49]	$204,364	$183,814	$163,264	$142,714	Training and communica-tions	$694,156
South total w contingency ($)	$916,677	$1,179,974	$1,339,768	$1,436,768	South total w/contin-gencies	$4,873,188

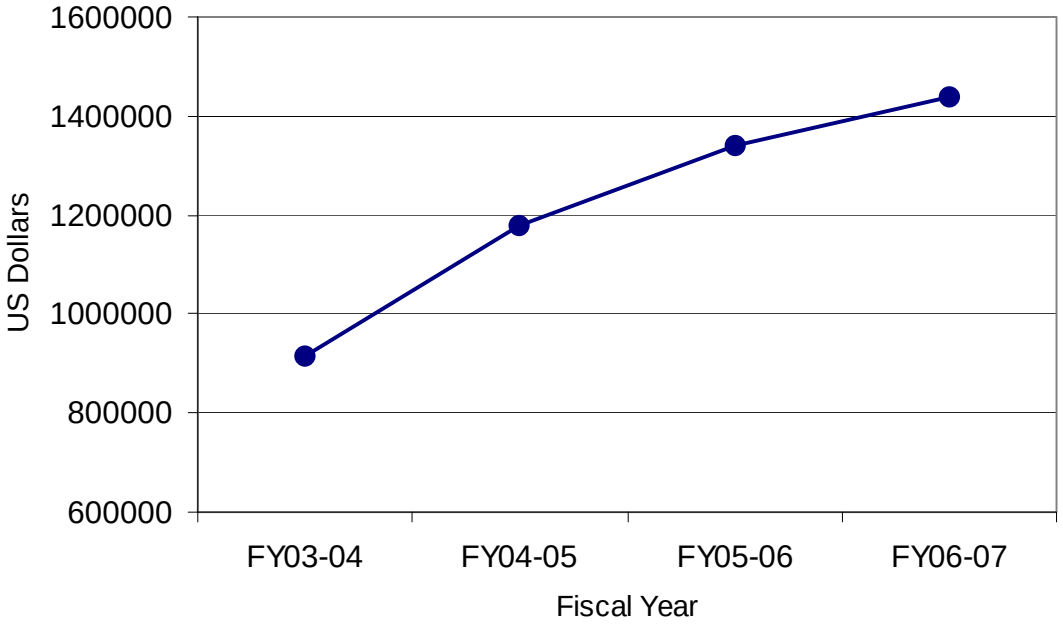
Graph 1 gives the projected budgets for the years 2003 to 2007 based on the medium case scenario as proposed by Colby (2003) and estimates given in Table 17.

[47] Includes: personnel, rent and utilities, operations and maintenance, supplies, travel (rangers) and data for GIS

[48] Includes: facilities, boat and related equipment, vehicles, mooring equipment/supplies, audio-visual equipment, computer equipment, diving equipment, furniture and international shipping cost.

[49] Includes: training and public awareness.

Graph 1 Projected budget for the CMA



11. Consultation

The following people were consulted during the preparation of this Plan. The individuals, their organizations and the topics of discussion are listed below.

Name	Organization	Topic
Dr. Moustafa M. Fouda	EEAA	Protected area planning and management
Dr. Mohamed A. Borhan	EEAA	Oil Spill Contingency Plans in Egypt
Mr. Ayman Mohamed Gomaa	EEAA	Management issues in the southern Red Sea off Egypt
Mr. Ali Salam	EEAA	Red Sea marine turtles
Mr. M. El. Gheny	EEAA	Dugongs
Rangers based in Marsa Alam	EEAA	Management issues in the CMA
Rangers based in El Quseir	EEAA	Management issues in the CMA
Admiral Narder	PSU	Moorings
Dr. Jack Frazer	Smithsonian Institute, USA	Red Sea marine turtles
Mr. Hany L Hakin	TDA	TDA plans along the Red Sea
Dr. Chris Simpson	Manager of Marine Park Branch, CALM Australia	Septic discharge and effects on the marine environment
Mr. Hesham Mostafa Kemel	Red Sea Diving Safari	Visitor use and impacts
Mrs. Mindy Baha El Din	Local eco-tourism specialist	Seabirds and eco-tourism impacts
Dr Michelle Waycott	James Cook University	Indian Ocean seagrasses – taxonomic status.
Dr. Helene Marsh	James Cook University	Management of dugongs

Name	Organization	Topic
Dr. Alain De Grissac	EU/Ras Mohamed Marine Park	Management and protected area planning in Ras Mohamed MP
Dr. Mohamed M. Abou Zeid	Associate Professor, El Azhar University	Proposed modification of the Harbors of Marsa Alam and Hamata
Dr. Sven Uthicke	Australian Institute of Marine Science	Seacumber harvesting and management
Ms. Wera Leujak	PhD Student Ras Mohamed NP	Recreational impacts and management issues
Gen. Moustafa Basiouny	Mayor of Marsa Alam	Boating and Harbor activity at Marsa Alam
Mr. Ashraf Saadawy	Marsa Alam Desalination Plant	Influence of the plant on the marine environment
Mr. Mahmoud M. Aly	Ghuson Port Manager	Influence of the port on the marine environment
Mr. Sferif Fawzy	Marsa Ghaleb Marina Manager	Influence of the marina on the marine environment
Mr. Philip Jones	El Gouna Marina manager	Moorings
Mrs. Kirsten Ehlert	Wadi Gemal Dive Centre	Exploitation of natural resources on Wadi Gemal Island
Mr. Ross McGrath	Red Sea Diving Safari, Hamata Camp	Diving and boating impacts in the Fury Shoals
Mr. Amra Ali	HEPCA	Moorings and tourists boat activity
Mr. Mohamed Habib	RSDA	Tourism boat and SCUBA diving activity
Mr. Ahmend Tawfik	Divers International – Hilton Plaza Hotel	Safari boat activity
Mr. Ed Coe	RSSTI	Tourism development and potential
Dr. John Snyder	Consultant, RSSTI	Tourism development
Mr. Amir H. Gohar	RSSTI	Tourism development

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Appendix A: Seagrass meadows in the Wadi Gemal - Hamata Protected Area, Egypt

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Introduction

Seagrasses are flowering plants able to live permanently in the marine environment. Thirteen species are known from the western Indian Ocean (Gullstrom *et. al.* 2002) and, according to Sheppard *et. al*. (1992), eleven species of seagrass extend into the Red Sea. In the Red Sea, most species are wide spread, but *Halophila decipiens* has only been recorded from the Gulf of Suez (Sheppard *et al*. 1992). In addition, most are restricted to unconsolidated shallow, soft bottom areas, however *Halophila stipulacea* has been reported from 70 m in the Gulf of Aqaba (Lipkin 1977, cited in Jones *et. al.* 1987).

Costanza *et. al.* (1997) argued that seagrass meadows are, on a global scale, the third most valuable ecosystem (on a percent hectare basis), preceded only by estuaries and flood-plains. The value of seagrass lies in its ability to:

- stabilizes seafloor sediments
- provide shelter or substratum for other marine organisms
- act as nursery areas for crustaceans and fishes
- trap and recycle nutrients, and
- provide food for a variety of marine animals including the dugong (*Dugong dugon*)

The abundance and distribution of some tropical marine seagrasses exhibit significant spatial and temporal variability. Factors contributing to spatial variation include exposure, sediment stability, sediment type and nutrient availability. In addition, vertical distribution is influenced by light availability. Humans can also influence the abundance and distribution of seagrasses. Infilling of coastal environments, dredging, anchoring/moorings, eutrophication and harvesting can lead to localised or widespread seagrass mortality.

Despite its ecological significance and vulnerability to human disturbance, little research has been done on seagrass in Egyptian Red Sea waters. A broad-scale seagrass survey was undertaken in the 1990s along the Egyptian Red Sea coast (GEF 1997). Six species were recorded and their percentage cover, along a depth gradient, recorded.

The aim of this study was to provide a preliminary description of seagrasses in the northern section of the recently proclaimed Wadi Gemal – Hamata Protected Area. This information will assist EEAA managers to better manage this resource.

Objectives of the Study

The three main objectives of this study were to:

1. identify the species and estimate their percent cover at a variety of spatial scales
2. describe the spatial distribution of seagrass meadows

3. describe the relationship between seagrass cover and water depth

Methods

Study Area

The study area was located in the northern section of the Wadi Gemal – Hamata Protected Area, Egypt, and included waters off Shams Alam Resort, Ras Baghdadi, Sharm Luli and Umm Abass.

Survey Approach

The survey was conducted from 1 –12 March 2003. Given the large size of the study area, limited field time and a lack of aerial photography a Rapid Survey Assessment (RSA) was adopted. This included haphazardly selecting locations to be surveyed by divers using SCUBA. The major advantage of the RSA is that the observer can cover a large area and is free to follow the direction of the meadow. The primary limitation is that the observer has no navigational information to enable sightings to be related to a sampling site.

Locations were selected to ensure that all main marine environments in the study area were survey: nearshore waters; offshore water (> 20 m); offshore inter/subtidal sandflats; and sharms. In each location, a variable number of sites, of approximately 9 m², were sub-sampled using six 0.062 m² quadrats. Percent cover of each species was estimated for each quadrat. Sites were approximately 20 m apart. The number of sites nested in each location ranged from one to seven. The depth of each site was determined using a U.S.Divers Scan 5 dive computer. Water depth influenced the amount of time available for an observer to remain below water and thus directly influenced the number of sites that could be surveyed in each location. Identification of seagrass species was based on: Phillips and Menez (1988), and Lanyon (1985). Additional advice on the taxonomic status of the genus Halodule in the Indian Ocean was provided by Michelle Waycott (pers. comm. April 2003).

Statistical Analysis

Only descriptive statistics are used to illustrate patterns in the abundance and distribution of seagrasses. The unequal number of replicate sites per location made a robust inferential analysis problematic. Further, many resource managers find descriptive statistics easier to interpret than the more abstract analytical outputs produced by t-test, ANOVA or other statistical tools.

Standard Deviations (SD), rather than Confident Intervals, are shown on plots in order to illustrate variability among the smallest level of replication (i.e. quadrats). SD is simply the measure of the scatter or spread of all values in a series of observations.

Limitation of Study

Before describing the results of this study it is important to identify some of the limitations, not already highlighted, of this and other ‘once-off’ baseline studies. This is done to caution decisions makers against making wild generalizations and inappropriate management decisions based on the results of this study.

A primary limitation of this study is that it is not replicated in time. That is, it is a snapshot of a highly dynamic environment. This lack of temporal replication limits us from generalising about the results to times before and after this study. For example,

at the time of writing this report, the distribution of annual species, such as *Halophila ovalis*, may be very different from when the data were collected. Another limitation is that only a small area of the PA could be survey during the 10-day field trip. In particular, sites deeper than 25 m are not well represented in this study. Indeed, only a single site (at 45 m) was survey in waters deeper than 25 m.

Results

Locations Surveyed

Fourteen locations were surveyed during this study. Ten locations fringed the mainland: five north of Ras Baghdadi; three on the south side of Ras Baghdadi; one at Sharm El Luli and one at Umm Abass**.** The other four locations were located: approximately 1.5 km due east of Shams Alam Resort; the reef flat of Sharb Dahara; subtidal waters off the south-west corner of Sharb Dahara; and the north-west corner of Wadi Gemal Island. Seagrasses were not found at the latter two locations.

Species

Six species were found in the study area:

Family Potamogetonaceae

Cymodocea rotundata

Halodule uninervis

Syringodium isoetifolium

Thalassodenron ciliatum

Family Hydrocharitaceae

Halophila ovalis

Halophila stipulacea

Similar to Hurling (1979, cited in Jones *et. al.* 1987), we found leaf length and colour of *H. stipulacea* varied with depth. *H. stipulacea* at 45 m had longer, greener and softer leaves than specimens found in shallow water.

We also confirmed findings of previous studies (Jones *et. al.* 1987) that *H. uninervis* exhibits considerable phenotypic variation. *H. uninervis* in shallow water had leaves 0.5 – 1mm in width, but plants in deeper water had leaves up to 3 mm wide. In addition, the narrow leaf form sometimes possessed a black central vein that splits into two at the tip. Previously, specimens with this characteristic were assigned to *H. pinfolia*, but genetic studies by Michelle Waycott have determined that that there are only two *Halodule* in the world – *H. wrightii* in the Atlantic and *H. uninervis* in the Indo-Pacific (Michelle Waycott, pers. comm. April 2003).

Spatial Distribution

The known and predicted spatial distribution of seagrasses in the study area is shown in Figure 1, which can be found in Appendix 3, Maps. The predicted distribution relates to *H. stipulacea* off Shams Alam Resort and is based on the assumption that it extends as a continuous meadow from the mainland to at least 45 m. Because *H. stipulacea* has been observed in water depths exceeding 65 m, it probably occurs beyond the limits shown on Figure 1.

Variation in percent cover

Variation among water depths

Figures 2 and 3 show the relation between percent cover of five species of seagrasses and water depth. Note, that the same horizontal scale (x axis) is used for all species to allow easier comparison among species. C. rotundata is not shown because it was not recorded in any quadrats[50]. Each circle represents a site mean based on six replicate quadrats. The only exception is the circle for H. stipulacea at 45 m, which is based on a single synoptic observation made during a 20 min dive.

H. stipulacea had the greatest depth range (0.5 m to 45 m), forming extensive monospecific meadows at depths between 10 and at least 45 m (Figure 2a). All other species occurred in waters between 0.5 m to 10 m (Figures 2b, 2c, 3a and 3b), where they formed multispecific meadows. Percent cover of *H. stipulacea* was not homogenous across its depth range (Figure 2a). From 0.5 m to 10 m, percent cover did not exceed 20 % (mean 4.5 % ± 4 SD), but beyond 10 m, it ranged from 20 to 75 % (mean 50 % ± 5.8 SD). Beyond 25 m, cover of *H. stipulacea* declines, but the rate is unknown. Only one site was sampled beyond 25 m. At 45 m percent cover was approximately 20 %.

Variation among and within locations

To interpret spatial variability in the absence of depth related variability, percent cover for individual species were plotted for sites from similar depths. Four species exhibited variability in percent cover within locations (i.e. among sites in the same locations) and among locations.

Variability in cover, at the scale of site, was clearly evidence for *H. uninervis* and *T. ciliatum* (Figures 4 and 5). For example Site 2, Location 4 had 4x less cover of *H. uninervis* than Site 5. Similarly, cover of *T. cilatum* ranged from about 2 % at Site 2 to 18 % at Site 4, Location 6. Variability in cover among sites was also evident for *H. stipulacea*. Figures 6 and 7 show the percent cover of *H. stipulacea* from fives sites located in water depths ranging from 4 to 5 m and 6 to 7.5 m, respectively.

Figure 7 also illustrates variability in cover among locations (see hatched lines). Mean cover at Location 4 is approximately twice that of Location 6. Other comparisons were not possible given the lack of site replication with locations.

[50] *C. rotundata* was common in intertidal and subtidal meadows immediately adjacent to the dive centre at the Sharms Alam Resort.

Appendix A, Figure 2

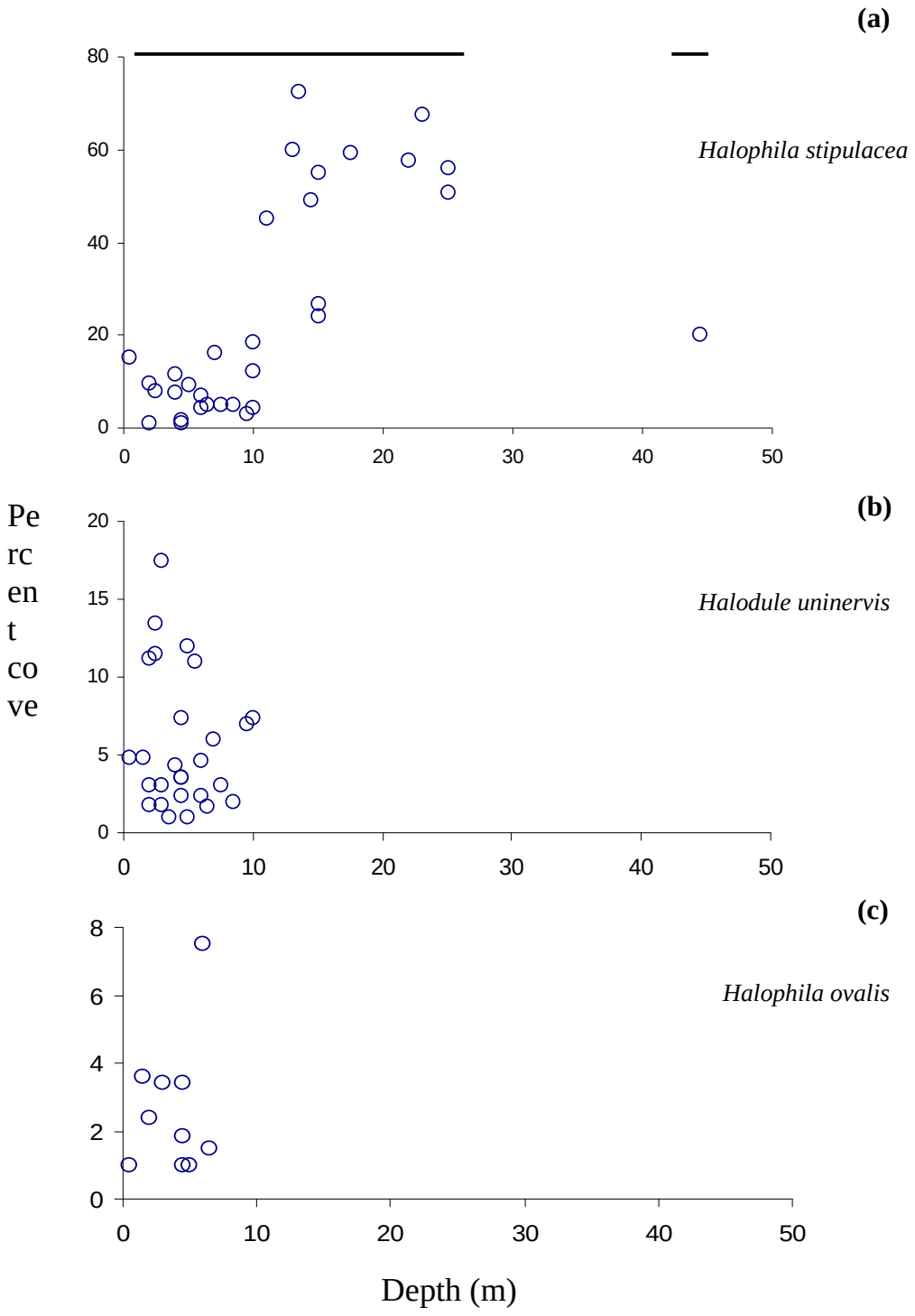

Figure 2: Relationship between percent cover of three seagrass species and water depth. Each circle represents a mean based on six replicate quadrats. The solid horizontal bars indicates the depth ranges surveyed. Note scale differences in the vertical (y) axis.

Appendix A, Figure 3

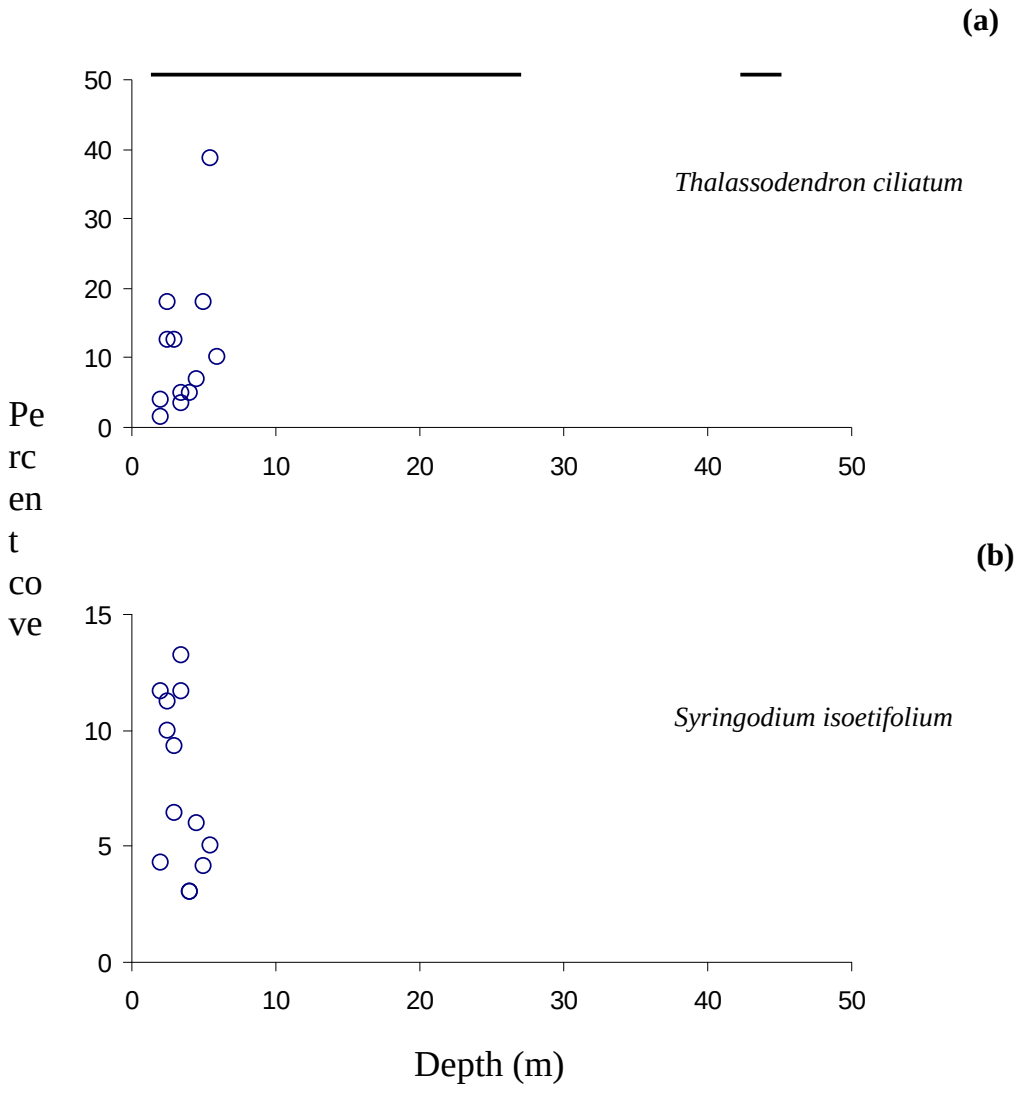

Figure 3: Relationship between percent cover of two seagrass species and water depth. Each circle represents a mean based on six replicate quadrats. The solid horizontal bars indicates the depth ranges surveyed. Note scale differences in the vertical (y) axis.

Appendix A, Figure 4

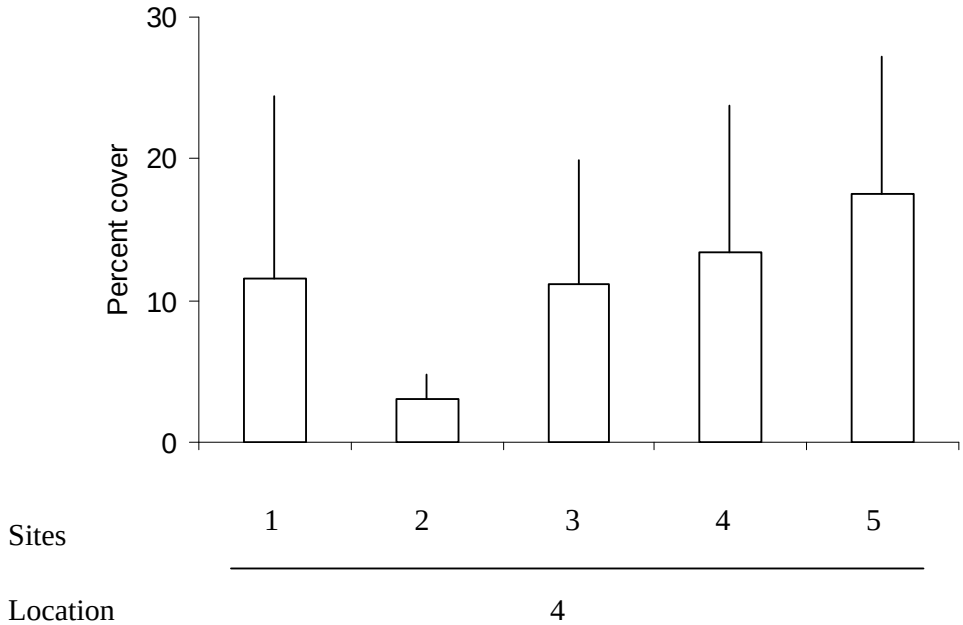

Figure 4: Mean (±SD) percent cover of *Halodule uninervis* from five sites at water depths 2 – 3 m.

Appendix A, Figure 5

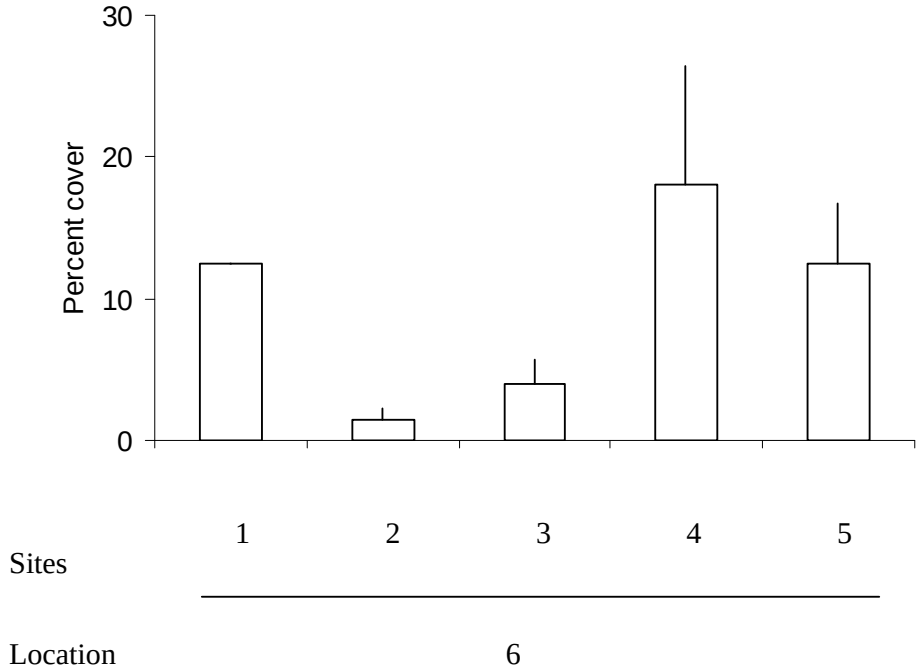

Figure 5: Mean (±SD) percent cover of *Thallasodenron ciliatum* from five sites at water depths 2 – 3 m.

Appendix A, Figure 6

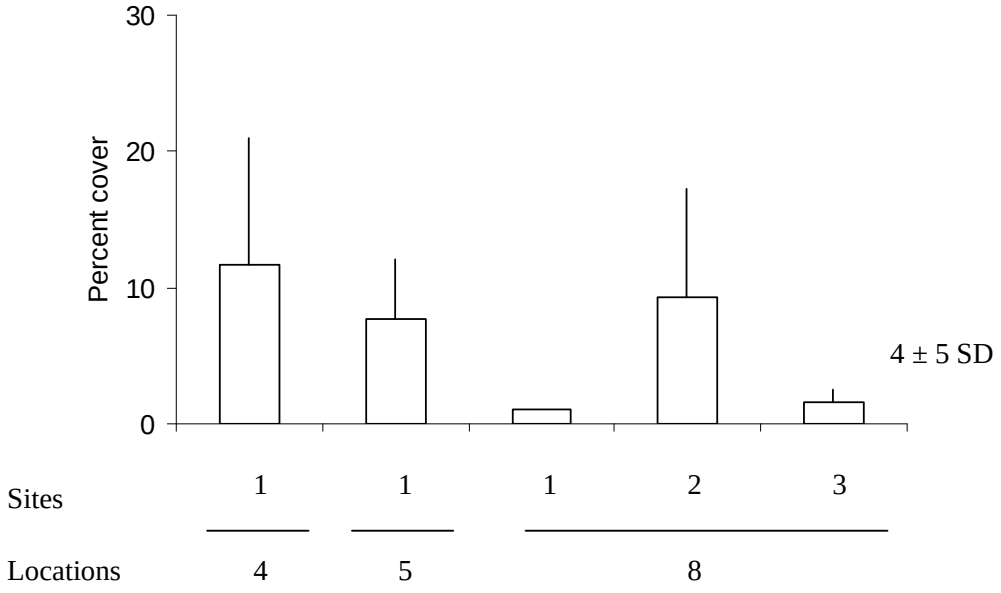

Figure 6: Mean (±SD) percent cover of *Halophila stipulacea* from five sites at water depths 4 – 5 m. Six replicate quadrats were sampled at each site. The dashed line shows the location average based on replicates sites.

Appendix A, Figure 7

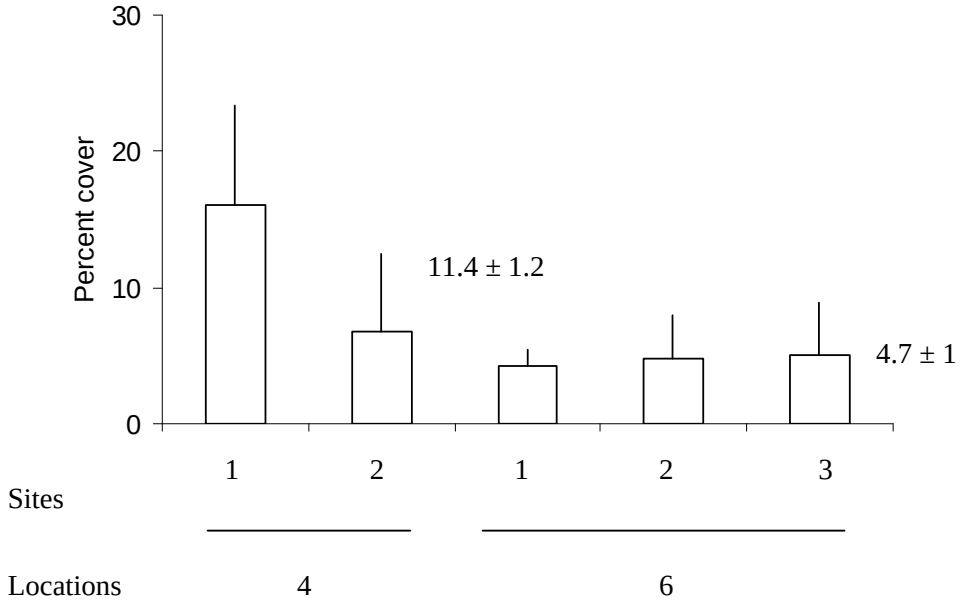

Figure 7: Mean (±SD) percent cover of *Holphila stipulacea* from five sites at water depths 6 – 7.5 m. The dashed line shows the location average based on replicate sites.

The long SD associated with many sites, suggest that cover varied markedly among quadrats in the same site. This is evidence of considerable variability in cover even at very short spatial scales (e.g. distances between quadrats ranged from 2 to 4 m).

Discussion

Six of the eleven known species of seagrass reported from the Red Sea were observed during this study. Of the remaining five species, *Cymodocea serrulata*, *Thalassia hemprichii* and *Enhalus acoroides* have been recorded from other areas of the Egyptian Red Sea coast (GEF 1997), and probably occur in the PA. *Halophila ovata* is known from Jeddah, Saudi Arabia (Jones *et. al*. 1987) and *Halophila decipiens* has only been recorded from the Gulf of Suez (Sheppard *et. al*. 1992).

According to Jones *et. al.* (1987) *H. stipulacea* is the most widespread seagrass in the northern Red Sea. We confirm that *H. stipulacea* has considerable ecological tolerance (Schwarz and Hellborn 2002), being found from intertidal to water exceeding 40 m in the study area.

All other species recorded in this study were restricted to a narrow depth range. This is generally consistent with other areas of the Red Sea (Jones *et. al.* 1987). However, *T. ciliatum*, which was not recorded deeper than 10 m in this study, has been observed in water exceeding 40 m in the Gulf of Aqaba (Lipkin 1979, cited in Jones *et. al.* 1987).

The seagrasses of Wadi Gemal – Hamata PA have significant biological importance. Notably, seagrasses are food for the dugong (*Dugong dugon*), which is listed as vulnerable to extinction at a global scale by the World Conservation Union (IUCN). Dugongs are frequently observed in the study area (Mohammed El Ganay, EEAA Hurghada, pers. comm. April 2003). Species of seagrass consumed by dugongs in the Red Sea are: *H. stipulacea*, *H. uninervis*, *T. ciliatum*, *C. rotundata* and *S. isoetifolium* (Lipkin 1975). All these species were recorded in the study area. Feeding trails, created by dugongs when they consume seagrass rhizomes as well as leaves, have been observed in meadows off Umm Abass and north of Ras Baghdadi. Trails appeared as shallow trenches, ranging from 10 – 20 cm in width, of varying lengths. Trails were only found in mixed meadows of *H. uninervis*, *H. ovalis* and *S. isoetifolium*. Researchers in Australia believe that dugong target these species for food because of their high nutritious value (Preen 1993).

Management Implications and Recommendations

Wadi Gemal – Hamata PA has important seagrass resources that need to be protected. Currently, there are no major human threats to seagrasses in the PA. However, boat anchors and chains continue to have localised impacts on some meadows, particular in Sharm El Luli and other areas where vessels frequently anchor on soft bottom seabeds. Soft bottom seabeds provide good holding for sand anchors, but also support seagrass meadows.

Resort construction and operation near sharms or marsas also pose a threat to seagrasses. Increased turbidity, associated with construction activity, and elevated nutrient loads, attributed to septic systems or direct sewage discharge from vessels, may stress seagrasses. These stresses will be exacerbated in semi enclosed water bodies where flushing is limited.

The following actions will assist EEAA to protect seagrasses in the Wadi Gemal – Hamata PA from human disturbance:

1. Undertake a comprehensive survey to describe the abundance and distribution of seagrasses throughout the PA
2. Identify threats to seagrasses in the PA and identify 'hotspots' of disturbance
3. Prepare a strategy to minimise disturbance of seagrasses by anchors and other threats

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Appendix B: Provisional site plan for Ras Bhagdadi

Background

What is a Site Plan? It is a conservation management document that is prepared for the purpose of directing a series of actions to solve problems. A Plan describes a specific area in terms of its geographic and biological features or assets, then reviews the status of the area and determines how the area is being used. Conservation issues or problems are identified and a management strategy is formulated to solve them. Finally, a series of actions are detailed for subsequent implementation.

Legal basis for Ranger activities. Site Plans are used by the EEAA Red Sea Rangers in their conservation activities in the Red Sea Protectorates, the new Wadi Gemal–Hemata Protected Area and Elba Protectorate. Ranger activities in the Red Sea are legally mandated under Law 102 (1983), Prime Ministerial Decree 642 (1995), and Prime Ministerial Decree 143 (2003).

Link to southern Conservation Management Plan (CMP). A regional-scale CMP is being developed to provide EEAA with an appropriate management response to deal with increasing human activity in the Red Sea. The CMP area incorporates all Egyptian territorial waters between Ras Toronbi and Ras Banas, inclusive of the Wadi Gemal–Hamata PA. An important strategy of the CMP is to prepare detailed Site Plans for biologically important areas that are experiencing intensive human activity.

Site Planning Objectives

Safeguarding the Ecology. The overriding objective is to maintain the ecological integrity of the site, to ensure that direct or indirect development activities do not degrade, and ultimately destroy, the site's natural assets.

Managing use of the site. Other objectives of this site plan are to:

- minimise disturbance of seagrass meadows by human activity
- prevent dugong and turtle mortality by fishing nets and fast moving boats
- minimise disturbance of corals and associated fauna by human activity

Site Location

Ras Baghdadi is located in the Wadi El Gemal – Hamata PA and is situated approximately 60 km south of Marsa Alam. It is about 3 km south of Shams Alam Resort, and is the closest point on the mainland to Wadi Gemal Island. The area that is covered by this site plan, including contiguous waters, is illustrated on Figure 1 (see Appendix 3,maps).

Status of Resources

Seagrass. Seagrass are abundant in waters adjacent to the Ras, but are particularly diverse on the south side. Monospecific meadows of *Halophila stipulacea* dominate waters deeper than 10 m, while multispecific meadows of *Halophila ovalis, Syringodium isoetifolium, Halodule uninervis* and *Thalassodendron ciliatum* are common in shallower waters. Dugongs consume most of these species, but *H. ovalis* and *H. uninervis* are believed to be the preferred food species.

Dugongs. Dugongs (*dugong dugon*) are frequently observed in coastal waters north and south of Ras Baghdadi. Adults and juveniles have been observed in the area. Feeding trails, created by this species, have also been observed in seagrass meadow off the north side of the Ras.

Marine turtles. Green turtles (*Chelonia mydas*) and possibly hawksbill turtles (*Eretmochelys imbricata*) nest on Ras Baghdadi and feed in adjacent waters. In Egypt, most nesting occurs from May to November.

Stingrays. Seagrass meadows south of Ras Baghdadi are important feeding and resting areas for at least four species of stingrays. Stingrays are most abundant during summer and are an important tourist attraction for the local diving centre.

Conservation Issues or Threats

Use of nets. Net fishing (mesh size >150 mm) is a major source of mortality for dugongs and marine turtles. Nets are also a major source of mortality for non-target fish species and can damage reefs. Unfortunately, net fishing is frequently conducted in the area and turtles have been observed entangled in fishing nets.

Boating activity. Dugongs and marine turtles are vulnerable to being struck by fast moving vessels. Reefs east of Ras Baghdadi are important diving locations. At least 30 dive sites are located the Wadi Gemal area. Thus boating activity is high in the area. Fishing boats also operate in the area. Anchors and chains can scour seagrasses. Some vessels shelter south of the Ras during strong northerly winds.

Turtle egg harvesting. Ababda are known to harvest turtles eggs for consumption.

Site Management Strategies and Proposed Actions

- Where practical fix buoy markers to delineate the boundary of site plan area
- Ban all net fishing in the site plan area[51]
- Ban all anchoring in the site plan area, except under emergency conditions
- Vessel moving through the site plan area must not exceed 10 kn[52]

[51] Net fishing by the non-indigenous population will eventually be phased out of the PA. However, this will require consultation with the local fishing community. Until this is achieved, an immediate localised closure of waters adjacent to the Ras is desirable to prevent dugongs and marine turtles from being drowned in nets.

[52] Based on speed limits for dugong protection areas in Australia

- A single mooring is currently located on the south side of Ras Baghdadi – no additional moorings will be permitted in the site plan area, unless with formal approval from EEAA
- Only one vessel is permitted on the existing mooring at any one time
- Divers and boats are not permitted to intentionally approach/chase dugongs
- EEAA rangers undertake random boat patrols in the site plan area to ensure compliance of rules
- EEAA rangers inform local Ababda that it is illegal to harvest turtle eggs
- EEAA rangers undertake periodic surveys of nesting beaches to ensure Ababda are not harvesting turtle eggs
- EEAA rangers disseminate these rules to dive staff, fishermen and Abdada living and or operating in this area.

Appendix C: Maps

Figure 1 Location map

Figure 2 Hard coral diversity and seagrass cover in the CMA

Figure 3 Mangrove stands in the CMA

Figure 4 Recent dugong sightings, turtle nesting sites and seabird rookeries in the CMA

Figure 5 Towns, Bedouin villages and resorts

Figure 6 Petroleum concession areas in the CMA

Figure 7 Fishing grounds and fish landing sites

Figure 8 Mooring locations in the CMA

Figure 9 Locations of reef flat disturbance in the CMA

Figure 10 Known and potential pollution sources in the CMA

Figure 11 Indicative zoning scheme for marine waters in the WGHPA

Figure 12 Location of EEAA and other relevant facilities

Appendix A, Figure 1

Appendix B, Figure 1