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Management Plan for Wadi El-Gemal–Hamata

IUCN Category II National Park

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Acronyms and Abbreviations

AED	Academy for Educational Development
AOP	Annual Operation Plan
CMA	South Red Sea Conservation Management Area
EEAA	Egyptian Environmental Affairs Agency
EEPP	Egyptian Environmental Policy Program
EGSMA	Egyptian Geological Survey and Mining Authority
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EU	European Union
GAFRD	General Authority for Fisheries Resources Development
GOE	Government of Egypt
GOPP	General Organization for Physical Planning
HEPCA	Hurghada Environmental Protection And Conservation Association
HSD	Health Services Directorate (governorate level)
IUCN	International Union for Conservation of Nature (World Conservation Union)
LE	Egyptian Pound (currency)
LF	Logical framework
MoA	Ministry of Agriculture
NCS	Nature Conservation Sector
PAMU	Protected Area Management Unit
PSU	Program Support Unit
SCA	Supreme Council for Antiquities
SFD	Social Fund for Development
TDA	Tourism Development Authority (Egyptian)
USAID	United States Agency for International Development
WFP	World Food Program
WGHPA	Wadi el-Gemal–Hamata Protected Area
WHO	World Health Organization

Executive Summary

This is a draft plan to manage the natural and cultural resources within the Wadi el-Gemal – Hamata Protected Area (WGHPA), established by Prime Ministerial Decree 134/2003.

This was declared a protected area (PA) by the Government of Egypt to ensure that existing and future pressures on the area's natural values were managed within an ecologically sustainable framework, maintaining the traditional and characteristic culture of the local population. The plan was also to act as a regional planning tool, enhancing the robustness of sustainable economic output in the region.

The management plan reviews the PA's most outstanding resources and indicates their relative significance. PA objectives are formulated based on national conservation goals set out in various statements, particularly the National Biodiversity Strategy and Action Plan (Natural Conservation Sector [NCS] 1998), and in conformity with international PA management standards established by IUCN. Management issues (problems, obligations, and opportunities) are identified, along with proposed policies and actions to be adopted by the NCS of the Egyptian Environmental Affairs Agency (EEAA). Management tools and resources are reviewed in detail. Guidelines for implementation, finance, and evaluation are provided.

Management Framework and Apparatus

The NCS/EEAA is the body legally obliged to manage the PA and apply relevant legal requirements under Law 102/1983 Law for the Natural Protectorates, and to fulfill national conservation objectives. This management plan is meant to be a guiding tool to the NCS/EEAA staff entrusted with the administration of WGHPA to facilitate their effective management of the region's natural resources.

The management of WGHPA will build upon the existing experience gained in other PAs in Egypt. The management apparatus formally recognized as part of the NCS/EEAA structure is adopted here; i.e., an autonomous Protected Area Management Unit (PAMU), headed by the PA manager would administer the PA. The PAMU will report to the Red Sea Regional PA Office in Hurghada, which in turn reports to NCS/EEAA Cairo.

Resources of WGHPA

WGHPA encompasses a great diversity of habitats in a uniquely compact setting, representing a complete terrestrial/marine ecosystem characteristic of the Red Sea coast. The region is of phenomenal natural beauty and outstanding biological diversity. The coral reefs are among the best and most diverse in the Egyptian Red Sea, and are home to a great diversity of fish and marine invertebrates. They have enormous economic value, providing the basis for international tourism activities and sustain locally important fisheries.

WGHPA includes a significant proportion of the mangrove resources of Egypt. At Hamata, thickets of *Avicennia marina* extends for 12 kilometers (km) in a semi-continuous fringe, and form important nurseries for economically important fish and nesting sites for many of the region's water birds. Substantial sea grass beds provide food for the threatened Green Turtle, *Chelonia mydas*, and Dugong, *Dugong dugon*. At least two species of marine turtles nest on islands, as well as on the mainland coast in the PA, where some of the country's most important turtle nesting sites are found.

The interior of the PA is a complex pristine mountain wilderness, inhabited by a diversity of wildlife including several endangered species, and representing an enormous resource for ecotourism activities. The Wadi el-Gemal watershed at 1,476.7 km² is one of the largest drainage basins in the Eastern Desert of Egypt. It is perhaps the best-vegetated wadi in the Eastern Desert, encompassing dense groves of *Tamarix sp., Balanites aegyptiaca, Salvadora persica and Acacia tortilis*, representing a unique relict of Sahalian vegetation.

There are 20 globally threatened species known from WGHPA, the most significant of these (i.e. species for which WGHPA can make an important contribution towards their global conservation) are: marine turtles, Dugong, White-eyed Gull, *Larus leucophthalmus,* Dorcas Gazelle, *Gazella dorcas*, and Barbary Sheep, *Ammotragus lervia*.

Table 1 provides a brief look at the diversity of taxonomic groups recorded in the WGHPA.

The area is inhabited by local pastoral peoples belonging to the Ababda Tribe, who still practice a traditional lifestyle largely in harmony with their environment. The area has many archaeological sites along important historic trade routes linking the Red Sea with the Nile Valley. Natural systems are still intact and development in the area is still in its infancy, but is expected to pick up pace in the near future. Mining and quarrying are relatively widespread activities, and there are several old inactive gold and emerald mines scattered throughout the area.

Table 1 Numbers of species of various taxonomic groups recorded in WGHPA

Group	Number of species
Algae	58
Sea grasses	7
Terrestrial flora	73
Coral (hard and soft)	86
Gastropods	96
Echinoderms	43
Fish	104
Reptiles	29

Management Category and PA Objectives

WGHPA is designated primarily as a National Park (PA managed mainly for ecosystem protection and recreation, IUCN PA management category II). This defines the PA as a "natural area of land and/or sea designated to:

1. Protect the ecological integrity of one or more ecosystems for present and future generations
2. Exclude exploitation or occupation inimical to the purposes of designation of the area
3. Provide a foundation for spiritual, scientific, educational, recreational, and visitor opportunities, all of which must be environmentally and culturally compatible."

WGHPA fits the National Park criteria: It is of substantial size, encompasses a unique example of a complete marine/terrestrial ecosystem not significantly altered by man and largely in pristine natural condition, has outstanding landscape features, has significant recreational value, and has sites of important spiritual significance.

Accordingly the main proposed management objectives for WGHPA are:

- To maintain the natural resources and conditions of the PA;
- To protect cultural heritage resources of the PA;
- To enhance the sustainable utility of natural resources in the PA through the establishment of appropriate management systems;
- To promote WGHPA as a focal point for ecologically sensitive tourism, thus expanding and diversifying the economic activity base in the region;
- To enhance the environmental quality of the WGHPA;
- To optimize socio-economic benefits to the indigenous population from the region's natural heritage;
- To promote public understanding and appreciation of Egypt's natural heritage.

Management Issues, Policies, and Actions

Thirty management issues have been identified. Management issues include problems that currently or potentially could degrade the values of WGHPA, as well as opportunities such as development of ecotourism, and obligations for the Protected Area Management Unit (PAMU) such as visitor safety. For each management issue, approaches and specific actions are identified within a comprehensive framework reflecting and reinforcing the primary objectives of the PA.

Management Tools

Zoning is a primary management tool. Eight internal management zones are proposed, with management guidelines provided for each zone. Table 2 gives some detail about these eight zones.

Table 2 WGHPA internal management zones

Name of Zone	Management Input	Permissible Impact Level
1. Strict natural zone	Low – moderate	Zero impact
2. Premium wilderness zone 3. No-take zone	Moderate	Low impact
4. Recreational zone 5. Archaeological protection zone 6. Traditional use zone	High	Moderate impact
7. Multiple use zone 8. Adjacent Area (Buffer Zone)	High	High impact

In addition, patrolling, law enforcement, monitoring, licensing, moorings, site and species action plans, signposting, and public awareness are recognized as important management tools for WGHPA.

Management Resources

It is anticipated the PAMU for WGHPA will need to include about 50 staff members within the next 5 years to effectively manage the PA's resources and achieve stated objectives. The PAMU staff will include five ranks starting with the PA Manager, Senior Rangers, Rangers, Junior Rangers, and Community Guards. WGHPA is divided into three management sectors: Northern, southern, and inland. Each sector would have a base office and its assigned staff. Initially the PAMU would be based in temporary office space at Shams Alam (northern end of the PA). Important management facilities for PAMU staff include patrolling vehicles and vessels, monitoring equipment and housing.

Plan Implementation and Management Priorities

The implementation of this plan will require that priorities must first be identified and addressed accordingly. Generally the first priority should be given to conflict resolution for large-scale activities that might be planned by TDA in the two "ecotourism development areas." These activities might have a geographically as well as ecologically significant footprint on the region. It is best to resolve such conflicts at the planning stage rather than during implementation or operation. Second priority is to halt or control the primary current adverse activities, which are degrading the natural resource base of WGHPA, and which will continue to do so unless management interventions are not made by PAMU. Third priority can be given to public awareness and education. The enhancement of natural resources and promotion of the sustainable utility of resources (such as ecotourism) are proactive measures that seek to improve future utility of the natural resources of WGHPA.

The integration and consultation of indigenous inhabitants should be a constant priority for the PAMU from day one.

Plan Update and Review

This plan is meant to be flexible and should be regularly updated to keep up with new facts. It should be completely reviewed every 5 years. A yearly Operational Plan would be developed by the PAMU to translate this plan into clear and more practical and measurable actions and targets, associated with a detailed budget.

1. Introduction

Egypt has declared its commitment to enhancing environmental quality and the promotion of sustainable use of its natural resources as a strategic choice for the future of the country. The Government of Egypt has adopted a National Biodiversity Strategy and Action Plan (NCS 1998), which call for the establishment and maintenance of a representative PA network in the country.

Since the passage of the cornerstone legislation mandating the establishment of PAs (Law 102/1983), Egypt has succeeded in establishing a network of 24 PAs covering some 95,000 km² representing over 9 percent of the nation's territory. These most valuable segments of the country represent a legacy and a reservoir for future generations. The PA model has proven to be one of the most effective natural and cultural resource management tools in the Egyptian context, and in several cases have proven to be an essential asset to regional development (as is the case in South Sinai). Excellent partnerships have developed between PAs and various compatible users, the tourism industry in particular. This has shown that PAs are not merely closed areas that do not contribute to the national economy, but indeed are valuable assets, which can be highly productive if appropriately managed (Fouda 2002).

As part of Egypt's drive towards rational and sustainable use of its natural resources, the Wadi el-Gemal–Hamata Protected Area (WGHPA) was declared in January 2003 by Prime Ministerial Decree 143/2003 under Law 102/1983 concerning PAs, making it the 24th PA to be declared to date. This was the outcome of technical facilitation provided by the EEPP–PSU in cooperation with the EEAA.

The EEPP–PSU work plan calls for the establishment of a management plan for the WGHPA, as part of the Southern Red Sea Conservation Management Plan. WGHPA is centrally situated in the South Red Sea Conservation Management Area (CMA) and occupies a substantial part of its territory. In addition, the status of WGHPA under the provisions of Law 102/1983, gives extensive authority for the EEAA to manage the resources of the region effectively. Thus, the WGHPA Management Plan is regarded as a central and focal component of the South Red Sea Conservation Management Plan.

1.1 Purpose of the Plan

The WGHPA management plan aims at facilitating the fulfillment of the PA's main objectives, through ensuring that existing and future pressures on the area's natural

resources are managed within an ecologically sustainable framework, maintaining the traditional and characteristic culture of the local population and acting as a regional planning tool to diversify land use along the Red Sea coast, thus enhancing the robustness of future economic output in the region.

Specifically the plan provides a review of the resources, opportunities, and problems in the PA, based upon which management policies and specific actions are identified within a comprehensive framework. Zoning is a primary management tool, with guidelines provided for specific zones. Site management plans are proposed for particular resource hotspots. Detailed instructions are provided to the PA manger and staff.

1.2 Framework of the WGHPA Management Plan

The management of the WGHPA is the responsibility of the NCS of the EEAA the body responsible for the management of the National PA Network under the MSEA.

The management of PAs in Egypt is subject to the provisions of Law 102/1983, which outlines and identifies the basic legal framework for managing a PA. PAs in Egypt have a standard management and administrative structure, sanctioned by the NCS/EEAA. In addition, the NCS has developed and adopted management planning approaches that are being applied to the National PA Network. The WGHPA management plan will be developed within this existing framework, taking into consideration local needs and limitations. Standardization and conformity with national level processes will facilitate both the smooth day-to-day on the ground management of the PA, as well as strengthen and streamline national PA management capacity.

This management plan is seen as a plan specifically designed to guide the management by the NCS/EEAA of the natural resources in WGHPA according to its legal mandate and obligations under Laws 102/1983 and 4/1994. Stakeholder consultation and participation in the WGHPA management planning process is an important component for its development.

Importantly, this plan should not be viewed in isolation but as an integral component of a suite of complementary management practices that should occur in the region adjacent to the PA. These include fisheries and hunting regulations, wildlife protection, pollution control and environmental impact assessment, as well as maritime transport and safety measures (see CMA Management Plan, Vol. 1).

1.2.1 Legal Framework

Law 102/1983 Protected Areas Law—The main PA legislative instrument, Law 102/1983 sets out the principles for the declaration of PAs and stipulates development restrictions and prohibited activities within and adjacent to the PA.

The Law obliges the EEAA, as the concerned administrative body, to:

- Forbid actions leading to the destruction or deterioration of the natural environment and biota or which would detract from the aesthetic standards of the PA
- Regulate scientific research
- Develop management plans for declared PAs
- Increase public awareness
- Regulate recreational activities in PAs to protect natural resources
- Establish control systems to enforce regulatory measures.

Article 3 of Law 102/1983 states, "It is forbidden to undertake activities or experiments in the areas surrounding designated protectorates [i.e. buffer or adjacent zone], which will have an effect on the PA's environment and nature, except with the permission of the concerned administrative body."

In addition, the Law established the "Protected Area Fund" specifically to finance the management of PAs; this fund includes all revenue from donations, grants, sales, entrance fees, fines, and subsidies. According to Article 6, the Fund can be used for:

- Supplementing the budget of the EEAA
- Enhancement of protectorates
- Undertaking surveys and field research
- Rewarding persons who provide information on offences or who apprehend offenders.

Prime Ministerial Decree 1067/1983—Designates the EEAA as the authorized body to apply Law 102.

Prime Ministerial Decree 264/1994—Sets out conditions, rules and procedures for definition and regulation of activities in natural reserve areas and provides the NCS/EEAA with executive administrative authority over natural protectorates. It has six articles and various conditions and rules and expressly forbids construction or development of any type without the permission of the EEAA.

Prime Ministerial Decrees 450/1986, 642/1995—Established the Elba PA, which includes all Egyptian Red Sea islands and the adjacent waters out to 1 km (22 islands) and all mangroves south of latitude 27°15′.

Prime Ministerial Decree 134/2003—Established WGHPA.

Law 4/1994 for the Environment—Establishes principles and procedures to address environmental issues in Egypt. This comprehensive law includes measures to address terrestrial, air, and water pollution. Law 4 notes that the EEAA has the power to administer and supervise PAs. Importantly, the law specifies that all development is required to go through an appropriate EIA process.

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 EIA. Furthermore, Article 60 prohibits all activities that cause any alteration or modification to the natural shoreline.

Law 4/1994 also prohibits the hunting, possession, transport, and sale of those species of wild fauna (alive or dead) determined by Executive Statutes of the same law.

Law 2/1973—Authorizes the Ministry of Tourism as the administrative body for the supervision and exploitation of tourism areas.

Law 117/1983—Provides for the protection of antiquities and historical sites.

Presidential Decree 374/1991—Establishes the General Authority for Tourism Development (TDA) to be responsible for allocation and sale of land in designated tourism areas. The local governorate approves development within recognized boundaries of urban areas.

Ministerial Decree 1611/1989 (Ministry of Justice)—Granted "police powers" to the manager of the EEAA governorate branch in which there is a PA and to the manager of the PA.

Ministerial Decree 1353/1996 (Ministry of Justice)—Vests certain employees of the EEAA, including Managers of Natural PAs with the capacity of "Judiciary Seizure Officers" relative to infringements of the Environmental Code enacted by Law 4/1994 and its Bylaws, relative to their competence.

Law 53/1966 Agriculture Law—Defines wild fauna protection regulations.

Decrees (Ministry of Agriculture) 28/1967, 5/1983, 66/1983, 1227/1998 and 90/1990—Lists the protected species in Egypt (12 mammals, 13 reptiles, and more than 100 birds).

Law 124/1983, Fisheries Law—This law deals with all living aquatic resources, fishing grounds, vessels, fishing methods, pollution, licensing, fees, penalties, and other matters.

Presidential Decrees 190/1983; 465/1983; 362/1984—The GAFRD was created by Presidential Decree No. 190 of 1983. Presidential Decree No. 465/83 gave the GAFRD the right and obligation to supervise, administer, and monitor the fisheries of Egypt. Presidential Decree No. 362 of 1984 declared that all license fees due for fishermen and fishing vessels are the property of the authority.

International Obligations—Egypt has ratified or signed a number of conservation-related international conventions including the Bonn Convention (CMS), Ramsar Convention, CITES, Biodiversity Convention, the African Convention on

Conservation of Nature and Natural Resources and the Convention concerning the Protection of the World Cultural and Natural Heritage.

1.3 Areas Addressed by WGHPA Management Plan

This management plan addresses the area of land and sea defined in Prime Ministerial Decree 143/2003 declaring WGHPA (Appendix 1). The decree describes the boundary of WGHPA with 14 geographical coordinates (Map 1), including an area of 4,770 km² of land, in addition to about 2,000 km² of marine waters. The decree also designates the boundary of two areas dedicated within WGHPA as "ecotourism development areas," one in the north at Ras Honkorab (22.3 km²) and the other larger one in the middle section of the PA including the community of Abu Ghusoon (41.9 km²). According to the PA declaration, the development areas are to be utilized for ecotourism.

WGHPA is situated in the Red Sea Governorate, approximately 50 km south of Marsa Alam. The PA encompasses a segment of the Red Sea coastal plain (about 70 km of coastline, including the ecotourism development areas) and mountains extending roughly between 24°52' N in the north and 24°05' N in the south; and between the Red Sea shoreline in the east to about 34°28' E in the west (the Sheikh Shazli road). The PA also includes Qurat el-Hartway Bay and a section of the marine environment including the islands of Hamata and Wadi el-Gemal Island.

1.4 Planning Period

The operational period for this management plan is 5 years, from 2003–2008. However, as situations change over time and new information becomes available, it is essential that some sections of this document be regularly updated and that a comprehensive revision is undertaken every 5 years. The PA Manager should initiate the review process and supervise intervening amendments.

1.5 Plan Structure

This plan follows, to a large extent, a structure developed by the NCS/EEAA and IUCN for use in Egypt's PA Network in May 2002. It starts with a description of the PA and its resources and an overview of its legal and socio-economic setting; then it reviews proposed management objectives. The next section provide an extensive appraisal of management issues along with proposed policies and actions to address them; then there is an overview of management tools and resources; then funding issues are discussed and a proposed budget provided; and finally there is a brief discussion of implementation and evaluation. Additional supportive information and maps are provided in appendices.

1.6 Main Roles of the Wadi el-Gemal–Hamata Protected Area

The PA will facilitate the maintenance of the natural and cultural resources of the region, through ensuring that existing and future pressures on the area's natural values are managed within an ecologically sustainable framework, maintaining the traditional and characteristic culture of the local population. The PA seeks also to act as a regional planning tool to diversify land use along the Red Sea coast and enhance the robustness of future economic output in the region. The PA will be critical in conserving biological components characteristic of the Red Sea littoral plain, which is not represented in any other PA in Egypt. It will also play an important role in the conservation of several highly endangered mammals and their habitats. Cultural heritage resources will certainly benefit from regular patrolling and presence of PA staff. Visitor regulations will introduce a badly needed element of supervision in this region. The PA would also promote controlled visitation to the sites.

WHGPA provides a management tool to better cope with an expected increase in human use of this area. This reflects a proactive approach to managing the human usage of the area rather than implementing reactive management strategies. The value of WGHPA will become increasingly apparent when large stretches of the Red Sea coastline is occupied with manmade structures, and visitors seek to experience the natural setting of the Red Sea. Here the PA will play a critical (and even an ethical) role in preserving not only natural resources and biological diversity, but also options for future generations: to see some of the coast in its natural state; to establish alternative development patterns in the future; and to utilize natural resources available in a different fashion.

1.7 Vision Statement

"Wadi el-Gemal – Hamata PA and its invaluable natural and cultural resources will be established as a world class attraction and an important regional asset for sustainable economic growth; as a result of systematic, responsive, and effective management and promotion of its resources".

2. Description of Resources

2.1 Physical Description

2.1.1 General Description

The WGHPA includes marine and terrestrial components. The terrestrial component encompasses a substantial segment of the Red Sea hills and coastal desert. Wadi el-Gemal and its delta are the focal attraction of the PA, which encompasses the entire watershed of the wadi. However, the PA takes in other adjacent desert and marine habitats, which complement the wadi, both ecologically and functionally (i.e., in terms of representing a meaningful management unit).

Wadi el-Gemal is the third largest wadi in the Eastern Desert, draining into the Red Sea, and one of the best vegetated, with an estimated watershed area of some 1476.7 km² (Mansour 2003). The wadi watershed includes the northern flanks of Gebel Hamata in the south, as well as the southern flanks of Gebel Nugrus in the north. Several other important wadis are encompassed in the PA such as Wadi Abu Ghusoon, Wadi el-Ranga and Wadi el-Rada. Several important peaks are included such as Gebel Hamata Gebel Nugrus, Gebel Hafafeet, Gebel Hamamid, Gebel Sartut, and Gebel Sikait.

The shores of the region are heterogeneous in nature, encompassing rocky, sandy, and muddy beaches. The coastline has several important landmarks such as the headlands of Ras Baghdadi and Ras Honkorab, Sharm el-Luli, and Qurat el-Hartway bay.

The marine component of the PA encompasses a strip of marine waters of an average width of 15 km. This component includes all the important coral reefs in the region, as well as five marine islands (the Hamata archipelago and Wadi el-Gemal Island, plus several minute sandy islets).

2.1.2 Climate

Wadi el-Gemal–Hamata PA falls within the hyper arid region characterized by arid climate and dominated by hot, rainless summers and mild winters. Precipitation falls mainly in the autumn and winter months, but is not an annual event; but is episodic and localized; often received in the form of short, heavy downpours causing flash flooding. The average annual precipitation is about 17.4 mm (meteorological stations of Ras Banas). The maximum amount of precipitation recorded in one day was 64 mm (24 November 1966). The monthly mean temperature varies between 24–38°C during summer and 12–26°C during winter. The relative humidity varies between

28 percent in summer and 57 percent in winter. The average evapotranspiration varies between 8.7 mm/day in winter and 28 mm/day in summer. According to the above-mentioned climatic parameters, the area from Marsa Alam to Ras Banas receives an average rainfall quantity of 98.78 million cubic meters/year (Mansour 2003, Table 2).

Over much of the year, northwesterly winds predominate; only in rare cases do southern winds occur. The velocity usually ranges between 66.07 km/h and 0.129 km/h with an average of 22.04 km/h in summer and between 62.93 km/h and 0.096 km/h with an average of 19.26 km/h in winter (Meteorological station Inst. Oceanography and Fisheries, Red Sea branch). In general, wind velocity is distinctly higher during the daytime, a phenomenon that can be explained by the higher temperature differences between the heated landmass and cool seawater during the day. Northwest winds blow litter onto coastal areas and islands.

2.1.3 Oceanography

The direction and speed of currents in Egypt's Red Sea have not been described in detail. Sea surface 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, near shore sea surface 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.

Winds also create a mainly NE–SW oriented wave motion. This leads to distinct higher waves in the exposed area, and drives longshore currents. This current by northerly wind in summer drives surface water southward. The reverse takes place in winter pushing water into the Red Sea from the Gulf of Aden. The marine area around the islands and along the coast is subjected to the wave action and therefore some areas are considered erosion zones. Because of nearly permanent air and water turbulence, a complete mixing of the water column occurs and no stratification is developed inside the water body. This is reflected also by the values of temperature and salinity, which show no significant differences between surface and bottom waters (Piller & Pervesler 1989).

Tides and tidal streams within WGHPA 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 & Morgan 1995). HW is about 1–1.5 hours 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 & 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 greater (for example 26°C in February and > 31°C in August).

Seasonal tides in winter in the Red Sea are more than 0.5 m higher than in summer. The tide is semidiurnal, maximum peak every 12 hours with a mean tidal range of about 0.65 m and maximum of about 0.95 m at the islands area.

2.1.4 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 al. 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 WGHPA have not been described in detail. Localized contamination of nutrients, hydrocarbons and heavy metals is likely in harbors at Abu Ghusoon, Marsa Alam, and Hamata. Table 3 compares water quality at various locations

Table 3 Some oceanographic parameters measured in July–August 1998 at different localities along the Red Sea coast of Egypt (Mansour et al. 2000)

Location	Dissolved Oxygen (mg/l)	Salinity (%)	pH	Oxidation Reduction Potential (Eh)	Temperature (°C)	Total Dissolved Salts (TDS) (g/l)	Specific Conductivity (ms/am)
Hurghada	5.44	40.3	8.65	333	27.8	38.1	59.69
Safaga	4.3	39.79	8.55	433	27	36.45	57.3
Quseir	4.4	40.4	8.5	389	28.3	38.2	59.3
Marsa Alam	4.22	39.91	8.71	336	27.35	37.91	59.24

2.1.5 Geomorphology

Geomorphologically, the area can be divided into three major units: the Red Sea high mountains, the coastal hilly area and lower mountains, and the coastal plain and the Red Sea coast. The coastal plain comprises several different morphotectonic features: rift shoulder, fault scarp, alluvial fans, inselbrge, piedmont plain, and raised beaches.

An elongated massive block of ultramafic rocks forms the highest mountains in the area, separating the watersheds of the Nile basin from that of the Red Sea basin. The coastal hilly area and the lower mountains form conspicuous topographical features between the coast and the main Red Sea hills. The isolated ranges and prolongation of the main igneous mass within the coastal plain helped in protecting the sedimentary rocks (especially gypsum deposits) by breaking the general erosional processes. The granitoid rocks are strongly weathered forming low to moderate country. On the other

hand, the gabbroic rocks are more resistant to weathering and hence form relatively higher hills.

The coastal plain has a low topography of a variable breadth ranging between 0.6 km in the north (Wadi Ghadir) to more than 12 km in the south at Hamata. Numerous parallel wadis draining the mountains dissect the coastal plain. Sedimentary systems from the piedmont to the Red Sea coast comprise alluvial fans, wadis, and littoral (reef) terraces. Modern fringing coral reef (50–100 m wide) extend along the coast. Coral reefs are lacking at the mouths of some of the larger wadis as a result of sediment (sand and pebbles) deposits during floods, hence *marsas* (landing spots) often occur at wadi mouths.

2.1.6 Coastal Topography

The coastline of the WGHPA 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* and *sharms*, which are usually the outlets of wadis. *Marsas* and *sharms* are uncommon features in WGHPA and support marine benthic assemblages that differ from those occurring on the more exposed areas.

Kotb et al. (2001) described six examples of fringing reef along the Egyptian Red Sea, all of which are found in WGHPA. 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
- 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 primary islands in WGHPA. Wadi el-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, Shawareet, Um Ladid, and Mahabis Islands, in addition to a fifth small island off the Hamata mangrove, which is periodically connected with the mainland at low tide. The islands range from 3–7 km off the mainland. These are low-lying islands with sandy beaches and raised fossil reefs, with fossilized coral and carbonate rocks purportedly of Pleistocene origin. The entire region around the islands is a shallow water area with rugged bottom morphology. The islands area is surrounded by well-developed fringing coral reefs consisting of shallow reef bordered by a sloping sandy bed. Beyond the shallow reef-flats and intertidal areas, the reef slope drops away and is replaced by sand or sand with sea grass or sand with coral patches.

2.1.7 Inland Topography

The inland part of WGHPA is composed essentially of high and rugged mountains, more or less coherently trending parallel to the coast and interrupted by a number of detached masses and peak. The highest peaks are concentrated in the southwest corner where they rise to elevations up to 1975 m (Gebel Hamata). The Nile basin – Red Sea watershed divide of the area runs over the high peak of the Red Sea Mountains with an average elevation of 650 m. The moderate relief occurs in the southeast and northwest, surrounding the high mountainous zone.

The most important hills and mountains are as follows: G. Hafafeet (1,341 m), G. Nugrus (1,505 m), G. Zabara (1,360 m), G. Ghadir (864 m), G. Sukari (630 m), G. Ghyweil (1,062 m), G. Sikait (796 m), G. Sabahia (694 m), G. Lawi (615 m), G. Rada (556 m), G. Leweiwi (663 m), G. Um Kabu (644 m), G. Abu Hade (663 m), G. Khariga (927 m), G. Um Harba (718 m), G. Um Regeba (568 m), G. Um Maghar (851 m), G. Museraibe (1,021 m), G. Abu Etl (643 m), G. Um Sueh (748 m), G Shawab (762 m), G. Kab El Ahmer (604 m), G. Um Abbas (660 m), G. Mahali (612 m), G. Tarafawi (1,361 m), G. Sertote (1,368 m), G. Mureir (612 m), G. Sarobi (468 m), G. Hamata (1,975 m), G. Qulan (376 m) G. Um Leham (999 m), G. Khashir (1,562 m), G. Ras El Khorate (1,658 m), G. Ejat (1,596 m), G. Mikibit (1,412 m), G. Zitit (898 m), G. Mukhatata (570 m), G . Abu Jurdi (1,096 m), G. Um Junud (880 m) and G. Um Mayat (976 m).

The area is dissected by a large number of wadis that initiate from the mountainous terrain and most run towards the Red Sea following the general eastwardly slope. Slope gradient is mostly steep in the upper reaches of drainage ways and tends to be gentle to the east. The wadis are mostly oriented E–W, WNW–ENE, NNW, and N E (Ahmed, 2001). The main wadis are important as a network of tracks in the area and as the main arteries for underground water.

The main wadis of WGHPA with their tributaries and branches from north to south are:

1. Wadi Ghadir: - Wadi Ghuel, Wadi Fagas, Wadi Um Ud, Wadi Sabahia, Wadi Zabara (Wadi Atabi, Wadi Um Abid, Wadi Um Dafiri, Wadi Um Lasaf)) and Wadi Allawi (Wadi Lewewi)
2. Wadi Khalilate El Bahri
3. Wadi Khalilate El Qibli
4. Wadi Sharm Fakeri
5. Wadi Araier: - Wadi Rimarim
6. Wadi El Gemal: -Wadi Hulous (Wadi Abiad El Hulous, Wadi Mahali, Wadi Tarfawi, Wadi Um Semiuki, Wadi Marasan, Wadi Abu Gerifat, and Wadi Abu Etl), Wadi Um Suerab El Gemal, Wadi Durunkat, Wadi Haffafit (Wadi Abu Had, Wadi Hafeifit), Wadi Nugrus (Wadi El Nom, Wadi Abu Rasheid, Wadi Abu Sada and Wadi Seket), Wadi Mukhatatat, Wadi Um Sueh, Wadi Um

Heran, Wadi Nasbia, Wadi Abiad (Wadi Um Seyal), Wadi Um Kabu, Wadi Ghazal

7. Wadi Um Abbas: - Wadi El Anz
8. Wadi Abu Ghsoon: - Wadi Dabaka, Wadi Abu Ghalga, Kab El Ahmer, Wadi Shawab, Wadi Romit, Wadi Abu Ashush, Wadi Hakkara and Wadi Dibag
9. Wadi Ranga, Wadi Sarobi, Wadi Dendikan, Wadi Rusas, Wadi Um Seiral, Wadi Hamata, Wadi Seleim and Wadi Hilefifi, Wadi Masturra.
10. Wadi Qulan, Wadi Saneiyat
11. Wadi Rada, Wadi Qulan El Atshan
12. Wadi Um Ramarim.

2.1.8 Geology

From the geological map of the region (EGSMA 1977 and CONOCO 1987) and findings during field investigations (Mansour 2003), the exposed basement rocks include, from oldest to youngest, the following mapable units:

1. Gneiss and migmatite
2. Metasediments
3. Metavolcanics
4. Serpentinites
5. Metagabbro diorite complex
6. Older granitoids
7. Hammamat group
8. Gabbros
9. Younger granitoids.

Dyke swarms of different types and colors are widely distributed in these rocks. Colored dykes in black metavolcanics form fascinating structures in some areas. The basement rocks are rich with geologic structures such as faults and folds. These structures are fascinating even for the layperson. Shear zones are the most important structural features in the area. They open out to the north to form a flower structure. El Ramly et al. (1993) made a structural map of the Hafafeet area and recorded eleven phases of deformations. Faults of Cretaceous age in the area trend NW–SE. The minor folding in this area is complex varying from recumbent to upright.

The Neogene and Quaternary sediments occupy the eastern flank of the basement rocks. From Wadi Ghadir to Wadi el-Gemal the piedmont gives good examples of the relative positions of sedimentary formation along the coast where the Precambrian basement, faulted by clysmic and possibly Aqaba oriented faults locally comes within a few kilometers or less from the Red Sea. Above the basement, Miocene evaporates and Pliocene continental and marine beds forming a belt of coastal hills overlie transgressive Miocene dolomites. In the wadis, late Pliocene to recent sediments

include clastic and marine deposits. In the area between Wadi el-Gemal and Wadi Ranga, the Abu Ghusoon formation overlies basement rocks and uncomfortably underlies the Ranga Formation. Subsequent faulting caused relative lowering of sea level and the Abu Dabbab evaporates at the foot of the main middle Miocene carbonates of Um Mahra formation. Uplift of the rift periphery led to the deposition of the Pliocene sediments in areas nearer to the present Red Sea. In the area between Wadi Ranga and Wadi Rada a relatively narrow coastal plain lies between the basement range and the Red Sea coast. Lower Miocene (Ranga Formation) crops out immediately to the east of the basement range. This unit is overlain uncomfortably by carbonates of the Um Mahara formation which, in turn are bounded to the east by the Miocene Abu Dabbab evaporates belt to the south of Wadi Rada. Down to Wadi Lahmi, a relatively wide (12 km) tectonic depression formed a relatively deep embayment in the basement, bounded by N120–140 and N50–60 fault. Upper Miocene silisiclastics were deposited at the foot of the basement rock. In the eastern parts, a dominantly carbonate (Shagra Formation) forms the latest marine Pliocene sediments. Pleistocene siliciclastics (Samadi Formation) constitute most of the outcrops within the fore mentioned structural embayment where they extend southwards to Wadi Um Ghazal.

Alluvial fans of different widths (N–S) and length (E–W) are represented by several terraces steps, sometimes occurring as single features flanking the sides of the wadis but on occasions arranged in vertical successions, forming flights along the sides of the present wadi channels. These fans are composed mainly of sand and gravel.

Geometrically, the modern extension of coastal plain is very similar to its Pleistocene counterpart. A few facies similar to the older Pleistocene facies are nearly restricted to extreme shallow water defined by their dominant biota, morphology, and sediment type. As elsewhere along the Red Sea, the fringing reef is the seaward extension of the coastal plain.

Structural analysis of the basement complex in the area reveals four main deformation phases made in the tectonic framework of the area (Abdel Aziz, 1999). The oldest phase was represented by NW-trending folds and NE-dipping low-angle thrust faults. The folds are upright gentle synclines and anticlines of varying dimensions plunging gently in a SE direction. The folds and thrusts were formed by compressive stress acting from the NE direction. The pattern of orientation of the quartz c-axes within the foliation indicates orthorhombic symmetry.

The second phase is represented by NW–SE left lateral strike-slip faults, which may belong to the so-called Najd Fault System. The paleostress analysis of these faults using slip lineations data indicates that they had been formed by a horizontal triaxial compressive stress acting from ESE – WNW direction. Strain analysis of stretched pebbles collected from shear zones belonging to this trend revealed that most of the analyzed pebbles are of oblate and prolate types. The maximum stretching direction

of the pebbles is the NW–SE. The crystallographic preferred orientation of the quartz c-axes confirmed the left lateral sense of the faults.

The third phase of deformation is represented by E–W left lateral strike-slip faults with small vertical components. The paleostress analysis using the slip lineations data indicates that the faults had been formed by a 20 plunging compressive stress acting in ENE – WSW direction. Fry analysis of deformed grains indicates that the strain ellipse is oriented in the E–W direction.

The fourth phase of deformation is represented by NNW – SSE right lateral strike-slip faults. The paleostress analysis using the slip lineation data indicates that the faults had been formed by a horizontal compressive stress acting in NNE – SSW direction.

2.1.9 Drainage Basins

Along the Red Sea coast flash floods represent a rare natural but ecologically important phenomenon. The area is occasionally subjected to heavy showers during winter, followed by torrential floods that may cause disastrous damage to roads and misplaced structures. According to climatic parameters, the area receives an average rainfall quantity estimated at 98.75 million cubic meters/year (Table 4). Twenty-three drainage basins with outlets on the Red Sea were defined in the area between Marsa Alam and Ras Banas (Table 2, Mansour 2003). They range between small (11.52 km^2) and large (1,476.7 km^2) with a drainage density between 1.4 and 3.8. The drainage network is well developed, integrated, and fairly dense, but is not consistent all over the area. Wadi Ghadir and Wadi Rada have high values of relief and ruggedness and this gives a short time of concentration of runoff. Therefore, the probability of flooding is very high. Wadi el-Gemal has the highest value of maximum runoff, followed by Wadi Lahmi and Wadi Ghadir. This explains the good vegetative cover of these drainage basins. In contrast, the basins of Wadi Ranga and Wadi Um el-Abas can be classified as less prosperous basins.

Table 4 Estimates of rainfall and runoff quantities in main basins in and near WGHPA (Mansour 2003)

Basin Name	Area (km^2)	Annual Rainfall Quantity (106 m^3/year)	Maximum Rainfall in One Day (10 m^3)	Maximum Runoff in One Day (10 m^3)	Minimum Runoff in One Day (10 m^3)
Wadi Samadi	63.26	1.1	4.05	2.66	0.24
Wadi Um Tundeba	67.07	1.17	4.29	2.82	0.25
Wadi Ambaut	90.47	1.57	5.79	3.8	0.34
Wadi Nakari	48.34	0.84	3.09	2.03	0.18
Wadi Ghadir	554.24	9.64	35.47	23.28	2.08
W. Khalilat El Bahri	13.28	0.23	0.85	0.56	0.05

Basin Name	Area (km^2)	Annual Rainfall Quantity ($106\ m^3$/year)	Maximum Rainfall in One Day ($10\ m^3$)	Maximum Runoff in One Day ($10\ m^3$)	Minimum Runoff in One Day ($10\ m^3$)
Wadi Khalilate El Qibli	11.52	0.2	0.74	0.48	0.04
Wadi Sharm Fakeri	73.05	1.27	4.68	3.07	0.27
Wadi Araier	261.32	4.55	16.72	10.98	0.98
Wadi El Gemal	1476.7	25.7	94.51	62.02	5.54
Wadi Um Abas	337.97	5.9	21.63	14.19	1.27
Wadi Abu Ghusoon	495.29	8.62	31.7	20.8	1.86
Wadi Ranga	309.63	5.39	19.82	13	1.16
Wadi Qulan	57.33	1	3.67	2.41	0.21
Wadi Rada	156.77	2.73	10.03	6.58	0.59
Wadi Um Ramarim	48.83	0.85	3.13	2.05	0.18
Wadi Khashir	464.01	8.07	29.7	19.49	1.74
Wadi Lahmi	967.08	16.83	61.89	40.62	3.63
Wadi Um Ghazal	16.42	0.29	1.05	0.69	0.06
Wadi Qurat El Hartwai	37.21	0.65	2.38	1.56	0.14
Wadi Staiya	39.06	0.68	2.5	1.64	0.15
Wadi Sharm El Luli	60.15	1.08	3.85	2.53	0.023
Wadi Um Dahise	24.12	0.42	1.54	1.01	0.09
Total		98.78	363.08	238.27	21.073

2.1.10 Groundwater

In the deserts of Egypt the surface water resources are generally very limited. Therefore, groundwater resources constitute a cornerstone for the livelihood of local people and many biotic elements. The groundwater resources in the Eastern Desert originate mainly from occasional rainfall that partially infiltrates through the friable loose sediments and accumulates in basement depressions or is trapped by faults and buried dykes.

In the WGHPA, investigations of groundwater quality have been carried out by Ahmed (2001) in three main wells in Wadi el-Gemal basin (Bir Wadi el-Gemal 24°30′14″N 34°42′34″E, Bir Um Ghanam and Bir Hafafeet 24°30′00″N 34°49′00″E). The average salinity of groundwater varies from one year to another as well as from one season to another. The salinity ranges between 490 ppm (Bir Um Ghanam) and 3,185 ppm (Bir Hafafeet) in August 2000 (Table 5). The minimum salinity that was recorded in Bir Um Ghanam (490 ppm) is due to the location of the well close to the recharge areas (Ahmed, 2001). This situation accelerates the direct infiltration of

rainwater into the open fractures where it comes out as springs. The average salinity of Bir Wadi El Gemal is 960 ppm. In Bir Hafafeet, the evaporation process causes a considerable increase in water salinity (3,185 ppm). Moreover, the water of the area is slightly alkaline where pH values range from 7.38 (Bir Wadi el-Gemal) to 7.83 (Bir Um Ghanam) (Table 5).

Dissolved solids and total hardness of the collected water samples from Bir Um Ghanam and Bir Wadi El Gemal are mostly under WHO (1984) maximum permissible limits for drinking water and therefore, can be used safely for drinking purposes after microbiological treatment. The total dissolved and total hardness of the water samples of Bir Hafafeet were above the WHO (1984) maximum permissible limits for drinking water and therefore, the water can not be used for drinking purposes.

Table 5 Results of ground water chemical analysis (ppm) of Wadi el-Gemal Basin collected in August 2000 (Ahmed 2001)

Parameters		Bir Um Ghanam	Bir Wadi el-Gemal	Bir Hafafeet
TDS		490	960	3185
PH		7.83	7.38	7.40
Cations	Ca+2	66.40	91.20	103.20
	Mg+2	13.60	27.35	78.10
Anions	HCO3-	106	62	228
	Cl-	62	68	784
	SO4-2	130	180	125
Total Hardness		222	340	578
Turbidity		7	—	—
Trace metals	Fe+2	0.06	0.05	0.01
	Mn+2	0.10	0.00	0.03
	Cu+2	0.00	0.60	0.75

2.2 Biodiversity Resources

2.2.1 Habitats

Marine Habitats

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 PA[1] it was deemed unnecessary at this

[1] 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 × 15 m for the pancromatic imagery and 30 × 30 m for

stage to attempt a more detailed classification scheme. However, preliminary observations indicate that there are seven broadly defined marine habitats that can be recognized in the PA.

- coral reefs
- sea grass meadows
- mangrove stands
- intertidal pavement with algae
- intertidal sand
- subtidal sand, and
- 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 PA.

Coral reefs
Coral reefs are perhaps WGHPA's most distinctive and sensitive habitat, supporting by far the greatest biodiversity in the PA. The Red Sea has some of the most attractive, intact, well developed, and biologically diverse coral assemblages in the world. Riegel & Luke (1997a) described at least 11 coral assemblage types from the Egyptian Red Sea and defined them by the dominant coral genus or genera, exposure (windward/leeward) and topography. In the PA, 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 below.

Windward Acropora assemblage—This assemblage is found 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' (Riegel & Luke 1997a).

Leeward Porites assemblage—As implied by its title, this assemblage is typically found on the leeward side of reefs. They are dominated by large *Porites* colonies, commonly *Porites lutea*. The genera *Pavona, Hydnophora* and *Favia* may characterize the reef edge.

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the multispectral imagery. Both have limited water depth penetration. This made it impossible to delineate among most habitats even at a coarse scale.

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

Sea grass meadows

Sea grass meadows are amongst the most distinct habitats of WGHPA, supporting similarly distinct communities of benthic fauna and fishes. Sea grasses are important food items for globally threatened Dugongs *Dugong dugon* and Green Turtles *Chelonia mydas*. However, little research has been done on the seagrasses of WGHPA. Five sites sampled in the PA during the GEF project contained sea grass. Percent cover of sea grass varied significantly among sites, as well as within sites.

Seven species of seagrasses have been recorded from WGHPA (see account under species). Near Wadi el-Gemal, six species of seagrasses were observed within the small *marsa* adjacent to the Shams Alam Diving Centre. The most widespread species appears to be *Halophila stipulacea*, which forms extensive mono-specific meadows in waters between 6 and, at least, 45 m (see Map 4). Species of sea grass consumed by dugongs in the Red Sea are: *Halophila stipulacea, Halodule uninervis, Thalassodendron ciliatum, Cymodocea rotundata* and *Syringodium isoetifolium* (Lipkin 1975).

Pelagic

This habitat includes the water column and ranges in depth from the surface to depths exceeding 1,000 m near the PA'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 PA because no studies have been done to describe the composition and abundance of plankton found in deep waters off the PA.

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 characterize the subtidal sediment fauna of this region of Egypt, or how their abundance and distribution is influenced by water depth and its correlates.

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 PA 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 al. (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 al. (1987) also provides a detailed summary of the organisms of this habitat.

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 *Turbinaria, Padina*, and *Sargassum* and greens, such as *Halimeda*. Red algae (*Rhodophyta*) may also be abundant 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 al. (1998a, 1998b) described macro algae living near mangrove stands in the PA. They found few species per site (typically less than 10) and reported red algae to be the most abundant macro algae.

Littoral Habitats

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* is the more common. There are 28 mangrove stands[2] distributed along the Egypt Red Sea (Saenger 2002). Razek et al. (1998a, 1998b) described in detail a small number of mangrove stands along the Egyptian Red Sea, while Saenger (2002) gave a more general description of the 28 mangrove stands known or documented from Egypt.

Only *Avicennia marina* is found in WGHPA, however the PA supports a significant proportion of the mangrove resources of Egypt. Nine mangrove stands (Table 6) and many isolated individual trees are recorded from the PA (Map 2). Included in this list is a stand of dwarf mangroves recently discovered in a location 1 km north of the Shams Alam Resort (Wadi Araeir). In addition, two stands are located on offshore islands.

Table 6 Mangrove stands in WGHPA

Location Name	Geographic position
Wadi Araeir	24º 42’N 35º 05’E
Wadi El Gemal Delta	24º 40’N 35º 05’E
Wadi El Gemal Island	24º 40’N 35º 10’E
Ras Baghdadi	24º 39’N 35º 06’E
Sharm El Luli	24º 36’N 35º 07’E
Hamata Mangroves	24º 18’N 35º 22’E – 24º 24’N 35º 15’E
Shawareet Island	24º 21’N 35º 24’E

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

Location Name	Geographic position
Wadi Lahmi	24º 13'N 35º 26'E
Qurat El Hartway	24º 06'N 35º 29'E

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.

Littoral Saltmarsh
The salt marsh vegetation is dominated by T*amarix nilotica, Zygophyllum album, Aeluropus sp., Sueda monoica*, and *Nitraria retusa*.

Fresh Water Swamp
The delta of Wadi el-Gemal contains the only known natural fresh water swamps on the Red Sea coast in Egypt. Although occupying a very small area, the swamp is important as a relict habitat, which supports typical flora (*Phragmites*, *Cyperus* and some *Hydrophytes*) and fauna. Some highly localized forms could be found, but this needs further verification.

Islands
There are four marine islands included in the PA (Wadi el-Gemal Island, and three islands in the Hamata group), in addition to two very small sandy islands, which are said to become inundated occasionally and one island which is tenuously attached to the mainland (in the Hamata area).

Marine islands offer an important habitat for many organisms. Seabirds and marine turtles (see details below) intensively use these islands for nesting, due to the lack of predators and disturbance. Biogeographically, each of the islands represents a unique natural evolutionary experiment, which has evolved over millennia and could provide important insights into the ecological past of the region.

Urgent, effective management of these islands should be a priority for future conservation efforts in the region.

Terrestrial Habitats

Coastal Desert
The desert bordering the Red Sea is very dry, and vegetation is largely restricted to the mouths of larger wadis, which carry occasional flash floods from the Eastern Desert mountains to the sea. Here the vegetation is typically characterized by dense growth of *Tamarix nilotica* associated with *Zygophyllum album*, *Z. coccineum*, and occasionally scattered *Acacia tortilis*. Examples of this vegetation assemblage in the PA are found at the moth of Wadi Umm el-Abas, Wadi Sharm el-Luli and Wadi Abu Ghusoon.

The coastal desert also enjoys localized higher humidity than the interior of the Eastern Desert, which sometimes forms dew. This meager input allows a scant plant cover of vegetation to exist in a very narrow band along the Red Sea coast, concentrated mainly in small runnels and shallow, sandy depressions.

Gravel and Sandy Plains
This is the least productive of the region's habitats. Vegetation is scant and largely confined to depressions and runnels where sufficient rainwater accumulates. Some large plains fringe the coastal mountains, where vegetation is composed primarily of *Zygophyllum coccinum* and *Lemonium sp*. Further inland in the up stream portion of Wadi el-Gemal, large sandy plains are found dotted with large granite outcrops. The vegetation here is dominated by the grasses *Panicum turgidum* and *Stipagrostis plumose*.

Wadis
The desert in this section of the Eastern Desert is made of a maze of complex wadi systems and hills. Wadis are the most characteristic feature of the landscape of much of the Eastern Desert, and the most important ecologically. Wadis are the drainage system of desert mountains, formed over millennia, concentrating meager precipitation into limited areas, allowing vegetation and other life to get a foothold in a patchy fashion in an otherwise very inhospitable desert. Wadis start near the summits of mountains as numerous shallow precipitous runnels dissecting the slopes. At lower elevations, the runnels coalesce into larger well-defined channels, the beds of which are often covered with large rocks. Near the foothills, the wadis are wide with a sandy or silty bed. Here the densest vegetation is to be found in most cases, depending on the size of the area that the wadi drains and the average precipitation that falls there.

The fact that Wadi el-Gemal is one of the best-vegetated wadis in the Eastern Desert can be explained by its extensive watershed, which includes two of the highest mountains in that region (Gebels Hamata and Nugrus). The relative abundance and regularity of flooding in the Wadi el-Gemal drainage system has allowed the development and retention of well-stratified vegetation communities, probably representing a relict representation of environments that were more widespread throughout the Eastern Desert during past fluvial episodes. This taken into consideration illustrates the significance of the conservation of the Wadi el-Gemal system in its entirety.

The plant communities of Wadi el-Gemal include several well-developed and stratified assemblages (Prof. Mohamed Kassas pers. com. May 2002). At the delta of the wadi Mangroves *Avicennia marina* grow on the coastline, followed by a saltmarsh belt with several halophytes, *Aeluropus sp., Nitraria retusa*, and *Tamarix nilotica* bushes. In the first segment of the wadi, dense *Tamarix nilotica* bushes grow on silty and sandy soils, with scattered *Acacia tortilis* trees on the gravely banks of the wadi. Further upstream *Tamarix aphylla* co-dominates with *T. nilotica* forming dense

thickets intermixed with scattered individual *Balanites aegyptiaca*, *Acacia tortilis,* and *Salvadora persica*. In the middle portions of the wadi, dense growth of *Balanites aegyptiaca* is found (one of the largest strongholds of the species in Egypt) intermixed with *Acacia tortilis*. The characteristic plant community of the upper section of the wadis is dominated by *Acacia tortilis* and *Zilla spinosa*.

The density of the *Balanites aegyptiaca* trees in certain parts of Wadi el-Gemal in particular, but also in other neighboring wadis is striking; it is by far the dominant species and sometimes forms a forest-like growth. The tree is valuable, its fruits are used medicinally (to control diabetes) and are collected by the local population and sold as a cash crop; the branches are palatable and grazed by camels; and the wood is collected as fuel.

At the eastern end of the main stream of Wadi el-Gemal and beginning at approximately 5 km from the shoreline, large stands of *Salvadora persica* are present. Similar huge stands are present in Wadi Allaqi and Nabq PAs. Smaller populations of *Salvadora persica* were also encountered in other wadis, sometimes in association with Acacia trees, e.g. Wadi Halous.

Mountains
The terrestrial portion of WGHPA is predominantly mountainous, being situated on the eastern flank of the spine of basement mountains that extend along the Red Sea. It encompasses fairly high mountains reaching up to 1,975 m at Gebel Hamata (the second highest in the Eastern Desert) and 1,505 m at Gebel Nugrus.

Mountains usually receive considerably more precipitation than the surrounding desert, often allowing comparatively more life to exist in a unique but restricted habitat. For this reason desert mountain habitats are of particular interest, since they usually support unique faunal and floral elements.

The mountain effects are typically observed on higher mountains (over 1,000 m), such as Gebel Hamata, which enjoys the greatest precipitation in the region. Gebel Hamata has been likened to Gebel Elba in its ability to condense orographic precipitation from prevailing northerly winds (Kassas 1993). This is due to its considerable height and proximity to the sea. Vegetation on Gebel Hamata is also comparable (to some extent) to that on Gebel Elba (Kassas 1993).

2.2.2 Species

Flora

Seagrasses and Algae
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 sea grass are known from the Red Sea (Sheppard et al. 1992). Many species are widespread, but *Halophila decipiens* has only been recorded from the Gulf of Suez and *H. 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* have been found in waters exceeding 40 m.

Seven species of sea grass have been recorded from WGHPA. *Halophila stipulacea* and *Thalassia hemprichii* were reported to form scattered beds in the PA. In the Hamata Archipelago, *Holdule uninervis* and *Halophila stipulacea* form mixed beds on the leeward side on some islands (T. Rouphael, pers. com. July 2002). Sea grass species reported from the WGHPA include:

- Thalassia hemprichii
- Thalassodendron ciliatum
- Halodule uninervis
- Cymodocea rotundata
- Halophila stipulacea
- Halophila ovalis
- Syringodium isoetifolium

At least 58 species of marine algae are expected in the PA (GEF 1997).

Terrestrial Flora
Floristically, Kassas (1993) classifies the Wadi el-Gemal – Hamata area as a part of the "Southern (Nubian) Section" of the Eastern Desert. Barakat (2003) reported that the flora of WGHPA comprises 73 plant species of which 53 are perennials and 21 are ephemerals. The terrestrial plant species found in WGHPA are listed in Appendix 5.

Zahran & Willis (1992) and Barakat (2003) recognized nine floral communities in WGHPA (Map 3):

Mangrove Community
Climatic conditions and shoreline morphology in the coastal part of the PA allow the presence of mangrove trees, which are confined to small sheltered bays cut into the beach where the characteristic *Avicennia marina* form monotypic bushy forests. *Avicennia marina* is one of the 55 species of mangrove growing in tropical and subtropical coastal areas. Another species; *Rhizophora mucronata* grows on the Red Sea coast further south.

Salt Marsh Community
Distinct zones are evident within the coastal plant communities corresponding to their levels of salinity tolerance. The salt marsh communities often fringe mangroves on the coast and their inland extension depends on the raised land further west. The plant cover is formed of stands of uniform growth of a single dominant species and a few associates, mainly halophytes. Thus a mosaic of the following species is often recorded and varies according to local topography and soil salinity: *Arthrocnemon/ Salicornia, Atriplex halimus, Atriplex farinose,* and *Zygophyllum album*.

Coastal Dunes Community
Further from the shoreline, distinctive vegetation could be observed growing on sand dunes, forming phytogenic mounds or hillocks. *Tamarix* mounds are perhaps the most prominent among these but there are several other species growing within this type of ecosystem such as: A*eluropus brevifolius, Limonium axillare, Stipagrostis sp., Zygophyllum album, Zygophyllum coccineum, Tamarix aphylla* and *Tamarix nilotica*.

Reed Swamp Community
Reed swamps are present where there is seepage of fresh or brackish water onto the surface. The large swamp at the mouth of Wadi el-Gemal (the Wadi el-Gemal Delta) holds the only example of a reed swamp over much of the Egyptian Red Sea. This special condition has lead to the development of a peculiar floristic assemblage, characterized by the presence of reeds but also some halophytes in addition to palms. The swampy areas are dominated by reeds: *Phragmites communis, Cyperus sp.* and *Scirpus sp*. The delta of Wadi el-Gemal also harbors other species, the most notable of which are: *Avicennia marina, Tamarix aphylla, Tamarix nilotica, Zygophyllum album, Zygophyllum coccineum, Limonium axillare, Hyphaene thebaica* (Dom palm), and *Phoenix dactylifera* (date palm).

Coastal Plain Community
This extends from the littoral area to the foot of the coastal mountains and is characterized by semi-halophytic, *Limonium axillare* and *Zygophyllum coccineum*, as well as small thickets of *Tamarix aphylla*, *T. nilotica* and *Salvadora persica* and the smaller herbaceous *Zilla spinosa* and *Pulicaria crispa*.

Downstream Vegetation Community
The littoral downstream of wadis supports a vegetation in the intermediate area between the coastal desert plain and main wadi vegetation and varies according to the geomorphology and soil characteristics. The eastern part, closer to the coast and where the soil is sandy and saline, usually supports halophytic to xerophytic species with *Zygophyllum album, Z. coccineum, Z. berenicense, Tamarix aphylla* and *Tamarix nilotica*.

Wadi Vegetation Community
The main trunk of the wadis is dominated by *Acacia tortilis* and *Balanites aegyptiaca* (as in Wadi el-Gemal). Associates are *Acacia ehrenbergiana* (which sometimes replaces *A. tortilis*), *Panicum turgidum, Leptadenia pyrotechnica, Lycium shawii*, *Aerva javanica, Solenostemma argel, Citrullus colocynthis* and *Ochradenus baccatus*. Chasmophytes such as *Capparis decidua* and *C. spinosa* grow in rock crevices along the wadi sides (but also in upstream of wadis such as in Wadi Um Lassaf). *Maerua crassifolia* trees were a rare find, associated with Ac*acia ehrenbergiana, Panicum turgidum, Cleome droserifolia, Trichodesma africana* var. *homotrichum* as in upstream of Wadi Halous.

The following list includes other plants recorded in the main stream of various wadis within the PA: *Caylusea sp., Chrozophora oblique, Citrullus colocynthis, Cleome*

africana, Erodium sp., Fagonia sp., Heliotropium strigosum, Launaea spinosa, Linaria arabica, Lindenbergia abyssinica, Lotus deserti, Pulicaria crispa, Senna alexandrina, Tephrosia cf. nubica, Trichodesma africana var. homotrichum, Zilla spinosa, Zygophyllum berenicense and *Zygophyllum coccineum*.

Plateau Community
A distinct vegetation community inhabits the extensive inland sandy plateau in upper Wadi el-Gemal is dominated by the perennial palatable grass *Panicum turgidum*, in association with *Zilla spinosa* and *Pulicaria crispa*. Also present are: *Stipagrostis sp., Erodium sp., Heliotropium cf. strigosum, Senna alexandrina, Cleome africana, Ochradenus baccatus* and *Acacia tortilis*.

Montane Community
This community inhabits the mountains facing the Red Sea and reaches more than 900 m. It is characterized by Mo*ringa peregrina, Ficus palmata, Lindenbergia abyssinica*, and *Kickxia nubica*. Several rare species are recorded here, these include: *Acacia mellifera, Rhus oxycantha, Ficus salicifolia* and *Adiantum capillus veneris*.

Fauna

Coral
The clear, warm waters of the Red Sea support some of the most attractive and biologically diverse coral reefs in the world. About 300 species of scleractinian corals are recorded from the Red Sea, with more than 250 species from 58 genera reported in the central-northern Red Sea (DeVantier et al. 2000). Two hundred and five species of scleractinian coral are known from South Sinai (Reigl & Luke 1997a) and 132 species of hard and soft corals have been recorded from Egypt's Red Sea coastline between Gemsa and Shalatein (Kotb et al. 2001). About 86 species of corals are currently known from the PA (GEF 1997). Further surveys will undoubtedly increase these numbers.

In WGHPA the percent cover of coral is highly variable, even over short distances (<10m) (T. Rouphael, pers. com. June 2002). Kotb et al. (2001) sampled 12 sites on mainland fringing reefs in the PA and found that the number of hard coral species varied from 0 to >50 percent (Map 4). *Stylophora* is the dominant genus on the reef flat and *Porites* and *Montipora* the dominant genera in deeper water (GEF 1997). Areas of high coral abundance include the reef face near Abu Ghosoon and opposite the fishing village at Wadi Abu Ghusoon. Eighty-six species of coral have been recorded between Wadi el-Gemal and Hamata, making it one of the most diverse regions in the Egyptian Red Sea (GEF 1997). However, like coral cover, the number of species per site varies significantly.

Other Marine Invertebrates
Tropical marine and coastal habitats support numerous species of sponges, jellyfish, crustaceans, mollusks, bryozoans, and echinoderms. Over 2,441 species of mollusks, 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.

The reefs of the PA 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.

Zoo/phytoplankton
Sheppard et al. (1992) provides a comprehensive, albeit dated, review of the plankton of the Red Sea. Razek et al. (1998a, 1998b) gives a more recent description of the spatial distribution and community composition of phytoplankton adjacent to mangrove stands in the PA. They found that phytoplankton was composed mainly of benthic diatoms. In contrast, Beltagi (1997) 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 South 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.

Terrestrial Invertebrates
Not much is known about the terrestrial invertebrates of the region in particular; however it is generally characteristic of that of the Eastern Desert.

Fishes
The Red Sea fish fauna has been extensively reviewed by Ormond et al. (1984), Ormond and Edwards (1987) and Sheppard et. al. (1992). About 1,000 species are known from the Red Sea (Sheppard et al. 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 percent) are endemic to the Red Sea.

Two hundred and sixty-one species of inshore fishes, representing 89 genera, have been observed between Gemsa and Shalateen. Of these, 104 were found in the PA (GEF 1997).

Reptiles

Terrestrial Herpetofauna
Reptiles constitute the most prominent component of the local terrestrial fauna. There are at least 25 terrestrial reptiles inhabiting the Wadi el-Gemal – Hamata area (Marx 1968, Baha El Din 2003) (listed in Appendix 11). The characteristic reptiles of the region include the lizards *Acanthodactylus boskianus* and *Mesalina guttulata*, the geckos *Tropiocolotes steudneri*, *Pristurus flavipunctatus*, and *Ptyodactylus*

hasselquistii, the agamids *Agama spinosa* and *Uromastyx ocellata*, and the snakes *Cerastes cerastes* and *Psammophis aegyptius*. Most of these species are fairly common and are observed regularly (see Map 5).

The species with the greatest conservation concern is the Ocellated Dab Lizard *Uromastyx ocellata*, which is targeted by professional animal collectors, who illegally collect and export large numbers of the species every year for the international pet trade.

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*. Two species, *E. imbricata* and *C. mydas* are known to nest in the Red Sea, both of which have been recorded nesting in the PA (Map 6).

In WGHPA, green turtles are reported to nest on the mainland at Umm el-Abas and Ras Baghdadi, and on Wadi Gemal Island and Siyul Island, in the Qulan Archipelago (Frazier and Salas 1984, Salam 2001, Abd El Ghani 2002). M. Hanfay, PSU Hurghada, (pers. comm. April 2003) has also recorded five old nests approximately 1 km north of Shams Alam Resort. According to Ali Salam, EEAA Hurghada (pers. comm.), green turtles nest in Egypt from May to November. The distribution of hawksbill nesting locations in the PA is less clear. S. Baha El Din, PSU Hurghada (pers. comm.),, found nests of this species on Wadi el-Gemal Island in June 2002, and A. Salam, EEAA Hurghada (pers. comm. March 2003), mentioned that a small number nest on Ras Baghdadi. Frazier et al. (1987) reported that hawksbill nested from April to July in Egypt.

Birds

The resident avifauna of WGHPA is composed of some 45 species. A much larger diversity of species visits the area as migrants and winter visitors; however the breeding and resident species can be considered a permanent and integral component of the local ecosystem (Goodman and Meininger 1989, Baha El Din 1999, Baha El Din 2003) (see list in Appendix 12).

Water and Sea Birds

There are 13 water and sea bird species associated with and largely confined to the marine environment in WGHPA. These are: Red-billed Tropicbird *Phaethon aethereus*, Brown Booby *Sula leucogaster*, Straited Heron *Butorides striatus*, Reef Heron *Egretta gularis*, Goliath Heron *Ardea goliath*, Spoonbill *Platalea leucorodia*, Osprey *Pandion haliaetus*, Sooty Falcon *Falco concolor*, Sooty Gull *Larus hemprichii*, White-eyed Gull *L. leucophthalmus*, Caspian Tern *Sterna caspia*, White-cheeked Tern *S. repressa*, Lesser Crested Tern *S. bengalensis*, Brideled Tern *S. anaethetus*, and Kentish Plover *Charadrius alexandrinus*. The Crab Plover *Dromas*

ardeola probably also breeds sporadically. Juveniles and adults of this rare species were observed during summer on the Hamata islands (see Map 7).

Red Sea islands are extremely important for breeding water and sea birds. Most of the Red Sea seabirds breed exclusively on islands, which are few, highly accessible and vulnerable to disturbance. At least 12 water and sea bird species are known to breed on Wadi el-Gemal Island and the Hamata islands (table 7). Because these islands hold internationally important numbers of breeding seabirds, particularly the Red Sea endemic White-eyed Gull *Larus lecophthalmus*, they were designated as globally important bird areas (IBAs) by BirdLife International.

The Red Sea coast falls along an important migration route for hundreds of thousands of waterbirds, which are seen migrating in flocks offshore. Although most of these birds pass through without stopping, many will rest in the intertidal zone along the coast. The shallow intertidal flats associated with the Hamata mangroves provide an important staging and wintering ground for good numbers of migrant waterbirds, including globally vulnerable species such as the Sociable Plover *Vanellus gergarius*.

Table 7 Estimates of breeding water and sea birds (and birds of prey) on islands and mangroves in WGHPA, according to observations during 2002-2003 (Baha El Din 2003)

Species	Wadi el-Gemal	Sandy islet N.	Siyul	Shawareet	Mahabis	Um Ladid	Sandy islet S.	W. Gemal mangrove	Hamata mangrove
Phaethon aethereus	Old nests			Old nests					
Egretta gularis	15			10				X	X
Ardea goliath									?
Butorides striatus	X			5				X	X
Platalea leucorodia	5-10			1-2				X	?
Pandion haliaetus								X	X
Falco concolor	50		X	30	X	X			
Larus hemprichii	<30		20	?	10	5			
Larus leucophthalmus	200		50	20	20	?			
Sterna repressa		100s					>500		
Sterna caspia	20		5	X	?	?			X
Sterna bengalensis	?		?	?					
Sterna anaethetus			700						
Dromas ardeola			1 ?						
Charadrius alexandrinus	X		4		?	?		?	3

Figure = pairs of breeding birds. X = breeding occurs but no estimates made. ? = probable breeding.

Birds of Prey

An outstanding diversity of breeding birds of prey is found in WGHPA (nine species), seldom found in any other part of Egypt (Baha El Din 2003). In fact, WGHPA is unique among Egypt's PAs in maintaining a very high species richness of birds of prey, including one globally threatened species (Lappet-faced Vulture *Torgos tracheliotus*) and one rare and declining species (Lammergeyer *Gypaetus barbatus*) (see Map 8).

Since birds of prey are placed high on the trophic cycle (being predators) they are ecologically sensitive and are usually considered good indicators to the health of the ecosystems they inhabit. Thus, the high species richness recorded in WGHPA perhaps reflects the health of the local ecosystem and relative abundance of prey items. It also reflects the limited disturbance WGHPA still enjoys. Birds of prey have declined all over Egypt (as is the case in many parts of the world) due to hunting, falcon catching, habitat loss, pesticide use, and pollution.

The most common species of birds of prey in the inland desert habitats include Lanner Falcon *Falco biarmicus*, Long-legged Buzzard *Buteo rufinnus*, Egyptian Vulture *Neophron percnopterus*, Pharaohs Eagle Owl *Bubo ascalaphus*, and Hume's Tawny Owl *Strix butleri*, while Bonelli's Eagle *Hieraaetus fasciatus* and the magnificent Lammergeyer *Gypaetus barbatus* are very rare breeders, only discovered in the region during fieldwork in the spring of 2003 (Baha El Din 2003).

Along the coast, Osprey *Pandion haliaetus* is a widespread and characteristic resident breeding bird of prey in WGHPA. It nests on the islands of the region and also in mangroves on the coast. The Egyptian Red Sea population is considered one of the largest in the world (Goodman & Meininger 1989). The Sooty Falcon *Falco concolor* is also a prominent breeding species on the islands of the region, which hold a large proportion of its small world population.

The globally threatened Lappet-faced Vulture *Torgos tracheliotus* occurs regularly in the region, particularly around the Sheikh Shazli settlement, and probably breeds locally.

Desert Birds

A considerable diversity of terrestrial birds occur in the desert habitats of the Hamata – Wadi el-Gemal region (see Map 8). Characteristic birds of the mountains, wadis, and desert include Sand Partridge *Ammoperdix heyi*, Desert Lark *Ammomanes deserti,* Trumpeter Finch *Rhodopechys githagina*, Mourning Wheatear *Oenanthe lugens*, Hooded Wheatear *Oenanthe monacha*, Crowned Sandgrouse *Pterocles coronatus*, and Brown-necked Raven *Corvus ruficollis*. Characteristic birds of desert plains include Spotted Sandgrouse *Pterocles senegallus*, Bar-tailed Desert Lark *Ammomanes cincturus*, and Hoopoe Lark *Alaemon alaudipes*.

Mammals

There are some 24 terrestrial mammal species known from the Wadi el-Gemal – Hamata area (Osborne & Helmy 1980, Qumsiyeh 1985, GEF 1997, Baha El Din 2003) (see Map 9). The mammal community of the wadi and plain habitats includes the Desert Hedgehog *Paraechinus aethiopicus*, Dorcas Gazelle *Gazella dorcas*, Lesser Gerbil *Gerbillus gerbillus*, Greater Jerboa *Jaculus jaculus*, Cape Hare *Lepus capensis*, Rüppell's Sand Fox *Vulpes rueppellii*, and Striped Hyena *Hyaena hyaena*. The mountain community is characterized by Nubian Ibex *Capra nubiana*, Hyrax *Procavia capensis*, Egyptian Spiny Mouse *Acomys cahirinus*, and the Bushy Tailed Jird *Sekeetamys calurus*.

The area holds one of the largest and healthiest populations of Dorcas Gazelle *Gazella dorcas* in the Eastern Desert. Up to 60 animals were counted in the downstream portion of Wadi el-Gemal in April 2000 (Baha El Din 2003). Wadi el-Gemal and its tributaries represent an important refuge for gazelles particularly during drought years, when browsing is limited over much of the southern section of the Eastern Desert. Animals from a large area probably congregate in the wadi to take advantage of its abundant vegetation.

Nubian Ibex *Capra nubiana* numbers are limited and confined to areas where surface water is available readily. The Barbary Sheep *Ammotragus lervia* possibly still exists in very small numbers and is in urgent need of some conservation action.

Carnivores are generally scarce, the most commonly seen being Rüppell's Sand Fox *Vulpes rueppellii*, while the Stripped Hyena *Hyaena hyaena* is present but in small numbers. The Sand Cat *Felis margarita* and the Caracal *Felis caracal* are likely to occur rarely in the region. They are both known sporadically from the rocky and sandy desert habitats of the Eastern Desert.

Cetaceans

Gladstone & Fisher (2000) listed 13 species of cetaceans from the Red Sea. These include the Common Dolphin *Delphinus delphis*, Bottlenosed Dolphin *Tursiops truncates*, and pilot whale *Globicephala spp*. The Bryde's Whale *Balaenoptera edne*i 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 PA remains unknown. The Spinner Dolphin *Stenella longirostris* appears to be common in many areas of the PA. 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.

Dugongs

The Dugong *Dugong dugon* 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 (1957) collected specimens from near Hurghada. Riegel & Luke (1997a) reported that Dugongs regularly occur in areas south of Ras Banas, and isolated populations existed at Safaga Bay, Um Redj, and Marsa Embarak. Dugongs are also commonly observed in waters near Wadi el-Gemal (K. Ehlert, Manager, Sharms Alam Diving Center, pers comm. December 2002). In March 2003, T. Rouphael, PSU, and A. Salam, EEAA, observed a Dugong swimming in shallow waters opposite the Sharms Alam Resort near Wadi el-Gemal. The area where the Dugong was swimming had sea grass meadows composed of *Syringodium* and *Halodule*, and large mono-specific 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 Sharms Alam Resort and an adult (± 3 m in length) near Ras Baghdadi (K. Ehlert, Manager, Sharms Alam Diving Center, pers. comm. April 2003).

Recent sightings of this species in the PA are shown in Map 10. Also shown is the location of Dugong feeding trails. Feeding trails, created when Dugongs feed on sea grass rhizomes, were observed in *Halodule uninerivs/Halophila ovalis* meadows at Umm el-Abas and Ras Baghdadi (T. Rouphael, pers. com. April 2003). According to Preen (1993) *Halodule* and *Halophila* are the preferred food because of their relatively high nutritional value.

Endangered Species

Besides holding a great diversity of biological components, the PA supports several threatened and rare taxa of fauna and flora (see Table 8). The Barbary Sheep *Ammotragus lervia*, Dorcas Gazelle *Gazella dorcas*, Dugong *Dugong dugon*, Nubian Ibex *Capra nubiana*, Sand Cat *Felis margarita*, White-eyed Gull *Larus leucophthalmus*, Spoonbill Platalea *leucorodia archeri*, Green Turtle *Chelonia mydas*, Hawksbill Turtle *Eremochelys imbricate*, and Mangrove Trees *Avicennia marina* are amongst the globally endangered biological components of conservation concern (according to IUCN), that are found in the PA.

Table 8 Globally threatened species in WGHPA according to IUCN (2002)

Global Status (IUCN 2002)	Local Status	English Name	Latin Name
		Mollusks	**Mollusca**
Lower Risk	Common	Tridacna	*Tridacna maxima*
Lower Risk	Common	Tridacna	*Tridacna squamosa*
		Reptiles	**Reptilia**
Endangered	Uncommon	Green Turtle	*Chelonia mydas*
Critically Endangered	Uncommon	Hawksbill Turtle	*Eretmochelys imbricata*
		Birds	**Avis**
Vulnerable	Uncommon	Lappet-Faced Vulture	*Torgos tracheliotus*
Vulnerable	Rare	Spotted Eagle	*Aquaila clanga*
Vulnerable	Uncommon	Imperial Eagle	*Aquila heliaca*
Vulnerable	Rare	Lesser Kesterl	*Falco naumanni*
Near Threatened	Common	White-eyed Gull	*Larus leucophthalmus*
		Mammals	**Mammalia**
Near Threatened	Unknown	Pipistrel Bat	*Pipistrellus ariel*
Vulnerable	Rare	Dugong	*Dugong dugon*
Near Threatened	Rare	Sand Cat	*Felis margarita*
Critically Endangered	Extinct	Leopard	*Panthera pardus*
Data Deficient	Common	Rueppels Sand Fox	*Vulpues rueppelli*
Critically Endangered	Rare	Barbary Sheep	*Ammotragus lervia*
Endangered	Uncommon	Nubian Ibex	*Capra nubiana*
Vulnerable	Uncommon	Dorcas Gazelle	*Gazalle dorcas*
Near Threatened	Uncommon	Stripped Hyaena	*Hyaena hyaena*
Lower Risk	Uncommon	Spinner Dolphine	*Stenella longirostris*

2.3 Cultural Heritage Resources

Archaeological surveys and excavations conducted/directed since 1991 in and on the immediate periphery of the region designated the WGHPA have recorded 38 sites ranging in date from Ptolemaic (late fourth/early third century BC) to Islamic (Appendix 14 & 15, Map 11). The sites include road stations, some of which are fortified wells (known to the Greeks and Romans as hydreumata) along the trans-desert routes between Berenike (Bernice) and Edfu/Koptos (Hodos Berenikes) and

along the Via Hadriana, a highway built in the second century AD and used until late antiquity and which, in the area under consideration here, ran parallel to the Red Sea coast. The Via Hadriana originally extended from Antinoë/Antinoopolis on the Nile in Middle Egypt near modern Sheikh Ibada over to the coast near Ras Gharib and then paralleled the coast terminating at Berenike. There are also gold and beryl/emerald mines and associated settlements, animal tethering lines (used by crews that resupplied and carried quarry/mine products between the Eastern Desert and the Nile), cemeteries and late Roman sites (fourth-early sixth century AD) of unknown function. The latter may be Christian era communities (Sidebotham 2003).

Appendix 14 & 15 present a list of known archaeological sites in and on the periphery of WGHPA. Most of these sites are not well studied or document yet, and many other smaller sites might still be unknown. Continued surveying of the region will, undoubtedly, reveal the existence of other ancient remains. Also not included in this study are the numerous secondary and minor ancient roads, routes and paths, and isolated graves and tombs in singles or small clusters that have been found throughout the region. These lists do not claim to be exhaustive. Not listed are numerous segments of ancient (unpaved) cleared road segments, which, in many cases, are marked with cairns and/or towers. There are also segments of numerous secondary ancient roads, mountain paths (some artificially cut through passes which they traverse) and hundreds of ancient graves (most of which have already been robbed).

A number of sites are most likely to attract interested laypersons and have the potential to become important archaeological attractions within WGHPA through a combination of their good state of preservation and/or size and ease of access, as follows: Dweig, Wadi el-Gemal, Sikait, Middle Sikait, Umm Harba, Kab Marfu'a, Nugrus, Gebel Zabara, Abu Hegilig South, Wadi el-Gemal east, and Seyhrig (see Appendix 14 & 15 for further details).

Evidence of prehistoric sites (ancient burial grounds, and prehistoric tools) is also scattered in many parts of the PA, but little information is available, as these sites have not been studied or documented yet (H. Barakat pers. comm.).

At the southwestern border of the PA lays the Shrine of Abu el-Hassan el-Shazli, the most famous Islamic shrine in the Eastern Desert. El-Shazli is one of the figures of Sufism and his roots link to the Prophet Mohamed (peace be upon him). He was born in Morocco, where he grew and studied to become a religious thinker.

El-Shazli traveled widely in his religious quest. He traveled to Baghdad and then Tunisia, where he lived in a town called Shazla (hence his name sake). Then he moved to Tunisia, the capital, where he became a popular figure. He eventually traveled to Egypt and stayed in Alexandria, where he preached in Al-Attarin Mosque. Then he moved to Cairo and after that to Upper Egypt.

In 1258, on his way to perform the pilgrimage to Mecca, Abu el-Hassan el-Shazli died in Wadi Homaythara, where he is buried. A shrine was built for him and became a

popular pilgrimage site for his followers. Thousands of people visit the Sheikh Shazli tomb every year from all over Egypt and North Africa (up to 150,000 in 2002). A big religious celebration is held every year before the Bairam feast (*Al-Adha*). The Ministry of Islamic Endowments built a new Shazli Mosque in 1969.

2.4 Indigenous People

Ababda are the main indigenous inhabitants of the PA. They are descendents of the Begga tribe, and are among the first peoples inhabiting the desert between the Red Sea and the Nile River. In the first century of the Islamic Hijra, they converted to Islam and merged with Arab tribes. Ababda are divided into four tribal groups: Al-Gamilia, Al-Fokra'a-Milkab, Al-Abodeen-Shanateer, and Al-Ashabab.

The Ababda have their own traditions, habits, and culture that are different from other Eastern Desert tribes. Although they speak Arabic, they also have a special language called "Tedway" or "Bedawit," which is only spoken and not written.

Grazing is their prime profession; they shepherd camels, sheep, and goats. They also collect plants, whether for food or trade. They are famous for making charcoal from the trees of the region. Hunting is not a main occupation, but a clever hunter is considered an important man. They use hunting tools such as traps, stones, and sometimes trained dogs. They are nomadic, always seeking areas with recent rainfall and good pasture. Their dwellings are small temporary structures called *khisha*. They use tree branches to build the house and cover it with cloth and wool. Houses are built on relatively high ground at a wadi's edge to avoid sudden floods. Women build the houses, which are considered to be the woman's private property.

Ababda consult their sheikhs and tribal elders to solve conflicts. In front of an arbitration council the two sides in the conflict raise their case and leave the final decision in the arbitrators' hands. The council declares its decision at the end of the session. The judgment usually dictates that the guilty person gives up a certain number of camels or other valuables.

In WGHPA, there are Ababda concentrations in Wadi el-Gemal, Wadi Ghadeer, Abu Ghusoon, and Qulan. In Wadi el-Gemal and its tributaries, there are about 15 families belonging to Ababda Tribes (Zidab, Kergab, and Nafi tribes). They herd, make charcoal, and some work as guards in the mines in the area. At the mouth of the valley there are two families working in fishing and tourism. In the Hamata area, especially on the coast at Mastora and Qulan, there are 20 families (Al-Okda, Al-Kamilab, Al-Nafi, Al-Kergab) working in fishing and tourism. There are three families (Kergab) in Wadi Rada herding animals and making charcoal next to the Rada well.

2.5 Existing Land Uses

2.5.1 Mining and Quarrying

The Red Sea Governorate contains the majority of the basement rocks of Egypt. These rocks dominate Wadi El Gemal – Hamata PA and provide many economic metallic, and non-metallic ores, and building materials. Basically, the Red Sea is famous for the granite and marble compete with the Italian ones. Archaeological sites at Nugrus, Sikait and Um Lasaf in the area have clarified the role of Beryl mining during the Roman Time. Quarrying white, gray and black granite is widely distributed in the area, especially Gebel El Abyad along Wadi Shawab. The basic mines associated with basement rocks are iron (Ilmenite), copper, gold, vermiculite, nickel, manganese, asbestos, mica, quartz and feldspar (Appendix 2 & 3, Map12). Other ores associated with sedimentary rocks are iron oxides, kaolin, potash, and phosphate, which is the most important ore in the Red Sea Governorate (ICP 2000). Sedimentary sequences of the coastal area also include large amounts of gypsum, anhydrite, sand and gravel.

Alluvial fans, braided streams, and raised beach, widely distributed along the coast are mainly composed of gravel and sand (about 90%) silicicalstics (quartz and feldspars). The major uses of these are in construction, particularly as concrete aggregate, road aggregate and other construction materials. Sand is also widely used as beach fill along the Red Sea coast. Their particle size, composition and physical quality make it one of the preferred aggregates to be used for constructions. Deposits close to granite rocks are very rich with feldspars, which can be used in ceramics. The occurrence of aggregates on the surface and their proximity to the roads and cities are obvious attractions. As the development increased the demand for aggregates is becoming a target for exploration. However, the conflict between economic and environmental considerations must be anticipated.

2.5.2 Fisheries

Barrania & Ibrahim (2003) provide a comprehensive description of the status of fisheries in the PA. Traditional local fishermen are increasingly leaving the industry for more lucrative opportunities in the dive and hotel industry. The Red Sea communities were essentially fishing centers. A few years ago, before the tourism boom, fishing and mining were the major activities in the Red Sea region. Two groups target fisheries resources in the PA: local fishermen (Ababda) and migratory fishermen from other governorates. 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, replace them and 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.

There are seven fish landing sites in the PA: Sharm El Luli (11 boats / 55 fishermen); Qulan Village (4 boats / 20 fishermen); and Hamata Harbor (10 boats / 50 fishermen) (Barrania & Ibrahim 2003). 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. Fishing is done from boats or from the shore using nets. The village has four boats, one of which is motorised. 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.

2.5.3 Tourism

The Red Sea is famous as a tourist attraction on both domestic and international levels. The natural resources of the Red Sea are very diverse and unique. Coral reefs provide a major impetus for tourist development throughout the tropics (Hawkins & Roberts 1994). Desert Safari is also popular. Historic sites, mainly Roman, widely distributed in the desert, attract interested people. The warm weather year round integrates these attractions and makes the Red Sea a very special destination. Also of importance is the location of the Red Sea Governorate, as a gate to visit the Upper Egypt especially Qena, Luxor and Aswan (see Map 13 for distribution of tourism resources in WGHPA).

It is estimated that there are upwards of two million tourists, of these around 1.5 million foreigners, annually visiting the Red Sea Governorate, with the majority in the Hurghada area (Cesar 2003). This is likely to change in the future as more tourism developments open in the south. The current tourism development pattern in the Red Sea Governorate is best described as “strip development” with wall-to-wall resorts lining the coast. Tourism resorts are scattered along the Red Sea from El Gouna 35 km north of Hurghada to Wadi Lahmi some 100 km south of Marsa Alam. According to one source, there are now 30,150 rooms on the Red Sea coast, with some 87,301 under construction and projections of 115,000 rooms between Hurghada and Marsa Alam by 2012 (Egypt Almanac 2003). The Tourism Development Authority (TDA), Ministry of Tourism is a driving force behind the tourism development along the Red Sea having jurisdiction over the large tracks of coastline that it sells to investors.

Like elsewhere along the Red Sea coast, the southern Red Sea sector is undergoing rapid development for tourism. While Marsa Alam remains a small coastal community, to the north between Quseir and Marsa Alam a huge tourism center is under development that will rival Hurghada and Sharm El Sheikh. A number of tourism villages are open in this area, while dozens of others are planned or under

construction. The largest of these resorts is Port Ghalib, a 18 km stretch including a marina having berths for 1000 yachts and hotels with 4000 room capacity along with a golf course and other facilities catering to tourists (pers. comm. Ed Coe, RSSTI). The recent opening of an international airport north of Marsa Alam is expected to act as a catalyst accelerating tourism in this sector. While the airport is mainly serving chartered flights at present, scheduled local flights have begun and it is expected to receive millions of tourists annually.

The area south of Marsa Alam only opened for tourism development and visitation a little over five years ago. Approximately 8 hotels are in operation or under construction between Marsa Alam and Wadi Lahmi (north and south of WGHPA), including several tourist villages and smaller ecolodge type hotels. Other hotels are planned in the area. Although there is a moratorium on tourism development south of Wadi Lahmi, rumors persist of plans to develop the Ras Banas area for tourism and the construction of a road between Aswan and Bernice linking the Nile Valley and the Red Sea will promote this.

There are hotels adjacent to the PA. The Shams Alam Hotel is situated in the northern buffer zone of the WGHPA, while the Zabargad and Lahmi Bay Hotels are found along the southern marine sector of the PA. Additional tourism development was planned and proposed inside the PA by the TDA, including land allocated to a developer at Marsa Um El Abas, the critical turtle-nesting beach. As part of the PA decree, two " ecotourism development zones" were designated along the coast, but the details of the type and extent of development to be allowed in these areas still needs further discussion between TDA and NCS (see further recommendations under management issues).

Tourism in the southern Red Sea mainly caters to the package tourism market. Most tourists come on package tours organized through foreign tour operators. The majority of tourists in the Marsa Alam area are either diving or leisure holidays, with the later increasing in number. Leisure tourism mainly involves the sun, swimming and general relaxation.

There was a reported 63,0000 tourists in the Marsa Alam area in 2000, nearly all foreigners (Caesar 2003). Formerly, Germans were the most numerous nationally in the southern Red Sea, mainly coming for diving, but recently they have been overtaken by the Italians who mostly engage in leisure or beach tourism (per comm. Karen van Opstral). The other nationalities reported visiting the area in smaller numbers are: the French, Russians, Americans and Scandinavians (Cesar 2003). Tourism in the Marsa Alam area tends to be a higher quality cliental than at Hurghada to the north with more money spent by visitor per day.

Local tour operators are contracted to provide the transfers and sightseeing excursions, which are sold as optional activities through the hotels and the foreign tour operators. In the Marsa Alam area sightseeing excursions are only offered by the

tour operators contracted to work with a particular hotel. Excursions by independent contractors are only sold if they cannot be provided by the local tour operator. Currently, the kinds of excursions being offered are limited; one of the most popular day trips is a visit to Shalateen to see the camel market.

The existing tourism to the WGHPA is mainly in the marine environment, with the highest visitor use in the vicinity of the Qulan Islands. Dive boats are regularly visiting the reefs in the area, with the numbers of boats and visitors increasing with the establishment of hotels. Dive boats as well as day-trippers are visiting the offshore islands. Lahmi Bay Hotel is organizing visits to one of the islands in the Qulan Island chain for picnics (pers. comm. T. Rouphael). Some snorkeling takes place along the coast, mainly off the hotel beaches. There has been some bird watching by tourists to the islands and coastal mangroves.

Safari tours to the desert areas of WGHPA are currently limited due to security restrictions. According to K. van Opstral, (pers. Comm.)the Red Sea Governor ordered the Ministry of Interior not to allow visitation to desert areas until the PA management has been established. The most popular form of desert tourism in the Eastern Desert is general adventure tours, camel rides, tea with the Bedouins and dinners in the desert (pers. comm. K. van Opstral). In the Marsa el Alam area there are larger tourism companies and several small independent operators organizing desert safari tours, including tours to the cultural heritage sites and for stargazing. Shams Alam Hotel was advertising desert adventures on quad runners in their hotel lobby.

There is also national tourism in the Marsa Alam region in the form of pilgrim to religious sites. There are a number of tombs belong to Moslem saints in the area; the most important of these is Sheikh Shazli. These tombs are visited by Egyptians from the Nile Valley and the Red Sea coast, as well as by some individuals coming from abroad. While the tombs are visited throughout the year, the largest numbers of visitors are during the Mulids, celebrations lasting several days for the birthday of the saints. Over 120,000 individuals were estimated to have attended the Mulid at Sheikh Shazli in winter 2003. There are rest houses and other basic establishments in Sheikh Shazli catering to the pilgrims.

Tourism Facilities in the Region

There is also a well developed tourism infrastructure catering to diving and marine based tourism in the vicinity (see Map 13). There is a relatively large marina at Marsa Alam and at a smaller marina at the ecolodges to the south. There is a pier at the Shams Alam Hotel, which mainly visits the island and the reefs in the northern sections of the PA. There is also port at Abu Ghusoon that visits the reefs and islands in the southern section of the park. Most of the hotels maintain their own dive shops.

2.5.4 Urban Centers and Settlements

There are three small towns in the buffer zone of the WGHPA: Abu Ghusoon, a mining port, Hamata and Sheikh Shazli; all three contain basic facilities and suffer from environmental problems so are not attractive for tourism. There is also small settlements scattered throughout the PA for local and itinerate workers working in the mining concessions (see Map 14).

Traditional uses (Grazing, charcoal production, and medicinal plants collection)

The majority of the indigenous population inhabiting inland parts of the PA practices a combination of grazing, charcoal making and medicinal plants collection. There is still insufficient information as to the volume of these activities, but given the relatively small population inhabiting the region (2,000-3,000 individuals, FAO 2002) the impact of these activities is likely to be limited.

2.5.5 Roads

There is a good road network linking WGHPA with major tourism centers along the Red Sea (Hurghada, Quseir, and Marsa Alam) and the Nile Valley (Luxor, Aswan). The main Red Sea coast road between Suez and the Sudanese boarder passes through the WGHPA. The PA is also accessible from the Edfu-Marsa el Alam Road via the asphalt road to Sheikh Shazli, which passes through the western section of the PA. There is an extensive network of dirt tracks and roads in the PA that were established by the mining concerns (see Map 13).

2.6 WGHPA Stakeholders

There is a large number of direct and indirect stakeholders and participants in the PA's activities. The main stakeholders and their involvement with the PA are briefly described.

2.6.1 Egyptian Environmental Affairs Agency

By law the EEAA is the competent governmental authority, responsibility and obligation to manage PAs in Egypt.

2.6.2 Red Sea Governorate

WGHPA as a whole falls under the administrative authority of the Red Sea Governor, who is the highest authority in the Governorate. The Governorate is responsible for regional planning and development strategies such as housing, road and tourism projects. The main Governorate departments who have interests in the PA include:

- The Quarry Department of the Governorate, which is responsible for issuing quarrying licenses.
- The License Administration, which is responsible for issuing building and development licenses.

- City and village councils are responsible for municipal development planning, water and power supply, rubbish collection and liquid waste disposal.

2.6.3 Tourist Development Authority

TDA is responsible for the planning of tourism developments, allocation and sale of land for investors in designated tourism areas. Much of the Red Sea coast is under the jurisdiction of the TDA.

2.6.4 Higher Council for Antiquities

Has responsibility for surveying and protecting antiquities and archaeological sites.

2.6.5 Ministry of Interior

The Ministry of Interior has under its authority the Police (including its various branches). It is the executive authority for Egyptian civil legislation.

2.6.6 The General Organization for Roads and Bridges

Is responsible for the maintenance of existing roads and construction of new ones.

2.6.7 Border Guards

The Border Guards have the responsibility of protecting all border regions of Egypt, including its coasts. Border Guards control access to the marine environment, and they request the issuance of permits for non-Egyptian visitors to off road regions of the Eastern Desert.

2.6.8 Investors

Investors and beneficiaries(hotel owners, tour operators, dive boats, guides, desert safari companies, etc.) of the Red Sea ecosystem have a direct stake in the ecological state of the region, and should have an interest in maintaining a high quality environment in the region.

2.6.9 Local Communities

The local Ababda communities are the traditional users of the natural resource base and as such are among the main stakeholders in the PA; their understanding and support of the PA's objectives and involvement in planning and implementing management interventions are critical. Local communities should be enabled to manage their own resources locally but as local communities may have to restrict their activities and so pay the opportunity costs for conservation, they should be entitled to share tangible benefits from the management of the PA to offset such costs and ensure their support.

2.6.10 Ministry of Agriculture

The MoA and several of its subsidiary organizations are actively involved in the region.

GAFRD is the official governmental authority in charge of regulating and developing fisheries and fish resources in Egypt, and have a large interest in any management measures that might affect the fish production in any region.

The MoA through the Desert Research Center is finalizing an agreement for a local community development project in the southern part of the Eastern Desert with funding from the World Food Program, which could involve the introduction of widespread water harvest measures (e.g. small dams in wadis) and drilling shallow wells, etc. Some of these activities are likely to encompass WGHPA.

The Locust Control Department uses vast amounts of pesticides in many parts of the Egyptian deserts when locust invasions are suspected.

2.7 Current Conservation Capacity at WGHPA and Vicinity

Other than WGHPA there is at present (in practice) two other "PAs" in the Red Sea Governorate: The Red Sea islands and coastal mangroves (south of Lat. 27°15') and the Elba PA (from north of Shalateen to the boarder with Sudan).

The Red Sea PA regional headquarters is located in Hurghada, with satellite offices at Quseir and Marsa Alam. Existing management mainly focuses on monitoring and enforcing Law 4/1994 and the regulations pertaining to coastal tourism development, patrolling and monitoring visitation to the protected islands, buoys establishment and monitoring reef damage by tourists. The management of WGHPA is still under formulation and the park manager and staff has yet to be appointed.

At present the NCS / EEAA capacity in the WGHPA region is limited. Currently (June 2003) there are four rangers assigned to a two apartment office based in Marsa Alam, equipped with a single Jeep. Their primary mission is to patrol a swath of the Red Sea coast extending from about Wadi Lahmi to Marsa Trombi. The rangers inspect coastal activities (mainly development) to ensure that no violations to the coastline occur.

Further south in the Elba PA up to 20 rangers are assigned to manage this 35,000 km² territory, with very limited resources.

3. Management Goals and Objectives

The management goals and objectives of WGHPA need to reflect both national policies and priorities, and local circumstances and needs. In the mean time the PA management should seek to adopt, as much as possible, the established international standards in this field (IUCN). These standards have evolved over many years and reflect an extensive global experience, presenting practical and tested solutions to common management problems.

3.1 IUCN Protected Area Management Category

WGHPA is designated herein primarily as a National Park (PA managed mainly for ecosystem protection and recreation, IUCN PA management category II). This defines the PA as a "natural area of land and/or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible".

The selection criteria set out by IUCN for this category is as follows:

- The area should contain a representative sample of major natural regions, features or scenery, where plant and animal species, habitats and geomorphological sites are of special spiritual, scientific, educational, recreational and tourist significance.
- The area should be large enough to contain one or more entire ecosystems not materially altered by current human occupation or exploitation.

WGHPA fits perfectly the National Park criteria: It is of substantial size, encompassing a unique example of a complete marine/terrestrial ecosystem not significantly altered by man and largely in pristine natural condition, has outstanding landscape features, holds a significant recreational value and has sites of important spiritual significance.

It should be noted that some minor sections of WGHPA would not qualify or be managed within the National Park criteria, such as the two designated ecotourism development zones on the coast. These areas will be subject to the zoning scheme of the PA and will have modified management requirements.

Management Objectives

IUCN outlined the following management objectives for National Parks:

- To protect natural and scenic areas of national and international significance for spiritual, scientific, educational, recreational or tourist purposes;
- To perpetuate, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources, and species, to provide ecological stability and diversity;
- To manage visitor use for inspirational, educational, cultural and recreational purposes at a level, which will maintain the area in a natural or near natural state;
- To eliminate and thereafter prevent exploitation or occupation inimical to the purposes of designation;
- To maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designation;
- To take into account the needs of indigenous people, including subsistence resource use, in so far as these will not adversely affect the other objectives of management.

3.2 National Objectives for Protected Areas

The Protected Areas Network of Egypt aims at maintaining the diversity and viability of the various components of Egypt's natural heritage, and to ensure their sustainable utilization, through conserving adequate representative examples of the country's natural ecosystems and landscapes, for the benefit of present and future generations: the intergenerational equity.

The main objectives PAs Network of Egypt are (adapted from NCS/EEAA policy documents):

- To conserve representative examples of all the nation's main natural habitats & physiographic regions;
- To help maintain the nation's biological diversity;
- To help maintain the nation's ecological viability;
- To protect the nation's most outstanding landscape features;
- To optimize socio-economic return from the nation's natural systems in a fashion that ensures their long term sustainable maintenance;
- To support Egypt's economic development strategies, particularly with regard to sustaining the tourism sector;
- To protect natural assets as future options available for economic diversification;
- To promote public understanding and appreciation of Egypt's natural heritage.

3.3 WGHPA Management Objectives

WGHPA aims at providing protection to the unique and invaluable natural and cultural heritage resources present in the region, while seeking to facilitate, ensure and promote the wise and sustainable use of these resources, maximizing benefits from the natural conditions and systems that govern the sensitive and valuable ecosystems of the region, and maintaining the traditional and characteristic culture of the indigenous inhabitants and improving their living standards.

The main management objectives for WGHPA set forth here are:

- To maintain the natural resources and conditions of the PA;
- To protect cultural heritage resources of the PA;
- To enhance the sustainable utility of natural resources in the PA through the establishment of appropriate management systems;
- To promote WGHPA as a focal point for ecologically sensitive tourism, thus expanding and diversifying the economic activity base in the region;
- To enhance the environmental quality of the WGHPA;
- To optimize socio-economic benefits to the indigenous population from the region's natural heritage;
- To promote public understanding and appreciation of Egypt's natural heritage.

4. Management Issues, Policies, and Actions

This section reviews the main management problems, obligations and opportunities for WGHPA, providing specific proposed management objectives, policies, actions and evaluation indicators for each.

4.1 Management of Existing Urban Centers

Several existing urban (non-tourism related developments) are found in or just outside WGHPA. The town of Abu Ghusoon is the only urban center within WGHPA, lying at the center of WGHPA coast, within the Abu Ghusoon eco-tourism development zone. The town of Hamata and Sheikh Shazli fall immediately outside the PA and within its buffer zone. These urban centers have the potential of having localizes negative impacts on the PA if current modes of operation are left unchanged. The few Ababda settlements scattered around the PA are small and tend to be mobile and have a limited impact on the natural environment.

There is a need to launch community development initiatives to upgrade and enhance the, urban centers in and around WGHPA particularly with regards to solid waste management and provision of health, education and other social services to the local communities. Grants and loans could be provided to local communities to develop tourism facilities and services, such a project would address poverty alleviation.

Objective: Urban centers within or adjacent to WGHPA operate in an environmentally and ecologically sound manner and become aesthetically compatible with the PA.

Policy: Urban centers in and around WGHPA should become environmentally compatible with the PA, through better control of solid and liquid waste, and through limiting urban expansion to their currently recognized limits. No new urban centers will be allowed in WGHPA. Ababda settlements within recognized traditional use zones will be permitted but all new dwellings are to be built in vernacular style.

Actions:

- Establish contact and direct communication between the PAMU and the Town or Village Councils of concern.
- Develop urban planning schemes, which take into consideration the conservation character and objectives of WGHPA.

- Clearly demarcate the current legal limits of each urban center on the ground, in order to detect violations.
- Enforcement of suitable building codes, which provoke local characteristic architecture and energy conservation.
- Discourage the use of introduced flora in landscaping.
- Establish suitable sanitary landfills and waste collection systems at the concerned urban centers. See further instructions under: Solid and liquid waste.

Indicators:

- Number of operational sanitary landfills near each urban center.
- Amount of solid waste in and around urban centers.
- Urban development plans established and sanctioned by stakeholders.
- Indigenous trees used for ornamentation.

4.2 Coastal Developments

To date coastal tourism developments along the Red Sea coast of Egypt has taken a very traditional extensive development approach. This type of linear development already exists or is planned in the Adjacent (Buffer) Zone to the north and south of WGHPA (south of Marsa Alam and Hamata, respectively), and overlooking long stretches of the marine component of the PA, with obvious risk to its marine resources. Threats include: Direct damage to coral reefs, sediment plumes from construction operations degrades the reefs, destruction of coastal habitats, disturbance to plants and animals, altering flood water flow, which can be a hazard to the environment and tourists if facilities are built in a wadi bed. Negative impacts reach far into the adjacent desert habitats through haphazard building material extraction and solid waste disposal.

The amount of damaged reef flat in the PA is minimal. In many areas of the PA, the reef flats are wide (>500m). 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. In addition to permanently damaging intertidal habitats on the reef flat, the new lagoons may become a chronic source of suspended sediments. 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.

Objective: To minimize as much as possible any current or potential negative impacts from tourism developments on WGHPA.

Policy: All violations, such as reef flat disturbance, building within the setback zone, building in wadi (flood) courses, and haphazard waste disposal must be halted.

Tourism developments in WGHPA Buffer Zone should become environmentally compatible with the PA, through better control of solid and liquid waste. Establishing suitable sanitary landfills and solid waste collection systems should be a prerequisite for approving all future developments.

Actions:

- Achieve consensus amongst stakeholders of the importance of maintaining a sound environment in the region.
- Establishing effective communication of the PAMU/EEAA with TDA and local authorities.
- Full EIAs will be obligatory for all development and installations, facilities and activities in the Buffer Zone before approvals are granted.
- The PAMU staff should participate in the assessment of EIAs for proposed developments in the Buffer Zone.
- All contractors will be obliged to restore the landscapes, as far as possible, before leaving any development site.
- Establish suitable sanitary landfills and waste collection systems for existing and future developments. See further instructions under: Solid and liquid waste.
- The PAMU to establish and maintain a register of all developments within the Buffer Zone, with a record of environmental conduct.
- The PAMU to continue to undertake periodic patrols of developments (operational and under construction) to ensure that regulations, such as setback are being followed.
- EEAA establish and maintain a register of locations in the PA where reef flats have been damaged by infilling or excavation for lagoons (in progress)

Indicators:

- Number of violations.
- Operational sanitary landfills.
- Amount of solid waste in and around tourist developments.

4.3 Development of *Marsas*

A *marsa* is a natural bay usually at the mouth of a wadi. It is an uncommon feature in the PA. The best examples of undeveloped marsa in the PA including Sharm El Luli and Sharm El Fakera. 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 PA. 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) describe 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 also 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.

Objective: To ensure that marsas and sharms continue to play their important natural ecological role.

Policy: Stop development of marsas. Maintain all undeveloped marsas as open-space for recreational and passive tourists use.

Action:

- The PAMU ban all development of resorts and other human habitation in and adjacent to marsas in the PA that are currently free of development.
- The PAMU monitors activities in marsas in WGHPA to ensure compliance.

Indicators:

- Proportion of undeveloped marsas in the PA.

4.4 Development in "Ecotourism Development Areas"

Two zones have been dedicated within WGHPA as "ecotourism development areas", one in the north at Ras Honkorab and the other larger one in the middle section of the PA including the community of Abu Ghusoon. According to the PA declaration, the development zones are to be utilized for ecotourism. The coastal zones of the WGHPA had been under the TDA jurisdiction, but with the declaration of the PA these areas now fall under the management of the Nature Conservation Sector (NCS). Tourism development activities within these two zones could have a significant impact on the overall WGHPA image and status. Thus, activities within them will have to be carefully evaluated and their operations closely monitored to ensure that they fit with WGHPA objectives.

Objective: To ensure that activities in the two "ecotourism zones" are compatible with the management objectives of WGHPA.

Policy: It is proposed that the "ecotourism development zones" would be left in a largely natural state, serving primarily as focal recreational areas for tourist developments north and south of WGHPA. Only limited exclusive ecolodge development would be permitted (adhering to TDA's ecolodge guidelines).

Ecotourism or low impact tourism would be allowed in these areas such as: camping, picnicking, swimming, snorkeling and sunning on the beach. General public use of the two areas for recreation will be assured. Important natural habitats and landscapes will be maintained as much as possible.

The middle ecotourism development zone around Abu Ghusoon is of relatively low biological and ecological importance, and can be withstand more development pressure; while the development zone in the north at Ras Honkorab is of the highest amenity value for tourism, and should be utilized for more exclusive ecotourism activity.

Management sharing arrangements need to be formalized between the EEAA and TDA. It is important for the two agencies to cooperate and work closely in the planning of these areas, as well as in monitoring during the construction and operation phases if any facilities are built.

Actions:

- EEAA and TDA to establish a joint committee for the management and planning of the two ecotourism zones.
- The joint committee will assess the appropriate number of ecolodge developments permitted maintaining adequate spacing between lodges to ensure the visitor experience, and identify appropriate areas based on carrying capacity studies.
- EIAs will be required for any development.
- The PAMU must review and verify all EIAs on the ground to ensure that they meet the guidelines and regulations for environmental management, particularly solid and liquid waste management.
- The PAMU will ensure that TDA's ecolodge guidelines are adhered to during construction and future operation.
- All contractors will be obliged to restore the landscapes, as far as possible, before leaving any development site.
- The PAMU will apply standard set-back regulations, prohibit coastal modification, prohibit construction in flood (wadi) courses.
- The PAMU will ensure that all solid waste generated be disposed outside WGHPA in designated landfill sites.
- The PAMU will ensure that all liquid waste is treated on site.
- The PAMU will prohibit the use of pesticides.
- The PAMU will prohibit the introduction of exotic species.
- The PAMU will monitor construction and operation of all facilities.
- The PAMU to establish and maintain a register of all developments within the ecotourism development zones, with a record of environmental conduct.

Indicators:

- Number of developments fully compliant with "ecolodge" standards.
- Number of violations to development codes.
- Number of introduced species of ornamentation plants.
- Number of desert shrubs free of garbage in sample wadi areas.
- Number of waste items on sample beach lengths.

4.5 Sustainable Tourism and Ecotourism Development

Tourism is the most important use of WGHPA and its natural and cultural resources. It is a reliable source of sustainable and substantial economic growth in many parts of the world if properly established and managed. In addition to creating economic opportunities and jobs for the private sector and generate benefits for the local community to enhance their standard of life, it is an important source of revenue for the PA to be reinvested back into its management. The facilitation and management of tourism and promotion of ecotourism in WGHPA is therefore one of the top management issues for the PAMU.

There have been a number of projects launched to develop sustainable tourism and ecotourism in the Red Sea region. In the 90's the GEF Red Sea Project conducted a number of studies about the resources of the area and proposed management guidelines for tourism. USAID has been supporting sustainable tourism development in the Red Sea region since 1994. As part of this initiative, RSSTI is studying the ecotourism development potential of the southern Eastern Desert referred to as the "Deep Range". While the aforementioned studies are a valuable source of information and recommendations on potential tourism development in the WGHPA, these studies do not reflect the area's status as a PA. The TDA-RSSTI studies and plans in particular need to be revised to be consistent with the PA regulations and management objectives, as well as incorporate the wealth of experience gained in ecotourism from other PAs around the country, particularly those in South Sinai and Wadi El Rayan.

Ecotourism is an activity that depends on and promotes a well-maintained natural environment and has shown to be a reliable source of sustainable and substantial economic growth in many parts of the world, if properly established and managed. WGHPA has excellent potential for ecotourism development given its unique natural and cultural heritage resources. A range of nature based tourism activities can be envisaged taking place in the WGHPA, including wildlife watching, diving, snorkeling and trekking are foreseen as the key activities. WGHPA likewise has high potential for leisure, recreation, adventure, beach tourism, safari and cultural heritage tourism.

WGHPA management must take into consideration the planned tourism development in the Marsa Alam area that is expected to grow exponentially in the next five to ten years. Given the few other attractions and activities for tourists in the southern Red

Sea, it is envisaged that the WGHPA will become a leading attraction and locus for tourism as the PA becomes established and known. The popularity of WGHPA is expected to rival that of Ras Mohamed National Park and Nabaq PA in South Sinai.

Two main potential target markets for the PA are foreseen:

1) Day trips by package tourists on leisure holidays staying at the coastal resorts. While the majority of these would be satisfied with a visit to the more accessible areas of the park, tourists with a higher degree of interest in nature and willingness to pay would probably want to take desert safari excursions or boat trips to the outlying islands.

2) The wildlife and ecotourists would be expected to spend longer durations in the PA. The majority of wildlife tourists would be divers and snorkelers, while ecotourists would probably be those who want a more general nature-cultural experience or have more specialized interests, such as bird watching.

Objective: To establish WGHPA as a focal point of sustainable ecotourism activities in the Red Sea Governorate, and make conventional tourism to the region more environmentally sensitive and sustainable.

Policy: PAMU should act proactively, but within a well-planned framework, to facilitate and promote tourism activities in the PA. A diversified tourism product should be offered to maintain the pristine nature of the resource base and the quality of the visitor experience. Priority should be given to the development of ecotourism as the best means to realize the park's management objectives. Furthermore, a premium tourism concept should be applied whereby the number of visitors would be restricted and higher fees charged to visit more sensitive, pristine and exceptional sites.

Actions:

- Inventory, map and assess the tourism resources of WGHPA as a baseline.
- Define the appropriate types of tourism, routes and carrying capacity for each management zone.
- Utilizing a participatory approach, devise and implement a tourism development plan for WGHPA, including guidelines, best practices and promotion strategy.
- Identify the appropriate visitor facilities and infrastructure for each zone, undertaking the necessary studies prior to establishment.
- The PAMU will develop a plan and system for the maintenance of visitor facilities.
- Conduct the necessary studies and support the development of at least two ecolodges in the PA.
- As part of an education and public awareness strategy for WGHPA, identify and implement educational and information program for visitors.
- The PAMU will insure that WGHPA visitor regulations are widely disseminated.
- Train PAMU staff to be responsive to tourist needs.

- Develop a visitor fee structure and system, as well as licensing and concessions fees for businesses operating in the park that can be reinvested back into the management of the PA.
- Establish relationships and form partnerships between the PA, tourism sector in particular the local hotels and tour operators and local communities.
- The PAMU will seek to reduce negative visitor impacts by regular patrolling of primary attractions and sensitive sites.
- The PAMU will monitor visitor impacts and responses through a comprehensive monitoring program. Impacts from visitors in the marine environment on important reef sites and critical species such as marine mammals, big fish such as sharks and groupers and sea turtles and impacts in desert on critical habitats e.g. amount of liter, car tracks and firewood collection, heavily used cultural heritage sites and species with high tourism appeal, such as gazelles.
- The PAMU will seek visitor's feedback as a means of assessing management effectiveness.
- Coordinate with the Coast Guard Intelligence to allow non-Egyptian tourists to visit WGHPA without the need for acquiring a permit.
- Coordinate with Tourist Police to arrange for non-Egyptians security.
- In cooperation with the appropriate stakeholders, develop and implement a tourism marketing and promotion strategy for WGHPA.
- Extend the boundaries of the WGHPA to include all the key desert tourism routes, particularly the down stream portion of Wadi Ghadir, to insure proper protection of resources and management of tourism.
- Involve the local community in tourism activities, such as working as guides, handicraft programs, community operated ecolodges and providing other goods and services to visitors.

Indicators:

- Number of tourists
- Percentage of ecotourists
- Number of days spent in WGHPA
- Number of repeat tourists
- Amount of revenue generated per tourist per night
- Number of visitor facilities established in WGHPA

4.6 Public Awareness

Raising local and national awareness of the importance of conservation management of WGHPA is essential for achieving the long-term management objectives of the PA. Public awareness in PAs aims to elicit the support and goodwill of stakeholders as a means of meeting conservation management goals. Public support flows from

relationships based on trust, respect and a sense of ownership of the PA, public awareness is, therefore, about participation, effective two-way communication and education between the stakeholders and the PAMU/EEAA.

Objective: To ensure public support for long-term PA objectives, through the promotion of understanding and valuation of PA role and function.

Policy: Public awareness and education will be a priority management activity for the PAMU.

Actions:

- Intensive direct communications between PAMU and local stakeholders.
- On the short-term, establish and continuously update public communication tools (signs, newsletter, brochures, posters etc.).
- Establish a detailed Public Awareness Strategy.
- Respond promptly to all inquiries from the public.

Indicators:

- Number of supportive stakeholders.
- Results of public interviews

4.7 Visitor Safety

With an anticipated increase in the number of visitors to WGHPA, both to the marine and terrestrial components, visitor safety and security should be considered. Although Law 102 for 1983 does not attach any particular legal responsibility to the EEAA for the safety of PA visitors, it is implicit and expected that the EEAA would seek to ensure some minimal safety levels to the visitors of any PA. This is particularly an issue when visitors start paying an entrance fee and expect services in return. For example St Katherine PA established a Mountain Rescue and Medical Emergency Unit.

Emergencies in WGHPA could include diving accidents, poisonous stings, dehydration, disorientation in the desert, car accidents, climbing accidents, etc. An important safety issue in the regularly visited Sikait-Nugrus area is the large number of unmarked deep ancient mining shafts, which pose potential dangers of serious injury or death to those hiking/trekking in the region.

Objective: Ensure an acceptable level of safety to visitors against the most likely life threatening incidents in WGHPA.

Policy: The PAMU should be capable to respond efficiently to medical emergencies. The PAMU will ensure that an adequate system is established and is fully operational at all times.

Actions:

- Establish an emergency response plan, which should identify the closest hospitals and doctors in the region and "best practices" for each of the most anticipated incidents in WGHPA.
- The PAMU staff should include one doctor, who should receive specialized training in emergency treatments.
- Other PAMU staff should get training in basic rescue and emergency medical response.
- An emergency phone number should be designated and distributed to visitors. Phone should be attended at all times.
- Conduct awareness campaigns among tour operators and ensure that visitors are aware of the emergency procedures.

Indicators:

- Number of treated incidents.

4.8 Roads

Roads have long-term ecological, social and environmental impacts. The construction of roads into formerly inaccessible areas causes major ecological and aesthetic impacts.

During construction and subsequent maintenance cause physical and aesthetic impacts, especially in difficult terrain; important habitats can be damaged and lost, and critical flood patterns can be disrupted, affecting natural vegetation patterns. Roads fragment natural landscapes and disrupt the free movement of wildlife and lead to road kills by traffic. Roads have a direct effect on socio-economic activities in the areas they pass through and can lead to widespread changes in the cultural landscape of an entire region.

Important regional and national highways pass through the eastern and western fringes of WGHPA. The main coastal highway linking the northern and southern Red Sea passes along the Red Sea coast. Additionally a tarmac road linking Sheikh Shazli with the Marsa Alam – Edfu road passes along WGHPA's western boundary. Regular and commercial traffic inevitably come in close contact with some of the more sensitive resources of the PA.

Objective: Reduce risks from major surfaced roads.

Policy: No new surfaced roads will be allowed within WGHPA. The position (route) of currently existing surfaced roads will be maintained. No adjustments or re-routing should be allowed except in the case of risks to public safety (for example, there are proposals to move the current coastal road some 5 km inland; this must be refused). Full EIA should be demanded for any significant road adjustment in WGHPA.

Generally through traffic will be restricted to the main highways. Leaving the highways is banned, except for PA visitors (paying or permitted visitors) and to local inhabitants. In the mean time the PAMU should capitalize on the opportunity to inform transient visitors to the PA.

Actions:

- The PAMU will liaise closely with Ministry of Public Works and the Red Sea Governorate to review road development plans.
- The PAMU will inform maintenance contractors of road construction standards.
- The PAMU will seek to restore road lines of spoil tips resulting from previous maintenance and repair (e.g. broken asphalt) and in the future enforce the removal of such spoil by maintenance contractors.
- Establish informative signs and instructions to alert drivers and passengers that they are in a PA.
- Providing resting areas with an educational context, to capitalize on the presence of casual travelers in the PA.

Indicators:

- Length of new surfaced roads.
- Amount of road construction related debris.

4.9 Off-road Vehicle Use

Off-road vehicle use has increased dramatically throughout the deserts of Egypt in recent years. Off-road driving is environmentally damaging to fragile desert ecosystems, causing soil erosion, compaction, crushed plants and disturbance of wildlife. The growing development pressure, increase in human population, particularly tourists, and the increased availability of 4x4 cars mean that the volume of off-road traffic in WGHPA is causing growing widespread impact. Multiple braided tracks are especially noticeable in wider wadis and plains and control and remedial measures are now required.

Objective: To regulate and limit, as far as possible, off-road driving within the PA.

Policy: All lands within the PA are considered as either limited or closed to vehicles. Driving off the main surfaced highways is prohibited, except for PA visitors (paying or permitted visitors), local inhabitants and vehicles working with permitted activities inside the PA. All off-road vehicles will be restricted to the main existing track in WGHPA, which are to be designated on management maps and marked on the ground. Routes are considered to be open unless indicated as closed on the ground by signs, barricades, or other physical considerations, which appropriately direct the user.

Actions:

- Survey and categorize various tracks according to their sensitivity to wildlife, importance to traffic, connectedness to habitations and sites of interest etc (see attached provisional map of tracks in WGHPA).
- Identify areas that need to be sealed off completely or where traffic should be diverted to avoid critical areas and where severe disturbance is being caused by traffic etc.
- Improve single tracks in critical habitats or where vehicles are making multiple or braided tracks and making it less practical to drive off tracks. Tracks can be improved at particularly bad patches where drivers tend to try better alternatives.
- Obstacles (large rocks etc.) can be placed at critical points in an aesthetic fashion in order to force drivers to follow a particular route.
- Sealing the terminal parts of critical wadis with no through passage to vehicular traffic, by placing natural boulder obstacles to prevent car access, but allow for the unobstructed passage of wildlife and floodwaters e.g. upper Wadi Halous. This will undoubtedly improve habitat conditions for wildlife in these areas and access on foot and by camel would be allowed.
- Liaise with safari operators over permitted routes and an enforceable code of conduct
- Posting obvious and easy-to-read instructions with codes of off-road driving at the entrances to important and heavily used tracks, indicating clearly the penalties for misconduct.

Indicators:

- Number of car tracks outside main track in sensitive wadis such as Wadi El Gemal.
- Number of track kilometers maintained.

4.10 Anchoring

Most tourist vessels operating in the PA in addition to many of the fishing boats must, at some time, remain stationery near reefs or other features that tourists wish to view or fishermen target for fishing. 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. In recent years the number and size of tourist boats has increased in the southern Red Sea, making their potential damage even greater.

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 the boat crews believe that it causes less physical damage to corals than anchoring. Whether this method of mooring is less damaging than anchoring remains unknown. 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).

Objective: To stop coral damage caused by anchors, anchor chains and cable mooring.

Policy: Direct anchoring is prohibited on coral reefs. Mooring buoys will be made available to PA users in regularly used permissible sites. All vessels in the PA must use mooring buoys when they are available. Eventually, no anchoring will be allowed where buoys are not present. Mooring maintenance will be an important component of the PAMU activities.

Action:

- The PAMU/EEAA implement the Mooring Buoy Strategy[3].
- The PAMU/EEAA to install moorings at frequently used reefs within permissible zones.
- The PAMU undertake boat patrols, at random periods, to assess compliance of regulations pertaining to mooring use and no-anchoring[4].
- The PAMU, 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 PA[5].
- The PAMU regularly inspects mooring buoys and arranges for their maintenance.
- EEAA undertake study to assess the ecological effects of cable-mooring.

Indicators:

- Number of moorings.
- Number of infringements relating to mooring use.

[3] PSU Hurghada has recently submitted a mooring buoy strategy.

[4] 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.

[5] 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 PA 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.

4.11 Boat Groundings

About 20 vessels run-aground per annum on reefs in the Egyptian Red Sea (A. Gomaa, Red Sea PAs Regional Office). These range in size from small wooden fishing boats (<6 m) to bulk carriers. The presence of an ever-increasing number of recreational boats in the Red Sea coastal environment means that increased risks to fragile marine ecosystems can be expected. Boat groundings are frequent in intensively used parts of the Red Sea, such as around Hurghada. Damage to the coral reef can be extensive. The lack (or reluctance of the use) of proper navigational equipment, combined with poor vessel condition and low navigational skills probably contributes to the current level of incidents.

Objective: To minimize risk to human life and damage to corals by boat groundings.

Policy: Establish a marine environment where proper navigational and boat safety procedures are followed.

Action:

- EEAA review navigational requirements and aids for all vessels operating in the PA.
- Inform boat operators of the risks and costs coral reef damage represents.

Indicators:

- Number of boat groundings

4.12 Marine Tourism Activities

Impacts associated with the activities that tourists undertake during a visit, such as reef walking, boating, snorkeling and SCUBA diving can be a chronic source of disturbance to corals and other benthic organisms and could result in localized physical destruction of corals even under low levels of use.

The effects of diving, in particular, have been well described in Egypt (Hawkins & 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 & 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[g1]. 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).

Objective: Stop coral damage caused by SCUBA divers, snorkelers and reef walkers

Policy: Deliberate touching, trampling, breaking or collection of all living and non-living marine material in the PA is prohibited.

Action:

- 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
- EEAA establish baseline and monitoring program to assess the status of benthic assemblages in heavily used marsas in the PA[6]

Indicators:

- Number of indicator species at monitoring sites.
- Condition of coral reefs at monitoring sites.

4.13 Indigenous People

Indigenous people include the coastal fishing communities and the Bedouins of the Ababda tribe inhabiting the desert regions of the park. Most of the local communities are extremely poor with little income earning potential. They also lack basic social services. At present there is little local community involvement and benefit sharing from tourism. Few locals are employed in the hotels and related businesses. Some Bedouins are living off the garbage from the tourism resorts.

Local people are an integral component of WGHPA; they have an intrinsic right to continue their traditional lives in WGHPA and to benefit from its natural resources. The welfare and prosperity of these people must be of primary concern for the future management of WGHPA. Although local people can contribute to the deterioration of natural resources of WGHPA, they are in fact a primary stakeholder, who should participate in a significant way in enhancing and benefiting from these resources on

[6] Marsas are uncommon features in the PA 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 PA because they provide access for divers and snorkelers to deep water and provide safe mooring areas for tourist vessels.

the long run. No management plan will be successful and sustainable on the long run without the full participation and support of the indigenous people.

Objective: Ensure maximal benefit to indigenous communities from WGHPA support of its management objectives.

Policy: There should be initiatives to involve the local communities in WGHPA and insure benefit-sharing from activities arising within it.

Actions:

- Regular consultations should be maintained with indigenous community representative, such as tribal leaders (sheikhs).
- The PAMU should seek to employ locals as community guards in the park, who can also provide services such as assist with waste management and trail maintenance.
- The PAMU should also stipulate that locals are employed in the businesses and facilities operating inside the park. Among the potential jobs, locals can work as tour guides and operate excursions such as camel trekking. Locals can also provide fish and meat and other goods and services.
- Local community handicraft programs can be developed based on traditional crafts such as rug weaving. More innovated handicrafts and other natural products could be developed using local materials, such as jewelry from gemstones, sale of minerals and stones, carvings from granite, and healthcare products from talcum and medicinal plants.
- Through the Social Development Fund (SDF) grants can be provided to the local communities for the development of community businesses, such as community operated cafeterias and ecolodges.
- In cooperation with tour operators initiate a program to train suitable indigenous people as tour guides.
- Locals could also operate wildlife attractions such as feeding and drinking stations.
- The PAMU will seek to establish a basic health monitoring system for local people, providing basic medication (through a trained medical ranger), and transferring more serious cases to near by hospitals.

Indicators:

- Average annual income of local inhabitants.
- Health status of indigenous people.
- Number of local people supporting WGHPA.

4.14 Abuse of Cultural Heritage

Tampering with antiquities is a problem in most of the remote cultural heritage sites in Egypt. Uninformed tourists contribute significantly to the degradation of

archaeological resources through trampling sensitive sites or collecting seemingly worthless artifacts. The rather indistinct nature of some archaeological sites (particularly prehistoric sites) might render them susceptible to damage as they can be easily overlooked and consequently overrun.

Intentional theft of artifacts is also widespread. Vandalism and haphazard quarrying and mining are other major threats. The Nuclear Material Authority is targeting the Roman Emerald mines in Nugrus and Sikait for possible extractive operations in the future.

Objective: Stop the deterioration and loss of archaeological resources in WGHPA and adjacent areas.

Policy: All tampering, excavation or collection of any material from or near known or potential archaeological sites (including historic mines) is prohibited. Only excavations sanctioned by the Higher Council of Antiquities will be permitted. Sensitive sites (identified in Appendix 16) will have controlled visitor access, while less sensitive sites will be open to visitors with appropriate precautionary measures taken.

Actions:

- A map of known archaeological sites in WGHPA to be prepared (see attached map), and updated.
- Sensitivity of sites to be evaluated and visitor management recommendation provided by experienced archaeologists (see Appendix 16 for site sensitivity and management recommendations).
- Establish close contact with the SCA and the local antiquities inspectors in Marsa Alam to coordinate efforts.
- Establish close contact with the Nuclear Material Authority, Egyptian Geological Survey and local quarrying authorities to inform them of PA restrictions and regulations.
- Establish a code of conduct for tour operators and tourists and inform them of restricted sites.
- Patrolling of highly sensitive and regularly visited sites should be intensified and organized in such a way that they are unpredictable to users.
- Monitoring of primary sites to be established to assess visitor impacts.
- Highly sensitive sites should be closed off with fencing or road obstacles, or by assigning local community guards.
- Restoration of critically damaged resources by sanctioned professionals should be encouraged.
- Mapping and documentation by sanctioned professionals should be encouraged.
- Prepare public awareness and education materials, and interpretive and instructional signs to visitors.

Indicators:

- Number of damaged archaeological site (number of incidents).

4.15 Solid Waste

Solid waste is a significant and visible problem in the coastal part of WGHPA and its adjacent zone. Solid waste in the region is largely generated from tourist development nearby and partly from marine traffic disposal of waste. Solid waste affects coastal vegetation and especially impacts mangrove communities, which tend to act as traps for flotsam that often accumulates in great quantities.

A landscape strewn with garbage in a PA suggests poor management and this lowers the visitors' regard for and appreciation of the landscape and its natural resources, especially if they have paid to enter and expect waste management to be provided as a visitor service.

Objective: To reduce solid waste inside and around WGHPA.

Policy: Solid waste management inside WGHPA must be a high priority for the PAMU. The general policy will be to prohibit the dumping of all waste inside the PA. All visitors to backcountry areas must carry out their solid waste and dispose of it appropriately. The PAMU will seek to support local City Councils with domestic waste management within the PA and its Buffer Zone. Tourism facilities (including hotels, ecolodges and boats) operating within WGHPA and its Buffer Zone should take full responsibility for disposing of their waste appropriately. Violators must be prosecuted rapidly.

Actions:

- Establish close cooperation between the PAMU and city councils and tourism developments and operators and encourage them to reduce the waste stream through recycling, separating organic waste at source and promoting a reduction in packaging and use of plastic bags.
- Identify and designate suitable sites for sanitary landfills and borrow pits within the Buffer Zone.
- Ensure all waste is disposed of at designated landfill sites.
- PAMU will install garbage bins at commonly used recreational sites along the coast within WGHPA) and ensure regular disposal of garbage. Bins will be placed out of sight. No bins will be placed in backcountry desert areas. Visitors there will be expected to take back their own garbage.
- Strict instruction must be given to boat operators not to dump waste in the marine environment, and encourage them to report offenders.
- Raise awareness among tour, boat operators and visitors of the importance of disposing of garbage responsibly and packing out garbage from backcountry areas.

- Conduct cleaning campaigns with the assistance of local businesses and indigenous communities.
- Prohibit burning of waste and fly dumping.
- Enforce the dumping of all building debris and spoil in borrow pits in designated localities outside the PA or in its Buffer Zone.
- Include waste management as a major prerequisite before approving any future investments in the PA Buffer Zone, or in the Ecotourism Zones.
- Enforce immediate prosecution of offenders.

Indicators:

- Number of clean beaches.
- Number of desert shrubs free of garbage in sample wadi areas.
- Number of waste items on sample beach lengths.

4.16 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 PA (Hassan 1998). This includes weathered crude oil on beaches and oil stained rocks. Gomma (2001) suggested that Marsa Ghalib Harbour 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 Ghalib Harbour, 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. P. 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 Governor 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 PA 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 and daily boats are also a chronic source of solid waste, including plastics, to the marine environment. Most stakeholders in the PA 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).

Objective: Ensure that vessels operating in and around WGHPA do not degrade the environmental quality of the PA through intentional or unintentional introduction of pollutants or waste.

Policy: No discharge of liquid or solid waste will be allowed from vessels in or adjacent to the PA. All vessels must dispose of waste at port. Appropriate facilities to receive and treat boat waste (both solid and liquid) should be developed at known sites on the periphery of the PA. Only vessels of good operational condition should enter the PA.

Action:

- The PAMU will conduct regular patrols to ensure that vessels operating in the PA are not disposing of liquid or solid waste, and that vessels are not producing oily discharge.
- The PAMU will inform stakeholders of PA regulations.
- The PAMU/EEAA will coordinate with stakeholders to ensure that existing and future harbors are supplied with liquid and solid waste disposal facilities.

Indicators:

- Number of violations.
- Number of ports with waste disposal facilities.
- Number of waste items on sample beach lengths.

4.17 Sewage

There are no approved sewage outfalls in the PA. 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. Hamata and Abu Ghusoon, the largest centers of population adjacent to the PA, 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.

Objective: Sewage generated in the PA and its Buffer Zone will have minimal effect on the environmental quality of the PA and it biota.

Policy: No discharge of sewage into the sea or on land. All sewage will be treated. Within the Buffer Zone sludge can be used as fertilizer, otherwise it will be disposed

in designated landfills outside the PA. No new septic trenches should be allowed, and the effect of existing ones should be assessed.

Action:

- The PAMU undertake study to assess the impact of septic systems on adjacent coastal waters in WGHPA.
- The PAMU patrol new resorts to ensure the developers comply with their licenses governing the treatment and disposal of sewage.

Indicators:

- Levels of pollutants in areas where septic systems are anticipated to have an impact on adjacent coastal waters in WGHPA.
- Number of new resorts and other infrastructure with operational treatment plants.

4.18 Major Oil Spill Risk

The risk of a major pollution event due to an accidental oil spill in the PA is high given the volume of commercial shipping that pass through the Red Sea. An oil spill in or adjacent to the PA would not only have detrimental effects on water quality but could also have significant ecological impacts on birds and intertidal assemblages in the PA. The EEAA is responsible for coordination of oil spills incident response and remediation (Borhan 1998). 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 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 PA and the current lack of spill control equipment (pers. comm. January 2003).

Objective: Reduce the risk of an oil spill causing significant impact on the PA.

Policy: Increase preparedness to deal effectively with any potential major oil spill in the PA.

Action:

- Red Sea PA GIS provide EEAA NSCP GIS Office with maps of mangroves and other sensitive habitats in WGHPA.
- EEAA develop a contingency plan to combat an oil spill in the PA
- EEAA establish a rapid oil spill response storehouse at El Quseir or Marsa Alam which will hold suitable equipment to combat a 3 tier size spill[7]

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

Indicators:

- Number of oil spills reaching land
- Development of an oil spill contingency plan for the PA

4.19 Charcoal Making

Charcoal production is one of the few traditional cash products available to inhabitants of the region. This is a process by which the wood, mostly of Acacia trees is transformed into charcoal through anaerobic combustion. Acacia trees are the back bone of the cultural landscape over much of the Eastern Desert (Krzywinski & Pierce 2001). Traditionally only dead trees and branches have been used for charcoal production, however due to increased economic demands on local people and shrinking resource base, live branches or even whole trees are sometimes cut down to provide for charcoal making. The activity is widespread in WGHPA, but there are no figures available to indicate the precise magnitude of the problem. Much of the charcoal is destined to the Nile Valley and tourist resorts for use in "Shisha" smoking.

The economic return from charcoal making is meager for the average Egyptian, however it is probably significant for the local inhabitants, as cash products are extremely limited for them. On the other hand the ecological impact of reducing the number of trees in this arid environment is extremely high. Tree fecundity is very low and it takes many years for trees (under normal conditions) to reach mature sizes.

Objective: To ensure that charcoal production does not affect the natural population dynamics of native woody vegetation and its ecological functions in WGHPA.

Policy: Charcoal production is contradictory to WGHPA's designation as a National Park and should be stopped in the medium term future (next five years). Since this is a traditional commercial activity, which the indigenous community relies on as a relatively important source of income, alternative income sources of income should be provided before a complete ban on charcoal production is enforced.

Actions:

- Initiate a specialized study to assess the current impact levels of charcoal production and the possibilities of eliminating this activity in WGHPA, identifying the likely socio-economic and ecological consequences.
- Implement a phased approach leading a complete ban on charcoal production in close consultation with local community leaders and members.
- Initially ban the activity from Strict Natural Zones, followed by a ban in Premium Wilderness Zones.
- The PAMU will seek to find alternative activities for affected families through employment as community guards (other ideas are listed under "Indigenous People").
- Inform and explain to the local inhabitants why charcoal making is being stopped.

- Patrolling to control for charcoal making in the non-designated zones.

Indicators:

- Amount of charcoal produced.
- Number of trees / tree branches felled for charcoal production.

4.20 Fuel Wood Collection

Wood is collected by indigenous people as a source of fuel. Dead wood is preferred but the lack of it leads the locals to break tree branches and leave them to dry so they could be used later for fire. But unlike for charcoal production smaller branches and twigs are used, and on a much smaller scale, making the impact of this activity of a smaller significance. Native inhabitants of WGHPA have an inherent right in utilizing the resources of their land, and they have done so in a mostly sustainable fashion for millennia. However, with the growth of the indigenous population, and increase in the number of tourists, campers and workers, who tend to collect excessive amounts of fuel wood to supply their campfires, the pressure on woody plants is becoming excessive.

Wood is an important resource in the desert. It is important for the livelihood of the local community, but also plays an important ecological role. Even dead wood is an important component of WGHPA's terrestrial ecosystem. Dead wood is the home of whole communities of detritus organisms, which consume and hide in wood debris. These creatures represent an important (though forgotten) component of the biodiversity of the region and play an important role in the ecology of the region.

Objective: To reduce the impact of fuel wood collection on wild flora of WGHPA and adjacent regions, and ensure its sustainability.

Policy: Only indigenous inhabitants will be allowed the collection of fuel wood. Visitors must obtain fuel from other sources, such as gas cylinders. The PAMU will seek to prohibit the collection of fuel wood for all visitor activities in WGHPA and to stimulate demand for alternative fuel. Utilization of solar technology and other renewable energy sources should be encouraged, particularly in ecolodge developments and by the military.

Actions:

- Prohibit the use of fuel wood by non-indigenous users of WGHPA, through awareness and enforcement.
- Inform tour operators and other visitors that they should bring their own supply of imported fuel wood, butane gas cylinders or kerosene stoves.
- Produce awareness materials on the threat of fuel wood collection to biodiversity.
- Hold workshops for stakeholders engaged in tourism businesses to increase awareness of the regulation of fuel wood and alternatives.

- Monitor the impact of implementing the above measures on fuel wood consumption.
- Establish a pilot venture to import fuel wood from the Nile Valley for sale to visitors to WGHPA.
- Design, test and manufacture simple solar stoves for demonstration purposes, with the aim of generalizing its use by indigenous inhabitants of WGHPA (use experience gained in St Katherine PA).

Indicators:

- Number of visitors using native fuel wood.
- Condition of vegetation in monitoring plots established near local settlements.

4.21 Grazing

Localized overgrazing is one of the main problems in WGHPA. However, until alternatives such as affordable feed supplements are available, the problem will remain intractable, as grazing is a long-standing cultural tradition linked directly to one of the most important livelihood sources of the local communities.

Camels regularly feed on mangroves in WGHPA. Some stands show evidence of significant grazing pressure such as ‘grazing lines’ on tall trees and cropped foliage cover 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. However, the cause of mortality remains unknown. 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.

Objective: To ensure that grazing pressure is maintained at sustainable levels.

Policy: The PAMU, with the co-operation and agreement of local communities, will seek to introduce an integrated program for sustainable grazing, particularly in critical habitats, such as mangroves and salt marshes.

Actions:

- Establish close communication with local community members to understand grazing patterns and issues.
- Conduct a study to assess the impact of grazing on the natural vegetation of the region, including mangroves.
- Grazing in mangroves should be restricted to Traditional Use Zones only.
- Grazing will be prohibited in Strict Natural Zones.
- Patrolling to enforce no grazing zones.

Indicators:

- Number of goats in selected monitoring sites.
- Number of camels in selected monitoring sites.

4.22 Fishing

Indigenous and itinerant commercial fishermen fish in the PA 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 have significant effect local fish stocks. Galal et al. (2002) reported that fishing by Bedouins in Nabq PA, 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 & Ibrahim (2003) reported that non-indigenous fishermen in the PA 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. Riegel & Luke (1997b) reported evidence of wide spread use of explosives in and adjacent to WGHPA in the past. Explosive fishing kills non-target species, including corals and other habitat-forming species. It remains unknown whether explosive fishing is still done in the PA. 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).

Objective: To establish sustainable and ecologically sound fisheries in the PA.

Policy: Reduce current level of fishing activity in the PA through limiting fishing rights to indigenous fishermen only, and reduce ecological damage through prohibition of illegal fishing methods and establishing no-take zones.

Action:

- The PAMU/EEAA and the Fisheries Authority to establish and implement a fisheries management plan for the PA (in progress)[8].
- The PAMU to establish and implement PA zoning scheme, which will include no-take zones.

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

- The PAMU to implement a gradual phasing out of non-indigenous fisherman active in WGHPA.
- All fishermen active in WGHPA will need to be licensed from the EEAA and registered with the PAMU. Licensees will be given clear instructions on the regulations of fishing in the PA and details of no-take zones.
- The PAMU will carry out an information and educational campaign to alert fishermen, fisheries authorities and coast guard active in the WGHPA region to the PA regulations.
- The PAMU will patrol the PA waters and prosecute repeat violators of regulations.
- The PAMU will monitor fish landings in and around WGHPA.

Indicators:

- Fish landing statistics in and around WGHPA.
- Population structure of commercial species.
- Number of operational no-take zones.

4.23 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 PA 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.

Objective: Limit the impact of human activity on dugongs, marine turtles and cetaceans in the PA.

Policy: Ensure that fishermen and boat operators active in the region are aware of the risks posed to dugongs, marine turtles and cetaceans, and of the complete protection they enjoy inside the PA. Prohibit vessels from speeding in important habitats and locations. Ban the use of all sporting speedboats in the PA.

Action:

- The PAMU identify critical habitat for dugongs and marine turtles in the PA.
- The PAMU develop strategy to minimize disturbance and mortality of dugongs and marine turtles in the PA.
- The PAMU to inform fishermen and boat operators active in the region of the complete protection dugongs, marine turtles and cetaceans enjoy in the PA.
- The PAMU to implement zoning scheme.

Indicators:

- Number of turtle and dugong caught by fishermen in WGHPA.

- Number of turtle, dolphins and dugong injured by vessels in WGHPA.

4.24 Collection of Marine Invertebrates

Since about 1999 the trade and selling of marine curios, such as corals and shells, has been greatly curtailed in Hurghada, Safaga, 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 PA indicate it is still heavily harvested (T. Rouphael (PSU), pers. comm. June 2002). The animal is harvested for its meat, but the scale of harvesting remains unknown. The meat is frequently sold commercially (dried) in some Red Sea urban centers, e.g. Suez.

About fifty species of sea cucumbers (Holothuriidae) are known from the Red Sea. Rampant poaching and over harvesting by licensed fishermen have lead to the commercial extinction of the most commercially valued species (M. Hanafy (PSU), pers. comm. January 2003). The status of all species in the PA 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 (Uthicke, Australian Institute of Marine Science, pers. comm. February 2003). Further, he does no advocate relocation of holothurians to overexploited fishing rounds unless genetic studies show that the relocated specimens are of the same genetic stock.

Objective: To maintain the natural population levels and ecological functions of marine invertebrates in WGHPA.

Policy: No collection of marine invertebrates will be allowed in WGHPA. As the long-term ecological damage from this activity is very high, with limited socio-economic consequence and clearly contradicts the PA objectives; the ban on invertebrate collection should be immediately effective.

Action:

- The PAMU/EEAA and the Fisheries Authority will coordinate efforts to enforce the ban on invertebrate collection in WGHPA.
- The PAMU will carry out an information and educational campaign to alert fishermen, fisheries authorities and coast guard active in the WGHPA region to the PA regulations.
- The PAMU will patrol the PA waters and prosecute repeat violators of regulations.

Indicators:

- Number and species of marine invertebrates found with violators.

- Number of violations.
- Numbers of indicator species in specified monitoring plots.

4.25 Collection of Medicinal Plants

The medicinal plants found in WGHPA are a valuable resource for local people. Balanites and Salvadora are two of the most valuable medicinal plants in WGHPA. The collection of Balanites fruits, and Salvadora branches and roots is a source of cash for the local population. However, if unregulated, this activity could lead to the degradation of the plants and affects their regeneration. In the mean time the income received by the local people represents a fraction of the true value of their products.

Objective: To ensure that medicinal plant collection is sustainable and the income to indigenous communities is maximized.

Policy: Best practices for the collection of medicinal plants, which insure sustainability should be applied. Collectors will be encouraged to process, package and market their own medicinal plants. PAMU will assist in facilitating marketing avenues.

Actions:

- Build consensus for a community agreement on sustainable collection levels for medicinal plants from WGHPA.
- Develop best practices for medicinal plant collection. The collecting system should be based on traditional indigenous conservation traditions.
- Developing a marketing strategy for medicinal plants from WGHPA.
- Encourage the GEF/UNDP/EEAA Medicinal Plants Project (which aims to establish sustainable harvesting practices for wild medicinal plants several PAs in Egypt) to assist and participate in developing the above activities.
- Encourage collectors to process package and market their own medicinal plants to add value to their product.
- Introduce a system for licensing collectors.
- Establish a local branch of the Medicinal Plant Association.

Indicators:

- Number / cover of medicinal plants in monitoring plots.
- Income from medicinal plant units.

4.26 Hunting

Hunting is a serious threat to large mammals in the region. Already Dorcas Gazelle Gazella dorcas have declined notably from much of the area, particularly the coastal plain due to excessive hunting, Catching and trapping of Nubian Ibex Capra nubiana

at watering holes is also a serious problem, in this and other regions of the Eastern Desert. Most seriously threatened is the Barbary Sheep Ammotragus lervia. Although most of the hunting is done by sports hunters from the Nile Valley, foreigners, as well as, army personnel, locals also trap wildlife for food. But this is not a significant source of food.

Commercial wildlife collectors (particularly reptiles) are often active in various parts of the Eastern Desert mainly to supply the international pet trade. The Ocellated Dab Lizard Uromastyx ocellata is one of the primary target species for collectors. Occasional falcon trapping is also known to take place along the Red Sea coast during autumn. Lanners Falco biarmicus and Sooty Falcons F. concolor are two native species which have suffered from this destructive activity.

Objective: To maintain the natural population levels and ecological functions of wildlife in WGHPA.

Policy: Stop all hunting and wildlife collection activities in the PA. The no-hunting regulations within the PA and it's Buffer Zone will be strictly enforced for all wild native species (this excludes catching commercial fish), and offenders will be vigorously prosecuted.

Actions:

- Frequent patrols of important wildlife locations and habitats. Special note should be given to securing water holes and wells, where wildlife might concentrate to drink or hunt.
- Mobilize Community Guards interventions and liaison activities in those areas and in seasons in which hunting (trapping and collecting) is reported.
- Vigorous interpretation program to local people explaining wildlife's ecological importance and the charismatic value of native wildlife for PA visitors, especially large mammals and particularly predators.
- Expanding eco-tourism destinations to remote areas to offer alternative income generation opportunities.
- At the local level, Community Guards should take note of animal collection or hunting activities, as local participants are usually involved.
- Install clear signs that indicate that wildlife hunting is strictly prohibited in the PA and its Buffer Zone.

Indicators:

- Number of selected indicator species at designated monitoring sites (Gazelle and Uromastyx are good indicator species, others need to be identified).

4.27 Mining and Quarrying Activities

Mining and quarrying activities in the WGHPA have been developed with little concern to the environment and the landscape qualities of the region. However, they have impacted only a limited area of the landscape to date. There are no regulatory mechanisms in place to assure environmental quality in future operations, which are likely to continue on a limited basis. The lack of such management tools is putting the resources of the region at jeopardy.

Quarrying has negative impacts on the environment; it causes aesthetic impacts, damages vegetation and soil, leading to reduced grazing, increased soil erosion and flooding, and reduces wildlife populations and habitat complexity. Quarrying and tourism are incompatible; quarrying must be a strictly localized activity while tourism should be an extensive activity to maximize economic returns. The geological resources contained within the PA are their basic fabric and the existence of exploitable geological resources should not necessarily mean that they are available for exploitation. It may be necessary to forgo the immediate exploitation of such resources in the interest of environmental conservation and for the sake of future generations.

Objective: To seek to minimize quarrying and mining activities in WGHPA and to ensure that existing activities do not destroy the long-term value of the PA's natural resources.

Policy: Mining and quarrying for ornamental rock or building material are by their very nature consumptive activities, which can never be sustainable and are therefore inimical to PA objectives. Law 102/1983 expressly forbids damaging or removing rocks or soil and the spoiling or destruction of geological structures. Therefore, the PAMU will seek to limit and reduce current mining and quarrying to the minimum. All quarrying and mining activities will be prohibited in important wildlife habitats, premium tourist areas, areas of natural beauty and archaeological, cultural and religious sites.

All quarrying and mining activities within the PA will require licensing from the EEAA. Mining and quarrying activity will only be licensed in Multiple Use and the Buffer Zones, for high economic mineral resources, and in areas away from viewers (sheltered areas) and has no other significant natural or cultural resources. Licenses will only be given after field evaluation and inspection of potential sites by PAMU staff. In the mean time the PAMU will seek to restore old quarry sites by promoting the utilization of granite waste and re-profiling sand and gravel borrow pits and spoil tips.

Actions:

- Identify mining and quarrying areas in WGHPA, and the operational / contractual condition at each.

- Liaise with the Red Sea Quarry Department to stop all granite quarrying activities, until permissible quarrying localities are identified on the ground, and sustainable quarrying techniques agreed upon.
- The PAMU in consultation with the Red Sea Quarry Department and the Egyptian Geological Survey will institute and enforce new regulations for the issuance of operator licenses, which specify codes to increase efficiency, reduce wastage and to minimize environmental impacts.
- On the basis of commercial, environmental and aesthetic considerations, the PAMU in cooperation with the Red Sea Quarry Department, and the Egyptian Geological Survey will define areas where quarrying activities are to be allowed within the Multiple Use and Buffer Zones of WGHPA. No quarry activities will be permitted outside these defined quarry zones.
- The PAMU will ensure that regular monitoring of all active quarry sites is implemented.
- The PAMU will ensure that operators are kept fully aware of quarry regulations.
- The EEAA will help initiate projects to introduce efficient modern methods of quarrying and mining, which reduce waste in the industry.
- The EEAA will promote the exclusion of all commercial mining and quarrying activities from within the PA when there are alternative sources of supply outside PAs.
- The PAMU will seek to restore the landscape at stopped quarry and mine sites in exposed localities (as a priority), such as at Wadi Shawab and in the vicinity east of Gebel Hamata.
- The PAMU will initiate a program to reclaim and utilize Granite debris at stopped quarry sites in exposed localities (as a priority), such as at Wadi Shawab and in the vicinity east of Gebel Hamata.
- Reasonable concession fees should be collected for each license for the benefit of the PA Fund.

Indicators:

- Number of active mines and quarries.
- Number of degraded mining and quarry sites.
- Maximal distance from quarry or mining site center where soil disturbance can be observed.

4.28 Threatened Species

WGHPA is home to a number of globally (as well as nationally) threatened species of fauna. The conservation of these threatened species is an international obligation, and one of the priorities of the National Biodiversity Strategy and Action Plan. The most outstanding threatened species in need of urgent management effort include desert

antelopes, marine turtles, birds of prey, dugongs and nesting seabirds (see Table 7 for a complete listing of globally threatened species).

Objective: To ensure the long-term in-situ survival of the globally threatened species found in WGHPA at their natural densities.

Policy: Globally threatened species found in WGHPA represent a critical resource in need of constant monitoring and special management effort.

Actions:

- The PAMU will seek to establish monitoring programs to establish the conservation status and population sizes of the most critically threatened species (Dugong, marine turtles, Barbary Sheep, Dorcas Gazelle and Ibex)
- The PAMU will establish Species Action plans for the above-mentioned species.
- The PAMU will conduct regular patrolling of critical habitats and locations for the above-mentioned species.
- The PAMU will establish scientifically rigorous monitoring programs for the above-mentioned species.

Indicators:

- Number of individuals of target species at designated monitoring sites.

4.29 Localized and Threatened Habitats / Locations

Some habitats are particularly vulnerable because they occupy very small areas and/or are naturally sensitive to disturbance, these include habitats or locations that are very small such as marine islands, mangrove stands, turtle nesting beaches and sensitive archaeological sites. A high degree of existing or anticipated human use (for recreation for example) at these sites, and the potential for conflict is an important factor in identifying sites of special concern.

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 PA remains unknown. Old campfire, considerable amounts of solid waste is and fishermen shelters and tables are observed on some of the islands. Wadi Lahmi Resort offers day trips to the Qulan Archipelago, where visitors explore islands such as Mahabis Island. The Wadi Gemal Dive Center infrequently takes birdwatchers to visit Wadi Gemal Island in spring and autumn. Mrs. Kirsten Ehlert, manager of the center 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 nesting season.

Objective: To ensure that sensitive habitats / localities found in WGHPA retain their natural, ecological or cultural values and functions.

Policy: Sensitive habitats and localities need particular management attention to reduce or eliminate the risks they face, case by case (e.g. most islands will be closed to visitors, while some will be subject to seasonal restrictions; turtle nesting beaches will be closed to visitors during the breeding season, and no structures will be permitted in their vicinity).

Actions:

- The PAMU will seek to identify the most critical habitats and locations in need of special management input. A preliminary list includes the following sites: Wadi El Gemal Delta, Sharm El Luli, the turtle nesting site at Marsa Um El Abas, Qulan and Hamata mangroves, the Qulan Islands and Wadi El Gemal Island, and Nugrus and Sikait Roman mining villages.
- The PAMU will establish Site Action plans for the above listed habitats and localities, and others, which are identified at later stages (see CMA Management Pan for pilot Site Action Plans).
- The PAMU will conduct regular patrolling of critical habitats and locations.
- The PAMU will establish scientifically rigorous monitoring programs for indicator resources at each of the above-mentioned localities.

Indicators:

- Variable at each habitat / location. To be specifies in each Site Action Plan.
- Number of nesting turtles and seabirds at important nesting sites.

4.30 Introduced, Feral, and Invasive Species

Alien invasive species is one of the most outstanding issues facing biodiversity today on a global scale. Along the Red Sea alien species of plants are widely introduced for ornamentation in tourist developments and can become invasive. Feral cats and dogs associated with human dwellings can be highly destructive to native wildlife. Feral cats are particularly damaging to reptile and bird populations, while dogs are known to hunt and disturb gazelles. Both cats and dogs can transmit diseases to wildlife. Feral donkeys are also a problem because of the impact they have on vegetation and water supplies (one donkey has the nutritional maintenance needs of three male ibex).

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. com. 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. Invasive macro-algae species from the Mediterranean posses a potential threat to marine species in the Red Sea.

There are three harbors in the PA that regularly receive vessels from international waters. Species introduced to these harbor could conceivably spread into adjacent waters. Alien species of marine fauna are also used in mari-culture in various parts of the Red Sea.

Objective: To eliminate all introduced, feral and invasive species from WGHPA, and prevent the introduction of any further ones.

Policy: The PAMU will seek to eradicate, in a humane manner, all feral, alien and invasive species inside WGHPA. No poisons will be permitted for alien species control. Further introduction of alien, particularly invasive, species in WGHPA will be prohibited.

Actions:

- The PAMU will prepare a list of feral and alien species found in WGHPA and record their distribution.
- PAMU to undertake biological survey of the harbors at Abu Ghusoon, Marsa Alam and Hamata to describe the occurrence of introduced marine species, and assess possible eradication.
- The PAMU will implement a humane eradication program for all alien species including feral cats and dogs, priority given to Strict Natural and Premium Wilderness Zones.
- Encourage the local inhabitants to round up feral donkeys from Strict Natural and Premium Wilderness Zones.
- Prohibit the use of exotic plants for landscaping in all developments inside WGHPA, and enforce the use of alternative indigenous species.
- Establish a nursery of local indigenous plant species to be used in landscaping in WGHPA. The World Food Program project in the southern Red Sea could assist in this effort.

Indicators:

- Number of introduced species.
- Number of individuals of feral / introduced species in designated monitoring plots.
- Number of non-indigenous plant species used in landscaping.

4.31 Scientific Research

Although the PAMU is primarily a management body and not a research institution, effective conservation management requires accurate and relevant information. Thus,

targeted and management issues oriented research is an important component of the PAMU's scope of work. On the other hand, unplanned research lacking clear scientific objectives could be counterproductive. Indeed some research can be highly damaging to important natural resources, especially if research design calls for the collection of large numbers of specimens of fauna and flora or other samples.

WGHPA is a valuable scientific resource that will increasingly attract scientists and researchers and these should be encouraged. Scientific research is one of the important activities, which PAs seek to promote and facilitate.

Objective: Ensure that all scientific research conducted within WGHPA is not detrimental to critical natural resources, is scientifically and ethically justified and helps advance the PA management objectives.

Policy: Meaningful non-intrusive scientific field research is an important activity to be encouraged in WGHPA. The PAMU will encourage and where possible support applied research both by outside researchers and by PAMU staff, according to planed priorities. Internal studies are the ones elaborated by the PAMU staff or financed by its administration to directly support the PAMU decision-making or management activities.

All external researchers must submit a detailed proposal to the PAMU/EEAA for approval. All data and research results are to be registered in the PAMU's IT/GIS unit as a matter of course.

Actions:

- The PAMU will prepare a schedule for priority research projects, which the PAMU staff should carry out, our can be contracted to external researchers.
- All researchers will have to submit a research proposal for PAMU/EEAA approval; outlining their intended research and methodology and indicate whether specimens of plants are to be collected, how and in what quantities, with justifications.
- Outside researchers will be encouraged and supported where practical to undertake applied research on condition that they submit; sign confidentiality and code of conduct statements and submit papers intended for publication for prior review.
- All researchers will be expected to acknowledge any support and submit a free copy of any paper, article or thesis arising from the research to the PAMU library.
- The PAMU technical staff will be encouraged to pursue relevant and applied research as part of their duties.

Indicators:

- Number of applied (i.e. management oriented) research projects.
- Percent of priority research topics addressed.
- Number of reports and reprints resulting from the research received by the PAMU.

5. Management Tools

5.1 Zoning

An important mechanism to achieve the objectives of WGHPA is a zoning scheme. The zoning scheme for WGHPA is a resource-based approach by means of which the area is zoned/classified according to its need for protection, level or intensity of management and capacity to sustain traditional, public or commercial use. The scheme provides guidelines for management actions and helps resolve conflicts, which frequently arise when attempts are made to conserve and utilize the same resource base. It also designates areas 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.

Table 1 Internal management zones for WGHPA

Name of zone	Management input	Permissible impact level
1- Strict natural zone	Low - moderate	Zero impact
2- Premium wilderness zone 3- No-take zone	Moderate	Low impact
4- Recreational zone 5- Archaeological protection zone 6- Traditional use zone	High	Moderate impact
7- Multiple use zone 8- Adjacent Area (Buffer Zone)	High	High impact

The WGHPA zoning scheme includes eight management zones (Table 8), falling under four categories of varying protection levels, ranging from a strict natural zone, where no activities are permitted, to a multiple use zone, where many activities of limited ecological impact are allowed under strict management constraints. An external zone category will be applied to accommodate the PA adjacent area: Buffer Zone. Tables 9 & 10 categories the most common or anticipated activities in WGHPA according to their permissibility in each of the zones, both on land and in the sea. Map 15 shows the proposed zoning scheme for WGHPA.

5.1.1 Zone Descriptions

Strict Nature Zones

General Description: Pristine natural areas set aside for the free interaction of ecological factors and worthy of total protection with no roads or other forms of modern construction. These areas are variable in size; for desert wildlife conservation they are usually relatively large i.e. up to a hundred square kilometers and remote to serve their purpose; for marine and coastal wildlife they could be quite small (such as small islands). Where appropriate and possible, "Wildlife Corridors" that link critical habitats should be zoned in this category.

Protection Level: High with zero impact if possible.

Objectives: To ensure the representation and continued existence of all resident flora and fauna elements within the PA in a natural state, to allow for movement of wildlife between critical habitats and to serve as monitoring sites.

General management strategy: No active management other than patrolling, halting of damaging activities, removal of feral species, etc.; only non-manipulative scientific research is allowed. Any existing tracks will be closed to public access and used only for management purposes.

Development: None permitted and all scientific facilities to be removable.

Public Use: Generally none permitted.

Premium Wilderness Zones

General description: Very high value natural areas set aside primarily for the use of a limited number of visitors to have a rewarding experience in a remote wilderness area.

These areas are extensive in size, often made up of several landscape units, free of man-made constructions and to be used only in a way that does not necessitate access roads. Transit corridors for tourists will also be zoned under this category.

Protection level: High protection: Minimal impact.

Objectives: The preservation of wilderness environments in a condition as close as possible to their natural states to serve low density, high value/premium wilderness adventure tourism and bring associated benefits to local communities.

General management strategy: To limit the number of visitors (in terms of absolute numbers, group size and number of groups per area), to ensure the preservation of a premium wilderness environment for high value backcountry recreation with limited ecological management. Premium backcountry fees should be charged for entrance to premium wilderness zones.

Development: None.

Public use/Permitted activities: Strictly regulated to limit absolute numbers, group size and number of groups. Local communities to carry on traditional practices as long as these do not exceed sustainable off take of resources; non-traditional uses i.e. groups trekking on foot or by camel, will be limited by aesthetic and physical carrying capacity as determined on the site's absorptive capacity but in all cases will be severely limited.

No-take zones

General description: A no-take zone is an area where harvesting of marine resources is strictly prohibited, but passive non-extractive types of ecotourism activities, which are considered environmentally benign activities and scientific research may be permitted.

Protection level: High protection. Low impact.

Objectives: The no-take zones aim at 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, and providing high quality localities for ecotourism.

General management strategy: Regular patrolling to ensure the halting of all fishing activities. Only a limited number of visitors should be allowed, to ensure the preservation of a premium high value resource with limited management input. Premium fees should be charged for reservation and use of no-take zones. Only non-manipulative scientific research is allowed.

Development: None permitted.

Public use: Restricted public use preferably limited to high quality diving and snorkeling tourists (ecotourists), who would have appreciation of the special conservation privilege these areas enjoy and the pristine condition they should be in.

Recreational zones

General description: Largely natural areas where public access is freely allowed but organized to provide visitors with a natural and rewarding experience in the PA. Largely natural areas with high scenic and cultural value and of moderate importance for biodiversity conservation.

Protection level: Medium level, minimal impact.

Objectives: To provide opportunities for easily accessible backcountry tourism that provides visitors with a rewarding natural experience and generates income for local people.

General management strategy: Active management to maintain natural areas and minimize impacts by installation of facilities, monitoring guides, enforcing Trekker's

Code etc. The aesthetic carrying capacity in these zones will be significantly higher than in Premium Wilderness Zones but specific limits will be set to maintain visitor expectations and standard entrance fees will be levied on users.

Development: Restricted to established Bedouin settlements, installation of camping sites, trails, markers and other facilities to limit visitor impact.

Public use: Organized access within prescribed carrying capacity.

Archaeological Preservation Zone

General description: Areas that contain individual or aggregations of important archaeological, religious or cultural sites. Normally relatively small areas that contain important archaeological, religious or cultural sites that require different levels of protection and management.

Protection level: High protection: Minimal impact. Some of the smaller sites will be physically protected by barriers to prevent vehicular access. Identification signs will be placed at each archaeological site giving restrictions on access.

Objectives: To protect archaeological sites within the PA, some of which may be accessible to visitors in partnership with relevant stakeholders and Government authorities.

General management strategy: Management strategies will depend on the particular site and partner agency but for accessible sites the general approach will be to ensure adequate safeguards and interpretative facilities to minimize visitor impact. Significant archaeological sites will be protected and managed in association with the Supreme Council of Antiquities.

Development: None except for the installation of appropriate protective measures and interpretative facilities, all of which should be removable.

Public use: Variable according to sensitivity with some sites permanently or seasonally closed to the public while others may be accessible on a controlled basis.

Traditional Use Zone

General description: Relatively large and well-preserved areas where only traditional Bedouin activities (herding, artisanal fishing) for using biodiversity are permitted but controlled. Primarily devoted to the development of indigenous systems and practices for the conservation and sustainable use of biodiversity and internal buffer zones for areas of high conservation interest.

Protection level: Medium level. Moderate impact

Objectives: To sustain and enhance traditional Bedouin lifestyles and practices.

General management strategy: Active management with controls on development and where resource conservation measures such as grazing reserves, recharging

groundwater supplies, veterinary surveillance and feral animal eradication can be practiced.

Development: Restricted. New tracks are permitted only to communicate with established settlements or areas related to traditional use. Upgrading and development of traditional agricultural activities, including wells and catchments dams, permitted with controls. Expansion of existing settlements allowed with vernacular architecture styles. Fixed facilities for tourism to be limited to Bedouin managed eco-tourism enterprises, e.g. eco-lodges.

Public use: Limited with access to outside visitors reserved for Bedouin mediated experiences that benefit local communities.

Multiple Use Zone

General description: Areas of low conservation value which are individually relatively small and collectively constitute a small proportion of the PA; that are already developed or scheduled as urban areas (Abu Ghusoon Town), ecotourism development zones; have already been highly impacted or are likely to be in the near future. These areas are generally already developed (urban areas), utilized (quarrying) or set aside for services essential to the PA or for the provision of the facilities and deleterious activities required for visitors.

Protection level: Low protection. High impact

Objectives: Sacrificial areas used for multiple purposes to concentrate urban development, commercial activities such as quarrying or high impact tourism activities in areas of relatively low conservation value.

General management strategy: Passive with activities monitored to ensure compliance with regulations. The ecolodge development zones within WGHPA will be subject to strict development controls in accordance with the widely accepted ecolodge development codes.

Development: As required, according to PA regulations and EIAs.

Public use: Generally open access for municipal areas within prescribed limits. For areas such as Wadi Ard, used for high impact commercial activities organized by operators for visitors such as quads, a reduced PA entrance fee will be levied on operators.

Adjacent Area (Buffer Zone)

General description: Strip of variable width surrounding the designated boundaries of WGHPA, as defined under Article 3 of Law 102 (Part II).

Protection level: Low to medium protection: Low, medium to high impact.

Objectives: To help minimize external threats to the PA from incompatible or unsustainable land-use practices occurring outside the legal boundary. Within the adjacent area there will be some form of management control over land use. In this regard the "adjacent area" will constitute a nominal "buffer zone."

General management strategy: It is forbidden to undertake activities or experiments in the adjacent area that will have an effect on the protectorate's environment and nature, except with the permission of the concerned administrative body. Within the adjacent area there will be some form of management control over land use and commercial activities.

Development: Permitted according to location and PA regulations.

Public use: Open access according to type of activity and PA regulations.

Table 2 Uses permitted in each zone of the terrestrial component of WGHPA

Activity/ Zone	Strict natural zone	Premium wilderness	Recreational zone	Archaeological zone	Traditional use zone	Multiple use zone	Buffer zone
Recreational uses							
Ecotourism (bird watching, wildlife photography, etc.)	No	Yes	Yes	Yes	Yes	Yes	Yes
Ecolodge development	No	No	No	No	No	Yes	Yes
Desert safari / camping	No	No	Yes	No	No	Yes	Yes
Use of quad runners	No	No	No	No	No	No	No
Trekking	No	No	Yes	Yes	Yes	Yes	Yes
Cultural heritage	No	Yes	Yes	Yes	Yes	Yes	Yes
Commercial uses							
Mining	No	No	No	No	No	License	License
Quarrying	No	No	No	No	No	License	License
Prospecting for minerals	No	No	No	No	No	License	License
Charcoal making	No	No	No	No	No	License	License
Transport	No	No	No	No	Yes	Yes	Yes
Traditional uses							
Collection of medicinal plants	No	No	No	No	Yes	Yes	Yes
Grazing	No	Yes	Yes	Yes	Yes	Yes	Yes
Collection of firewood	No	No	No	No	Yes	Yes	Yes
Visitation to religious sites	NA	Yes	Yes	Yes	Yes	Yes	Yes
Other uses							
Scientific research	Permit	Permit	Permit	Permit	Permit	Permit	Permit

Table 3 Uses permitted in each zone of the marine component of WGHPA

Activity/ Zone	Strict natural zone	No-take zone	Recreational zone	Multiple use zone
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
Spear fishing	No	No	No	No
Commercial fishing				
Hand lining / drop lines	No	No	No	License
Net fishing from shore	No	No	No	License
Net fishing from boat	No	No	No	License
Trap fishing	No	No	No	No
Trawling	No	No	No	No
Aquarium fish collecting	No	No	No	License
Spear fishing	No	No	No	No
Other commercial				
Aquaculture	No	No	No	Permit
Mineral exploration / development	No	No	No	No
Charter vessels – fishing	No	No	Permit	Permit
Charter vessels – other	No	License	License	License
Eco-tourism activities	No	License	License	License
Other recreational				
Boating	No	Yes	Yes	Yes
Surface water sports	No	No	Yes	Yes
SCUBA diving	No	Yes	Yes	Yes
Snorkeling	No	Yes	Yes	Yes
Reef walking	No	Yes	Yes	Yes
Beach activities	No	NA	Yes	Yes
Other activities				
Groyne, jetties, moorings etc	No	Permit	Permit	Permit
Scientific research	Permit	Permit	Permit	Permit

5.2 Patrolling

Patrolling is the main and most basic management tool to be used by the PAMU. ALL PAMU staff regardless of specialization (with the exception of technicians) will be obliged to participate in patrolling activities. It is expected that all PAMU staff (with exception of the PA Manager) will spend between 25-50% of their working time on field patrols, spending the balance of the time on their particular area of specialty.

Within NCS/EEAA patrolling is often considered to be synonymous with "monitoring". It is important to distinguish between the two activities (see further details under monitoring below). Patrolling consists of regular or irregular inspection of the PA and its resources, either on land or in the sea. The main objectives of patrolling are to enforce PA regulations, discover and stop violations to PA regulations by PA users and to detect any notable, broad changes in the PA's natural conditions, which might require further detailed investigation and monitoring.

Thus, patrolling intensity and frequency should be higher in PA zones where increased human activities are allowed (as in the Multiple Use, Traditional Use Zone and Buffer Zones).

Patrolling will be conducted by teams of PAMU staff (rangers and community guards). Patrolling teams must be in full uniform, to affirm their authority and identity. Patrolling teams will have multidisciplinary tasks. While the main objective is regulation enforcement, rangers on patrol could also collect data for use in monitoring programs; communicate with local inhabitants and community guards; maintain PA facilities (such as signs, buoys, tracks, etc.).

Specific patrolling schedules and routs need to be developed when PAMU staff is more familiar with visitor use patterns and issues. The patrolling schedule will identify specific routes, localities, times and teams to carry out the patrolling missions.

Safety considerations must be paramount for patrolling teams to avoid endangering PAMU staff. Long desert patrols should be composed of two vehicles, equipped with basic tools, spare tires, extra water and first aid kits. Similarly boat patrols must be equipped with life vests and first aid kits. All patrolling units should be linked amongst themselves and with the main PAMU headquarters via direct wireless communication.

5.3 Law Enforcement

Enforcement of the provisions of Law 102 for 1983 and Law 4 for 1994 is an important obligation for the PAMU. PAMU have police power enabling them to take action against violators of the law. Close contact and coordination with local coast guard and police is important to have effective law enforcement.

Law enforcement is one of the primary tasks of all rangers (regardless of specialization). ALL rangers should get basic training in enforcement procedures and expected professional behavior expected dealing with violators. Law enforcement is an important component of the patrolling activity, and patrolling teams should be prepared at all times to carry out their obligation in enforcing the law.

The legal officer (ranger) will be responsible for follow up of prosecution procedures and will keep track of record of details and relevant paper work.

5.4 Environmental Impact Assessment (EIA)

EIAs are one of the primary management tools for the PAMU. EIAs should be undertaken prior to the construction of any tourism facility inside the park. The EIAs should follow the Environmental Impact Assessment Guidelines (EEAA 1996), the Environmental Guidelines for the Development of Coastal Areas (EEAA 1996) and any relevant TDA guidelines. The final EIA should be reviewed, verified by and approved by the PAMU to insure that information presented is accurate and that the project complies with the PA's regulations and management objectives.

5.5 Licensing / Permits

Licenses are used to regulate certain long term and stable activities, where regulations do not need to be adjusted such as quarries and ecolodges. Permits are given for shorter periods where seasonal adjustments might need to be made on a short term basis, such as for fishing, research, entering closed zones, etc.

A comprehensive, consistent and stable licensing and permit system needs to be developed identifying activities which need to be licensed, prerequisites for licensing, and arrangements with other stakeholders who should participate in the licensing process.

Permits and licenses are also to be used as a method to inform users of the PA regulations and to educate them about its values. Thus, all licensees should receive a standard information / education package along with their permits or licenses.

The possibility of collecting fees for concession licenses should be investigated within the framework of revenue generation in Red Sea PAs at large. PSU is currently (2003) finalizing a revenue generation for Red Sea PAs for NCS/EEAA.

5.6 Site Action Plans

Site action plans are designed to provide specific and detailed management guidance to PAMU staff for small, discrete sites of particular concern due to significant conservation importance and sensitivity, and which could be subject to exceptionally high human pressures. An example would be a mangrove stand or sea turtle nesting

beach. Site action plans must conform to the PA zoning plan and its management objectives. Pilot site action plans have been prepared for Ras Baghdadi and Wadi El Gemal Island (see examples provided in CMA Management Plan). Table 11 lists locations that will require site plans. A site-specific management plan has been prepared for Dolphin House. The plan was developed by the EEAA, in consultation with local stakeholders.

Table 4 Some locations in WGHPA requiring site action plans because of their high conservation value that is threatened by human activity

Location	Values	Threats
Marsa Um El Abas	Turtle nesting beach	Egg harvesting, tourist visitation
Ras Baghdadi	Unique vegetation community	Livestock grazing, trampling
Wadi El Gemal Island	Turtle and seabird nesting area	Egg collecting, tourist visitation
Qulan Archipelago	Turtle and seabird nesting area	Egg collecting, tourist visitation
Sharm El Luli	Uncommon marine assemblages, sea grass meadow	Tourist visitation, boat activity, pollution
Sikait Ruins	Major archaeological site	Vandalism, collection of artifacts, disturbance
Nugrus Ruins	Major archaeological site	Vandalism, collection of artifacts, disturbance

5.7 Species Action Plans

Endangered species and species of particular concern due to their charismatic appeal to visitors, such as Dugong, marine turtles and dolphins need special attention to address their particular management needs. The globally threatened species listed in Table 7 are the fist candidates for species action plans. Key priority species will include Dugong, marine turtles and gazelles. PSU is currently preparing pilot species action plans.

5.8 Moorings

Establishing moorings has been the primary tool for the NCS/EEAA to control damage caused by small vessels active in the Red Sea anchoring directly on to fragile coral reefs. This is one of the main threats the marine tourism activities pause to the marine resources of the region.

Moorings are prescribed in the WGHPA for three main reasons:

1. They protect corals and other organisms by eliminating the need to anchor directly on the reefs.
2. They provide extra security and convenience for vessels visiting the PA.
3. To indicate where visitation is permissible in the marine part of the PA (i.e. moorings are to be placed only where diving activities are allowed, no anchoring will be allowed where buoys are not present).

Riegel & Luke (1997b) listed 9 locations where vessels anchored or moored in the PA (Table 12). Now most of the locations listed by Riegel & Luke (1997b) have moorings. In addition, there may be other areas in the PA where vessels continue to anchor or cable moor because of the absence of buoy moorings. The rates of vessel visitation given Riegel & 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 5 Known locations where vessels regularly anchor/moor in WGHPA

Location	Geographic location
Ghadeira Um Halhalla	24 51.77 N 35 03.77 E
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 El Gemal	24 39.71 N 35 07.99 E
Erg Dynamite (Wadi El 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

In 2002, the PSU staff in Hurghada realized the urgent need to install new moorings or replace damaged moorings on reefs south of 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 Quseir and Ras Banas, an area encompassing the PA waters. At the time of writing, 78 moorings, 76 pin and 2 mantas, have been installed, mainly in the Fury Shoals. The 76 pin moorings were installed on both the reef flat ‘reef-top pins’ or the reef floor ‘reef-floor pins’. The location of each mooring, the numbers of moorings per reef, maintenance recommendations and financial options are described in the Red Sea Mooring Buoy Strategy (see CMA Management Plan).

5.9 Monitoring

Monitoring is the primary source to direct and adjust management, and is thus an essential part of the management process. Monitoring generally involves the

collection of data over time with the objective of detecting change in a particular situation. It is an activity carried out with an objective in mind, usually to detect departures from a set standard. For example, to detect if certain activities in the PA are having negative impacts on particular resources, and to provide timely warning of the deterioration in the conservation status of certain species, thus allowing remedial action to be taken. Monitoring is not an academic exercise, but a practical one that must produce data to be interpreted and feed back into management mechanisms.

Monitoring should be a carefully designed and focused activity with specific objectives that aid in important management decisions. The monitoring process can be divided to two components, an initial one that involves assessing existing status of resources and establishing the methodology used to do that. The other is more or less the replication of this assessment or parts of it over time, using the same methodology. The initial phase is crucial because it sets the tone for a long-term effort, which if not well designed and thought out, and if not practical, would not produce the desired results and be sustainable.

In biodiversity monitoring it is impractical to design several parallel systems to address various taxonomic groups independently. It is more efficient and logical to adopt a general methodology applicable to all faunal groups and flora as much as possible.

In the initial stage the aim should be establishing methodologies to collect field data and collate baseline information on the resources of the PA. This would help develop an understanding of the natural trends and processes of the local ecosystem. In order to gain such understanding and to be able to distinguish between what is natural and not natural, results of monitoring over a period of time are needed.

Several important issues should be considered carefully at the outset of a monitoring scheme:

What to monitor? Data collected should show meaningful trends and be useful for future management applications, as well as be practical to collect in a sustainable fashion. In the case of biodiversity monitoring (for example) we should aim at monitoring species range, abundance and their habitat condition.

How to monitor? Monitoring should be systematic, regular (not necessarily frequent) and sustained. The methodology should be simple, requires minimal resources and can be integrated with more regular ranger activities.

How frequently to monitor? This should be relevant to the phenomena being studied. Although supplementary data should also be collected on an ad-hoc basis during regular patrolling by park rangers.

5.9.1 Grid Cell System

It is proposed to use a 0.10° grid system as the basis for recording all fauna and flora observations during regular patrolling missions in the PA. The grid cell system will greatly facilitate spatial analysis of data acquired and help to indicate gaps in geographical coverage. This will contribute to building up the knowledge base of the PA's resources and help identify gaps in knowledge; focus survey work to target poorly covered locations. Data collected in the field should be integrated with the existing database at the IT/GIS unit at Hurghada. The 0.10° grid system has been proposed and adopted in St Katherine and Siwa PAs as a basis for data collection and treatment. The uniformity in data treatment amongst PAs in Egypt will also facilitate the possibilities for comparative and system wide analysis.

5.9.2 Active Searching (Prospecting)

This is a non-quantitative simple and practical technique, the main objective of which is to document the presence and distribution of species within and among grid cells. Casual or opportunistic observations made by PAMU staff during routine tasks would fall within the scope of this data collection technique. All observations are to be recorded on standard forms.

5.9.3 Monitoring Specific Sites

Monitoring of specific sites can be adopted for two purposes, one to assess impacts on particularly sensitive sites or habitats, or at localities subjected to particular pressures; the other is establishing long term monitoring stations for the PA. The later requires establishing permanent transects at localities with good representation of the habitats and morphological features of the PA for long-term monitoring.

The PAMU could establish permanent monitoring routes linking series' of transects that sample the Protectorate's various habitats. These would be visited regularly in order to produce a reasonable time series that can be used in assessing changes in populations, impacts of human activities and responses to management practices etc.

5.9.4 Indicators

An effective way to monitor ecological and environmental change is to establish a group of indicators that would be the prime targets for future monitoring activities in the PA. In the section titled "Management issues, policies and actions" a group of indicators are proposed for each management objective. This need to be further refined and organized in logical clusters, which would form the backbone of the PA's monitoring program.

A popular ecological indicator is an "indicator species", which is a species of narrow ecological amplitude with respect to one or more environmental factors and which, when present, therefore indicative of a particular condition or a set of conditions. Thus, indicator species are often used to sum up the ecological condition of a particular environment. Ideally, indicator species should be prominent, easy to detect,

easy to identify and sensitive to environmental change. Examples of good indicator species in WGHPA include Dorcas Gazelles Gazella dorcas, Ocellated Dab Lizard Uromastyx ocellata and marine turtles.

5.10 Reporting

Reporting is an important activity for the PAMU. It serves to inform the central offices of NCS of progress made, problems and needs, and also lets the PAMU to take stock on a regular basis of its achievements and ability to meeting the PA management objectives.

All PAMU staff will submit a monthly report to the PAMU Manager by the 28th of every month. Community Guard reports will be collected by visiting Rangers on a monthly basis. The PAMU manager will be expected to submit the PAMU report (according to NCS specified format) to the Regional Red Sea PAs office in Hurghada and NCS head office in Cairo by the 1st of each month. A monthly financial statement is to be returned to the Red Sea PA financial controller in Hurghada by the 10th of the following month.

NCS also requests annual reports for each PA. The format for this report should be obtained from NCS offices in Cairo.

5.11 IT and GIS

IT and GIS are important, efficient modern management decision-making support tools. Already the GIS unit at the PA regional office in Hurghada has accumulated an extensive database of satellite images of the CMA and WGHPA and the distribution of the major coastal and marine resources and human resources in the region. However the efficiency and usefulness of GIS depends greatly on the overall design of its role in the management of the resources at hand.

A GIS unit will be established as part of the PAMU, and will function as a local node of Hurghada GIS unit and will interact with it directly and fluidly. The local unit will serve PAMU management needs and benefit from the already existing capacities at Hurghada. In the Mean time it will digest locally generated data and information to be used at the regional unit and at central NCS databases.

At the PAMU level the IT / GIS unit will collect data from monitoring programs, patrolling, the spatial distribution of human development, welfare and economic activity in the PA, and the distribution of sites and natural resources of conservation interest. The unit will ensure that data is processed in an orderly fashion and retained for future use and analysis by the PAMU. The IT / GIS unit should be involved from early stages in the design and formulation of monitoring programs to insure adaptability of collected data.

Monitoring and management of this database will be critical and demanding tasks. It must be possible to integrate information from a wide, but controlled and defined, range of categories, adopt new data categories when they arise, and be able to demonstrate the comprehensiveness and limits of the database.

A review process needs to be periodically undertaken to ensure that the Red Sea / WGHPA GIS information base is developing usefully. The priority is to identify a checklist of data categories of spatial information representing the human and natural processes in the PA, which need to be complete and up to date.

5.12 Restoration and Rehabilitation

Rehabilitation and restoration of landscapes and habitats is a management tool that is applied to regain the natural features and ecological functions, which were lost due to human impacts. Restoration and rehabilitation should only be applied only after the causes of degradation have been halted or are under control.

Examples of areas that need restoration in WGHPA include the now non-functional granite quarries in Wadi Shawab and in the Gebel Hamata vicinity. Removal of the large accumulations of solid waste from marsas and sharms (bays) and mangroves of WGHPA, would qualify also as restoration measures. Some of the degraded mangrove stands in the Hamata area could also be good candidates for a rehabilitation activity.

The PAMU will take the lead in landscape restoration along important tourism routs within WGHPA (removing accumulations of waste, graffiti, etc.), and will regularly organize beach cleanups at designated recreational localities.

5.13 Public Education and Information

Public education is one of the most important management tools in the PA, which seeks to increase public awareness and stakeholder support. Public information is important to notify users of the PA regulations and restrictions. The target audiences are indigenous communities, tour operators, tourists, local, regional and national authorities, hotels, investors and schoolchildren.

Particulars of public education and information activities should be worked out in a detailed Public Awareness Strategy to be established by the PAMU.

Short-term activities should include direct communication between PAMU and the primary stakeholders in WGHPA, publishing a broacher and establishing signage in the PA.

5.14 Signs and Signposting

Signposting of a PA is one of the principal elements needed to guide visitors and residents through the area, making them aware of the PA's existence and particular places and facilities. Signs would need to be posted throughout WGHPA as a means to inform and educate visitors. Three types of signs will be used: to inform visitors and other users of WGHPA of the boundaries of the PA, signs with instructions and prohibitions, and signs which inform visitors about facts of educational value or points of interest.

A comprehensive signposting plan is needed to ensure the entire system would be integrated and stylistically harmonious. All PA signposting within WGHPA will be consistent in style, should show NCS/MSEA/WGHPA logos, and whenever possible use natural materials.

Currently AED is preparing a number of educational signs for points of visitor interest and instructions to the PA users. AED will also prepare signs to delineate the legal boundaries of the PA and placed at the coordinates mentioned in the PA declaration (20 land based coordinates). Four suitable (relatively small, low key, and preferably made of local natural materials) will be placed on the southern and northern entrance of WGHPA along the coastal highway, one at the juncture of the Edfu-Marsa Alam highway and Sheikh Shazli road, and another at the northern entrance on the Sheikh Shazli road.

Other signs not belonging to WGHPA will be kept to a minimum with no roadside commercial billboards allowed within WGHPA. Within urban areas only one simple sign per establishment (hotel, restaurant etc.) will be allowed, this may be simply lit at night with no flashing or colored neon lights.

5.15 Visitor Facilities and Infrastructure

The park will need to develop a wide variety of infrastructure and facilities to cater to visitors. There would have to be detailed studies of visitor's infrastructure and facilities prior to construction. The design, construction and maintenance of such facilities should take into consideration environmental impacts and utilize ecologically sound designs, traditional materials and appropriate technologies. It is suggested that these facilities be constructed from local materials such as stone, in particular the scrap granite in the mines around the park. It is also recommended that adaptive reuse be employed whenever appropriate. There are a number of abandoned buildings inside the park, which belong to the local communities and mines that could be converted for use as visitor facilities.

5.15.1 Visitor Centers

The main visitor center is recommended to be situated along the coast road in either the northern or central section on an elevated location overlooking the sea, coastal

plain and mangroves. It is proposed that this center be developed as a tourist attraction with exhibits, educational facilities, a cafeteria and gift shop. Smaller satellite visitor centers can be established in other areas of the park, such as Sheikh Shazli and Abu Ghusoon marina.

5.15.2 Outdoor Displays

Outdoor displays can be set up at various sites for educational purposes. Such displays are recommended for sites of high visitor value, such as Wadi El Gemal Marsh, Hamata Mangroves, Marsa Um El Abas and the Wadi El Gemal entrance.

5.15.3 Tracks

Tracks would have to be marked and some upgraded. Some tracks would have to be closed for visitation for conservation reasons, such as the track through the down stream part of Wadi El Gemal (from the coast road up to the mountains).

5.15.4 Hiking Trails

Suitable areas for hiking trails need to be identified. Trails are needed in the Wadi El Gemal Delta, as well as at Nugrus, Sikait and Zabara.

5.15.5 Board Walks

A boardwalk is recommended at the Wadi El Gemal Delta and Hamata Mangroves to reduce destruction and disturbance to the natural vegetation.

5.15.6 Observation Towers and Hides

Observation tower(s) and hides could be constructed at appropriate locations to facilitate viewing and minimize disturbance to the wildlife. It is recommended that an observation tower be constructed at the Hamata Mangroves and hides erected near wildlife feeding and drinking sites.

5.15.7 Viewpoints

Along the asphalt roads and some desert tracks is recommended that lay-bys be established where vehicles could park to observe nature and photograph the scenery. Viewpoints are needed on the coast road, Sheikh Shazli road and track running along the edge of the coastal plain section of Wadi El Gemal.

5.15.8 Picnic Areas

Picnic areas can be developed at appropriate locations along the coastal and Sheikh Shazli asphalt roads.

5.15.9 Shelters

Permanent shelters providing shade from the sun could be built in suitable areas where there is high tourism use. Recommended sites for shelters are at swimming areas, picnic areas, campsites and next to visitor centers.

5.15.10 Campsites

Campsites would be identified in suitable areas throughout the park, including one on the coast at Ras Honkorab and another on the Sheikh Shazli road. Toilets, barbeques and other visitor amenities could be established at the high use sites mentioned above. It is recommended that campgrounds in the desert be simple sites sign posted where camping is permitted.

5.15.11 Waste Receptacles

At certain high use areas locations such as picnic sites inside the PA, appropriate (non-offensive) waste receptacles should be set-up and regularly cleaned out.

5.15.12 Piers

It might be needed at the island where wildlife tourism is developed to establish a means to facilitate disembarkation of visitors from the boats, such as Siyul and Wadi el Gemal Islands.

5.15.13 Toilets

Suitable biodegradable (waterless) toilets (such as those in use in St Katherine PA) will be needed at various locations where there is high visitor use, such as at the proposed recreational beach at Sharm El Luli.

6. Management Resources

In order to facilitate the effective management of the PA essential resources have to be made available. The single most important management resource is a motivated and committed staff with a good understanding of conservation management principles. The management of PA staff and clear well defined responsibilities, as well as, communication lines are important to establish a coherent and self sufficient management unit. Communications within the PAMU and with other Red Sea Rangers, as well as, with NCS is important.

Basic infrastructure and equipment are also needed to make the management duties of the PAMU possible. Sufficient financial sources will have to be made available to develop the PAMU resources over the next five years. Ideally self-sufficient systems should be developed, whereby financial support to the PAMU is linked to revenue generation mechanisms within the PA, or the national PA system.

6.1 The Protected Area Management Unit (PAMU)

The PAMU is the management unit responsible of management and administration of WGHPA. It is directed by the PA manager and it should normally report to the Red Sea PA Regional Manager in Hurghada, but direct reporting to NCS Cairo is expected on matters of urgent nature.

6.1.1 PAMU Staff

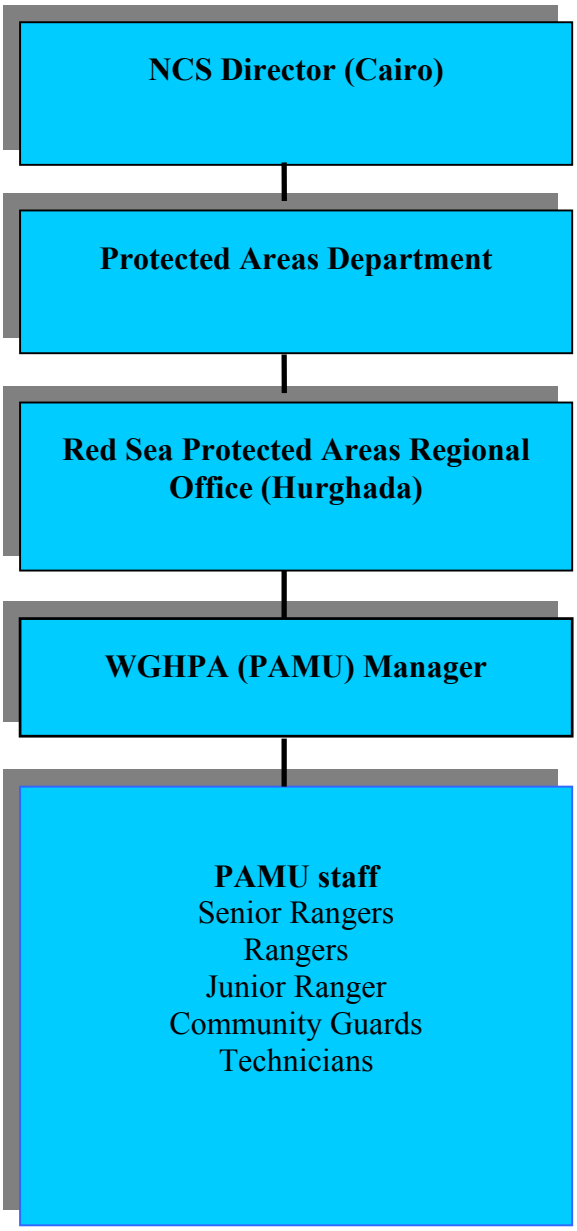
The PAMU staff is going to carry the responsibility for maintaining the resources of the PA and insuring that its objectives are met. Careful selection of future staff, clear job descriptions, training and well-defined career development lines are all important elements in developing a successful and effective team.

The PAMU administration will recruit sufficient suitable staff for the management of WGHPA. The global mean of PA staff per 1,000 km² is 27, while the average for Africa is 70 staff per 1000 km². In Egypt the situation is variable, at Zaranik PA it is at 80 staff per 1,000 km², while in St Katherine PA the staffing levels are at 16 staff per 1,000 km². The target of 20 staff per 1,000 km² was recommended for St Katherine PA in its management plan.

In WGHPA, where many management issues are comparable to those in St Katherine PA (except for the marine component), but less intense, a smaller number of about 10 staff per 1,000 km² could be sufficient as an initial target. Half that number would

probably be sufficient per 1,000 km² of marine habitats; this gives a target figure of about 50 staff members for WGHPA over the next five years. See Appendix 17 for a detailed staffing plan.

Figure 1 Organogram for WGHPA PAMU within the NCS.



Staff Career Development

It is important to establish a career track for PA staff to promote the spirit of achievement, encourage personnel development, allow the advancement of outstanding staff and provide NCS management a way of promoting qualified staff members. The following seven career ranks (Table 13) for PA staff within the NCS/EEAA has been adapted from the St. Katherine PA Management Plan with some adjustments. It is proposed to adopt this system throughout the PA network and to further formalize it within the NCS structure.

Table 6 Proposed career ranks for WGHPA staff within the NCS/EEAA

Rank	Basic qualification
Senior NCS management positions	Post graduate degree, over 10 years work in PAs
Regional Manager	Post graduate degree, 10 years work in PAs
PA Manager	University degree, over 5 years work in PAs
Senior Ranger	University degree, 5 years work in PAs
Ranger	University degree, 3 years work in PAs
Junior Ranger / technician	Recent university graduate
Community Guard	Basic schooling, nomination from local community leadership

PAMU Staff Duties

The main roles and functions of field staff defined below are based on the legislation concerning PAs (Law 102/1983 and Prime Ministerial Decree 264/1994) and on the Law of the environment (Law 4/1994). Rangers have general responsibilities for:

- The management of the PA
- The awareness and education of the public
- The application of regulations and enforcement of the law

Duties of PAMU Manager (PA Manager)

The PAMU manager is both the PAMU office administrator and field staff manager for the PA and should integrate, co-ordinate and stimulate the staff under his command so as to achieve the stated objectives of the PA for which he is responsible. The PAMU manager should be familiar with the PAs' legislative instruments and apply these as appropriate.

The PAMU manager will assist with the development of operational management plans for the PA under his control and have the responsibility for implementing such plans.

The PAMU manager is responsible for the efficient day-to-day operation and performance of their duties by the Rangers under his control. He is expected to implement NCS/EEAA PA policy and directives effectively and efficiently in liaison with other agencies and to lead the Ranger force by example. The manager's specific responsibilities include:

- Deploying Rangers and Community Guards and allocating monthly and daily tasks, including patrol schedules, in order to achieve the objectives of the PA under his control.
- Ensuring that Rangers and Community Guards know what is expected of them and how to do it. This will involve some training, especially of new staff prior to deployment.

- Co-ordination of Ranger and Community Guard activities, both in the PA and in the Red Sea PAs as a whole (with Hurghada office), to avoid duplication of effort and to ensure efficiency and the best possible use of resources. This will call for careful planning and intimate knowledge of where Rangers are deployed and for what purpose
- Receiving information and reports from field staff and transmitting relevant information to the appropriate authorities.
- Ensuring that Rangers are in uniform, smart and disciplined when on duty and conduct themselves in a manner befitting an EEAA staff member. The Manager will be expected to take minor disciplinary action where appropriate.
- The Manager will be accountable for ensuring that all PAMU property is properly cared for, maintained and serviced where appropriate.
- The Manager will be responsible for the proper disbursement and accounting of all PAMU finances.
- The Manager should ensure that all PAMU infrastructure sites are kept clean and refuse is disposed of in a proper manner.
- The Manager will ensure that required monthly and annual reports are prepared and sent to the PA Regional Office in Hurghada and to NCS offices in Cairo.

Duties of a Senior Ranger

As the PAMU manager cannot personally organize the individual activities of all the field staff some of the Manager's responsibilities will be delegated to a competent and experienced Ranger. The Senior Ranger will carry out any duty directed by the PAMU manager and which may be delegated to another field staff member only with the approval of the PAMU Manger. The Senior Ranger will be well acquainted with the PA conservation objectives and assist with the development of interventions to achieve these objectives. In addition to the general duties of a Ranger (see below) the Senior Ranger will be charged with the following:

- The Senior Ranger will be responsible to the PAMU manager for the care and cleanliness of all PAMU property. He should advise the manager of any items that need attention, particularly vehicles for which he is expected to maintain a strict service schedule (according to manufacturers' specifications) and ensure that logbooks are properly maintained.
- The Senior Ranger should ensure that an adequate patrol program and schedule is drawn up and followed; the Senior Ranger is responsible for collating all information from patrols and ensuring that the PAMU manager is kept informed of all developments on a daily basis.
- The Senior Ranger will be a fully participating member of the patrol program.

Duties of a Ranger / Junior Ranger

The Ranger is the foundation of the PAMU staff establishment without whom little of the EEAA's mandate for PAs would be possible. The Ranger is a member of a team who should be loyal and committed to the ideals of the NCS/EEAA and its mandate. Rangers are qualified professionals in their own right and will need to apply their specific skills to their work; at the same time they are expected to be versatile and use their initiative as circumstances dictate. The Ranger is the public face of the NCS/EEAA and on duty must be disciplined at all times and helpful and polite to all members of the public. In addition to their specific allocated duties Rangers will be expected to:

- Carry out instruction from the PAMU manager to the best of their ability. Duties assigned may include foot and vehicle patrolling (day and night), resource monitoring and data collection, public awareness, search and rescue, visitor management, refuse collection, equipment and infrastructure maintenance or cleaning, development planning and inspection etc. The Ranger will be expected to work as many hours as circumstances dictate.
- Carry out patrols as directed by their Manager and pass on information to their superiors and keep a log of all incidents.
- Uphold the laws for which they are responsible and initiate actions against transgressions of these laws without fear or favor.
- Wear a full uniform at all times while on duty and communicate and interact with the general public in a mature and controlled manner, to set a good example to fellow citizens and so portray the EEAA in a positive light. This includes vehicle handling and road safety measures.
- Be accountable for all PAMU property under their responsibility and to report any item that needs attention. Rangers will be responsible for maintaining vehicle logbooks for the vehicle of which they are given charge.
- Maintain specific and general reporting schedules.
- Encourage and assist the local community to undertake local conservation initiatives and community development projects through self-help projects.

Duties of Community Guards

The Community Guards will be a non-uniformed cadre to supplement the Ranger force; they will have no formal power and their primary functions will be to extend PAMU monitoring and regulatory activities to the more remote parts of the PA. They will report to PAMU Rangers. The community guards will carry PAMU identification cards and wear a National Park badge. The community guards will assist the Ranger force in the execution of their duties by:

- Reporting any hunting, killing, disturbance or collection of wild species (including plants) in or around the PA and monitoring and reporting on wildlife populations particularly of large mammals species.

- Reporting any developments such as building or quarrying in their area and monitoring development activities.
- Guiding and assisting Rangers, orienting visitors within their area of responsibility and assisting with mountain rescue and other emergency responses.
- Reporting on the condition of trails and paths and undertaking or arranging necessary maintenance.
- Looking after any established monitoring sites and equipment and manning established outposts or other PA property.
- Promoting PA regulations regarding resource conservation, e.g. grazing exclusion areas etc. within the local communities.
- Monitoring tourism activities within the area (i.e. recording visitor numbers, tour companies, dates etc.) and checking on and regulating visitor behavior to prevent visitors from cutting vegetation, discarding rubbish, writing graffiti etc.
- Cleaning visitor campsites of refuse and removing graffiti.
- Promoting local community conservation and development initiatives, e.g. establishing local conservation areas, waste management, social programs etc.

Distribution of PAMU staff

WGHPA covers a large area, including both terrestrial and marine components. It is impractical to manage the PA efficiently on a daily basis as a single unit and from one base. It is thus proposed to divide WGHPA into three management sectors: A northern, southern and inland sectors. See Map 16 and staffing plan (Appendix 17).

The Northern Management Sector
Starts from the northern boundary near Shams Alam resort and ends at the village of Abu Ghusoon, including offshore marine waters. The inland boundary will be the longitude of Bir Wadi El Gemal. The administration focal point of this sector will be near Shams Alam resort, where mobile cabins will be established for the PAMU staff in the short term. On the long term more substantial premises will be needed as PA headquarters, where the PA manager and most staff will be based, is likely to be based.

The Southern Management Sector
Starts from the village of Abu Ghusoon to the southern boundary of the PA near Hamata, including offshore marine waters. The inland boundary will be the longitude of Bir Wadi El Gemal. The administration focal point of this sector will be Hamata. Some old abandoned buildings can be rehabilitated to accommodate the PAMU staff in town.

The Inland Management Sector
The eastern boundary will be the longitude of Bir Wadi El Gemal, westwards to the Sheikh Shazli road (western boundary of WGHPA). This sector includes the inland most part of the PA. The administration focal point of this sector will be near at Sheikh Shazli town. Mobil cabins could be based there for the short-term use of

PAMU staff. This would be more of a satellite base for PAMU staff to use occasionally while on patrolling, etc. It is not envisaged that PAMU staff will be based there permanently in the short term. Community guards would man the PAMU facility.

6.2 PAMU Infrastructure

6.2.1 Office Space

In the short term, the PAMU administration will likely to be physically based in Marsa Alam, with temporary office space established (in the form of portable cabin) near Shams Alam resort. At a second stage similar portable space would be needed at Hamata and at Sheikh Shazli. Ultimately the PA offices should have permanently manned administration bases at Shams Alam and Hamata, with a part of the time manned base at Sheikh Shazli. Each of the administration bases correspond with the three management sectors identified above (see Map 16).

6.2.2 Piers

In order to launch an effective marine patrolling system PAMU will have to establish several bases, where its vessels would be maintained and harbored, and from which they can be launched on a regular basis. It is proposed that initially two existing piers be used for PAMU vessels: Shams Alam diving center and Hamata pier (see Map 16).

6.2.3 Outposts

Outpost stations should be established at critical road junctures, near critical resources, or regularly visited sites in the PA interior. At least three outposts will be needed, one at the north western corner of the PA along the Sheikh Shazli road (to serve as a possible point for fee collection); near the confluence of Wadi Nugrus and Wadi El Gemal (to support frequent patrols to the regularly visited antiquities); and at the confluence of Wadi Shawab and Wadi Abu Ghusoon (to inspect quarrying and mining related traffic) (see Map 16). In each of the above cases old, abandoned buildings or structures are available, which can be rehabilitated and used for the purpose.

These outposts should be simple structures, where some basic gear would be left (such as first aid, stores of water, sleeping bags, etc.) to facilitate temporary accommodation of patrolling teams. Rangers would not permanently man the outposts, but community guards from the respective areas would be assigned to maintain them.

6.2.4 Accommodation

Until more permanent infrastructure is established for the PAMU within the PA, staff will have to be accommodated at Marsa Alam. In the short term at least five apartments will be needed in Marsa Alam to accommodate the anticipated increase in

the number of rangers in the region. On the long run most of the PAMU staff can be accommodated at the planned Marsa Alam PA building (only 50 km drive Shams Alam resort), with limited accommodation made available at administration offices in the PA for on duty staff.

6.2.5 Maintenance Workshop and Storage

A maintenance workshop will be needed for PA equipment, vehicles and boats; and appropriate storage for spare parts and equipment. This will need to be located within the PA (probably near the Shams Alam office) to facilitate rapid on site fixing of equipment.

6.3 PAMU Equipment

The PAMU will need some essential equipment to support its activities in both the marine and terrestrial environments. See Appendix 18 for an indicative list of essential equipment for PAMU staff, targeted within the current planning period.

6.4 Maintenance of Facilities

Regular maintenance of equipment and facilities is an important component of the PAMU's duties to ensure the upkeep of the PAMU capital. A maintenance schedule will be established showing timetable of maintenance and defining the responsible staff for performing the tasks at hand.

7. Finance

Without sustainable and stable sources of funding the long term management objectives of the PA can be jeopardized. The NCS has long been seeking the financial self-sufficiency of the PA Network in Egypt. From the practical point of view this goal is very realistic and well within reach, however many administrative obstacles remain to be resolved. In fact many PAs in Egypt (particularly on the Red Sea) bring in substantial income, which can be further developed.

7.1 Sources of Funding

All PA's in Egypt receive core funding from annual GOE budget. This is a variable source of funding, which is largely directed towards paying staff salaries and benefits, and the establishment of infrastructure. Although the GOE has shown a great extent of commitment to PA development and financing, direct reinvestment in the conservation effort is essential for long-term sustainability.

The PSU is currently involved in developing a revenue generation strategy for the Red Sea (Colby 2003), which will hopefully soon establish an agreed framework for sustainable revenue generation and reinvestment in the regions PAs and conservation infrastructure. In view of current developments and efforts by the PSU / NCS in this respect, only brief reference will be made here to revenue generation possibilities.

There are three potential and realistic sources of revenue generation in WGHPA, one is user (entry) fees, concession fees or leases, and through the sale of PA products.

Presently, all revenues from other PAs are transferred to the Environmental Fund. This needs to be adjusted so that at least a certain percentage of the PA income is re-invested in its management. A proportion of the funds can also be allocated to the Red Sea Governorate to support environmental activities (e.g. waste management).

7.2 Entrance Fees

As WGHPA is located on a public road with significant through traffic, entrance fees in the strict meaning of the word will not be possible. Only users entering or using areas away from the main coastal road and the Sheikh Shazli Road or entering the marine environment would be charged.

Multiple fee collection methodologies would need to be applied. The most efficient method would be to advertise fee requirements and schedule and request users to buy tickets at administration offices at Shams Alam and Hamata. At specific recreational areas (such as Sharm El Luli) ticket collectors might have to be present on the spot.

The entrance fee should initially be as charged for entrance to Ras Mohammed NP and Nabq PA i.e. $5 for foreign visitors and LE 5 for Egyptians and residents (but this should increase in line with inflation) per day. The entrance fee would entitle visitors to access all permitted zones within WGHPA (both terrestrial and marine).

Only tourists will pay an entrance fee with children under 12 years entering free. There would be no charge for vehicles, as the entrance to the PA is on a public road. All locals, resident of WGHPA and officials will enter free of charge. Official groups, school or student parties and official guests will also be entitled to free entry following advance notification to the PAMU.

The PAMU staff will be (when the fee system is installed and fully functional) responsible for conducting random ticket checks, as part of their regular patrolling duties, to ensure that visitors have valid tickets.

7.3 Indicative Budget

An indicative budget will be developed after the review of this first draft of the management plan and based on the feed back of the reviewers and stake holders.

8. Implementation and Evaluation

8.1 Management Priorities

The implementation of this plan will require that priorities must first be identified and addressed accordingly. Generally the first priority should be given to conflict resolution for large-scale activities that might be planned by TDA in the two "ecotourism development areas". These activities might have a geographically, as well as, ecologically significant footprint on the region. It is best to resolve such conflicts at the planning stage, rather than during implementation, or operation. Second priority is to halt or control the primary current adverse activities, which are degrading the natural resource base of WGHPA, and which will continue to do so unless management interventions are not made by PAMU. Third priority can be given to public awareness and education. The enhancement of natural resources and promotion of the sustainable utility of resources (such as ecotourism) are proactive measures, which seek to improve future utility of the natural resources of WGHPA.

The integration and consultation of indigenous inhabitants should be a constant priority for the PAMU from day one.

8.2 Evaluation of Plan Implementation

The implementation of this plan will be considered effective when it can be verifiably shown that it is achieving its main objectives:

- The maintenance of the natural resources and conditions of the PA: Verifiable through results of monitoring programs.
- The protection of cultural heritage resources of the PA: Verified through patrolling reports indicating halting of adverse practices.
- The sustainable utility of natural resources in the PA: Verified through results of monitoring programs and the endorsement and adoption of the management plan by stakeholders.
- The establishment of WGHPA as a focal point for ecologically sensitive tourism: Verifiable through assessments of performance of tourism operators and their impact on the natural environment.
- The maintenance of environmental quality of WGHPA: Verifiable through results of pollution monitoring programs.

- Optimizing socio-economic benefits to the indigenous population from the region's natural heritage: Verifiable through monitoring data indicating improvements to health and income generation to local people.
- To promote public understanding and appreciation of Egypt's natural heritage: Verifiable through results of user surveys, including indigenous people's perceptions.

8.3 Revisions

This plan is intended to be a dynamic instrument. Continuous updates are expected and necessary to keep it accurate and up to date. It is envisaged that the plan should be completely reviewed and reassessed after five years, in light of achievements and shortcomings on the ground.

8.4 Annual Operational Plan

In order to facilitate that every day operation of the PAMU staff comply with the policy framework of this management plan and to ensure that short term actions actually contribute towards achieving the PA larger objectives, an Annual Operational Plan (AOP) will be prepared. The AOP will be drawn up in accordance with the policies and objectives set out in the management plan and will be prepared to justify the PA's annual budget request.

It will be the responsibility of the PA Manager to prepare the AOP, submit it to the Red Sea PA Regional Office and to NCS and get approval for it. This AOP will then be the PA's official annual work plan. The format of the operating plan will generally follow the format of this management plan.

The first draft of the AOP must be drawn up before the preparation of the annual budget for the PA, as the budget should be based on the AOP. The budget and justifying draft AOP will be presented to the Red Sea PA Regional Office and to NCS and when the approved budget is received, a final AOP will be prepared and distributed.

8.4.1 Procedures for Preparing an AOP

1. Identify priority actions as given in the management plan, plus any outstanding tasks and newly arisen needs. Establish priorities by classifying activities according to urgency: indicate tasks that are vital and must be completed, tasks that are necessary but not urgent and tasks that are desirable if resources are available.
2. Set a timetable for completion of activities.
3. Identify those activities that are dependent on prior completion of other activities and indicate which activities they must follow, as this will help the PA Manager to assign realistic priorities.

4. Plan out the tasks on a chart, with the most important activities fitted in first, to illustrate the correct time sequence for activities and to spread the workload evenly throughout the year.
5. Once activities are arranged on the chart the manager should prepare work schedules for each task together with the resources needed to complete each of the activities.
6. Once detailed task schedules and resource requirements are known, it should be possible to calculate annual budget needs.
7. Reschedule the AOP once the annual budget is approved to bring the tasks and priorities in line with funding constraints.

References

Abdel Aziz, A. A., 1999. Structural analysis of the Basement Complex in Wadi El Gemal area, South Eastern Desert, Egypt. Ph.D. Thesis, South Valley University, 335p.

Ahmed, A., 2001. Geomorphological and sedimentological studies on Pliocene – Quaternary alluvial fans, South Marsa Alam, Red Sea, Egypt. 425p.

Baha El Din, S. M. 1999. Directory of Important Bird Areas in Egypt. Bird Life International.

Baha El Din, S. M. 2003. The terrestrial vertebrate fauna of Wadi El Gemal- Hamata Protected Area. Report submitted to PSU/NCS.

Baha El Din, M. 2003. Evaluation of the tourism development potential and Management requirements for the Wadi El Gemal – Hamata Protected Area. Report for the PSU/EEPP.

Barakat, H. N. 2003. Evaluation of the flora and plant communities in the Wadi El Gemal – Hamata Protected Area. Report for the PSU/EEPP.

Barrania, A. & Ibrahim, A. 2003. The Status of Fisheries in the Egyptian Red Sea between Hurghada and Ras Banas and Proposed Fisheries Management Plan. Report for the Egyptian Environmental Policy Program (EEPP) and The Program Support Unit.

Beltagi, A. I. 1997. Report on Oceanographic Conditions in the Coastal Area of the Egyptian Red Sea. Report funded by the GEF.

Borhan, M 1998. Measures to Protect the Red Sea Marine Environment with Special Reference to Coral Reef and Mangrove Habitats. A Permitting Procedures, and B – Combating Oil Pollution. Consultancy Report Associated with the Egyptian GEF Red Sea Coastal and Marine Resources Management Project. Reported Funded by the Global Environment Facility.

Cesar, H. 2003. Economic Valuation of the Coral Reefs of Egypt. Report for EEPP-MVE. Funded by USAID.

Colby, M. 2003. Marine Protectorate Budget and Analysis and Scenarios. Report Prepared for USAID/EEAA Cairo.

CONOCO, 1987. Geological Map of Gebal Hamata, Scale 1: 500 000.

Davies, S. & Morgan, E. 1995. Red Sea Pilot. Imray Laurie Norie and Wilson. St Ives Cambridgeshire. England.

Debelius, H. 1998. Red Sea Reef Guide. IKAN. Germany.

Derraik, J. G. 2002. The pollution of the marine environment by plastic debris: a review. Marine Pollution Bulletin. 44. 842-852.

DeVantier, L., Turak, E., Al-Shaikh, K and De'ath, G. 2000. Coral communities of the central-northern Saudi Arabian Red Sea. Fauna of Arabia. 18: 23-66. Ed. Buttiker, W and Krupp, F. NCWCD/ MECMA

Edwards, F.J. & Head, S.M. 1987 (Eds) "Red Sea". Progamon Press, Oxford. 441 p.

EGSMA 1977. Geological map of the Marsa Alam and Hamata areas, Egypt, Scale 1: 250, 000.

El Ramly, M. F.; Greilling, R. O.; Rashwan, A. A. and Rasmy, A. H., 1993. Explanatory note to the geological and structural maps of Wadi Haffafit area, Eastern desert of Egypt. Geol. Surv. Egypt, paper No. 68, 53 P.

Fouda, M. M. 2002. Nature conservation in Egypt: An overview of history, achievements and future agenda. Abstracts - The First Egyptian-International Conference on Protected Areas and Sustainable Development: October 23-26, Sharm El-Sheikh, Egypt. Ministry of State for Environmental Affairs Egyptian Environmental Affairs Agency.

Frazier, J. and Salas, S. 1984. The status of marine turtles in the Egyptian Red Sea. Biological Conservation 30: 41-67.

Frazier, J., Bertram, G. C. and Evans, P. G. 1987. Turtles and marine mammals. In: Key Environment The Red Sea. Ed. A. J. Edwards and S. M. Head. Pergamon Press. pp. 288-314.

Galal, N., Ormond, R. F. and Hassan, O. 2002. Effects of a network of no-take reserves in increasing catch per unit effort and stocks of exploited reef fish at Nabq, South Sinai, Egypt. Marine and Freshwater Research. vol. 53, pp. 199-205.

Garrabou, J., Sala, E., Arcas, A. and Zabala, M. 1998. The impact of diving on rocky sublittoral communities: a case study of a bryozoan population. Conservation Biology 12. pp. 302-312.

GEF 1997. Report 2 – Baseline Report. Egyptian GEF Red Sea Coastal and Marine Resources Management Project. Reported Funded by the Global Environment Facility.

Gladstone, W & Fisher, P. 2000. Status and ecology of cetaceans in the Farasan Islands Marine Protected Area (Red Sea). In. Fauna of Arabia. 18: pp. 385-396. Ed. Buttiker, W and Krupp, F. NCWCD/ MECMA.

Gohar, H. A.F. 1957. The Red Sea Dugong. In: Publication of the Marine Biological Station Al Ghardaqa (Red Sea). pp. 3-50. Ed. Gohar, H. University of Cairo.

Gomaa, A. M. 2001. The city of Marsa Alam, Red Sea, Egypt, Coastal Managemnet Plan. Unpublished Msc thesis. Florida Institute of Technology, Melbourn, Florida.

Goodman, S.M. & Meininger, P.L (eds.) 1989. The birds of Egypt. Oxford University Press, Oxford.

Hassan, A. 1998. Marine Pollution Control. I – Field Observation Report. Report Funded by GEF.

Hawkins, J. P. & Roberts, C. M. 1992. Effects of recreational SCUBA diving on fore-reef slope communities. Biological Conservation. Vol. 62. pp. 171-178.

Hawkins, J. P. & Roberts, C. M. 1994. Effects of recreational SCUBA diving on coral reefs: trampling of reef flat communities. Journal of Applied Ecology. Vol. 30. pp. 25-30.

Hawkins, J. P., Roberts, C. M., Van't Hof, T., De Meter, K D., Tratalos, J. & Aldam, C. 1999. Effects of recreational scuba diving on Caribbean coral and fish communities. Conservation Biology 13 (4). pp. 888-897.

Hawkins, J.P. & Roberts, M.R. 1993. Can Egypt's coral reefs support ambitious plans for diving tourism? Proceedings of the 7th International Coral Reef Symposium Guam 2: 1007-1013.

ICP, 2000. Marsa Alam Improved Comprehensive Plan (ICP), Red Sea Governorate and Saudi Consulting Office, Red Sea.

IUCN 2002. IUCN red list of threatened animals. IUCN, Gland and Cambridge.

Jameson, S. C., Ammar,M. S., Saadalla, E., Mostafa, H. M. and Riegel, B. 1999. A coral damage index and its application to diving sites in the Egyptian Red Sea. Coral Reefs. Vol. 18. pp. 333-339.

JICA. 2000. The Study on Coastal / Marine Habitat and Biological Inventories in the Northern Part of the Red Sea Coast in the Kingdom of Saudi Arabia. Final Report. Main Text. March 2000. JICA, Japan.

Jones, A. D., Ghamrawy, M and Wahbeh, M. I. 1987. Littoral and shallow subtidal environments. In: Key Environment The Red Sea. Ed. A. J. Edwards and S. M. Head. Pergamon Press. pp. 169-193.

Jones, A. P. 2002. Red Sea Mooring Strategy. Report for EEPP-PSU Hurghada. Marine Solutions Company, El Gouna, Red Sea Governorate, Egypt.

Kassas, M. (ed.) 1993. Habitat diversity: Egypt. Publication of the NBU No. 1.

Khalil, M. & Abu El Rahman, N. 1997. Abundance and diversity of surface zooplankton in the Gulf of Aqaba, Red Sea. Journal of Plankton Research. Vol. 19. pp. 927-936.

Kobayashi, A. 1984. Regeneration and regrowth of fragmented colonies of the hermatypic corals Acropra formosa and Acropora nasuta. Galaxea 3. pp. 13-23.

Kotb, M. M., Abou Zeid, M. M. & Hanafy, M. H. 2001. Overall evaluation of the coral reef status along the Egyptian Red Sea Coast. Biologia Marina Mediterranea. Vol. 8 (1). pp.15-32.

Krzywinski K. & R. H. Pierce (eds). 2001. Deserting the desert. Department of Botany and Department of Greek, Latin and Egyptology, University of Bergen, Norway.

Lintner, S. F., Arif, S. and Hatziolos, M. 1995. The Experience of the World Bank in the Legal, Institutional and Financial Aspects of Regional Environmental Programmes: Potential Application of Lessons Learned for the ROPME and PERSGA Programmes. Background Papers from the Sea to Sea Conference, Jeddah.

Lipkin, Y. 1975. Food of the Red Sea Dugong (Mammalia: Sirenia) from Sinai. Israel Journal of Zoology. vol. 24. pp.81-98.

Loya, Y. 1976. Skeletal regeneration in a Red Sea scleractinian coral population. Nature 261. pp. 491-492.

Mansour, A.M. 2003. Wadi El Gemal – Hamata Protected Area: Mining and quarying activities, geology and mineral resources. Report Submitted to PSU / NCS.

Mansour, A.M., Nawar, A. & Mohamed, A.W. 2000. Geochemistry of coastal marine sediments and their contaminant metals, Red sea, Egypt: A legacy for the future and tracer of modern sediment dynamics. Sedimentology of Egypt, v. 8: 231-242.

Marx, H., 1968. Checklist of the reptiles and amphibians of Egypt. United States Navel Medical Research Unit Number 3, Cairo.

Medio, D., Sheppard, C. R. and Gascoigne, J. 2000. The Red Sea. In. McClanahan, T. R., Sheppard, C. C. and Obura, D. O. (eds). Coral Reefs of the Indian Ocean – Their Ecology and Conservation. Oxford University Press. pp. 231-255.

Meek, S. 1982. Structure, growth and regeneration in the astrocoeniid scleractinian coral, Acropora formosa. PhD Dissertation, James Cook University, Townsville, Australia.

Moore, R. 1989. The nature, diversity and conservation of Red Sea coral reefs in relation to water productivity. In: Wildlife Conservation and Development in Saudi Arabia. Ed. A. Abuzinada, P. Goriup and J. Nader.

NCS 1998. Egyptian biodiversity conservation strategy and action plan. NCS, EEAA.

NCS / EEAA 2002. A study for the declaration of Wadi El Gemal - Hamata as a protected area. Report submitted to the NCS / EEAA. (in Arabic).

NOSCP. 1997. Sea Surface Currents in Egyptian Waters.

Ormond, R & Edwards, A. 1987. Red Sea Fishes. In: Key Environments Red Sea. Eds. A. Edwards and S. Head. pp. 251 – 287. Pergamon Press.

Ormond, R., Dawson-Sheppard, A., Price, A. and Pitt, R. G. 1984. Report on the Distribution of Habitats and Species in the Saudi Arabian Red Sea. 123 pp. Jeddah; IUCN/MECMA/PERSGA, Kingdom of Saudi Arabia.

Osborne, D.J. & Helmy, I. 1980. The contemporary land mammals of Egypt (including Sinai). Fieldiana: Zoology, New Ser., No. 5.

Perrin, W.F. 2002. Spinner Dolphin. Pp. 1174-1178 in Perrin, W.F., Würsig & Thewissen, J.G.M. (eds) Encylopedia of Marine Mammals. Academic Press: San Diego.

PERSGA. 2001. Strategic Action Programme for the Red Sea and Gulf of Aden – Country Reports. Jeddah, PERSGA.

PERSGA. Undated. Strategic Action Programme for the Red Sea and Gulf of Aden – Country Reports. Country Report Egypt, PERSGA.

Piller, W.E. & Pervesler, P. 1989. An Actuopalaeontological approach, The Bay of Safaga, (Red Sea, Egypt): Beitr.Paleont. Oesterr., v. 15: 103-147, Wien

Qumsiyeh, M. B. 1985. The bats of Egypt. Special publications, the Museum, Texas Tech University, Texas.

Razek, M. S., Dorgham, M., Atta, Manal, Beltagi, M. and Kamel, K. 1998a. Mission to Establish a Model of Conservation and Management of Mangrove Ecosystems. Part 1. The Northern Sector (Hurghada – Qusseir). For the GEF Project.

Razek, M. S., Dorgham, M., Atta, Manal, Beltagi, M. and Kamel, K. 1998b. Mission to Establish a Model of Conservation and Management of Mangrove Ecosystems. Part 2. The Southern Sector (Abu Ghossoun – Hamatah). For the GEF Project.

Richter, C., Wunsch, M., Rasheed, M., Kotter, I. And Badran, M. 2001. Endoscopic exploration of Red Sea coral reefs reveals dense populations of cavity-dwelling sponges. Nature. Vol. 413. pp. 726-729.

Riegel, B. and Luke, K. 1997a. Red Sea Coast and Reefs Protected Area "Egypt's Great Reef", Produced for the EEAA and DNP. USAID, Hurghada.

Riegel, B. and Luke, K. 1997b. Red Sea National Marine Protectorate – Suggested Mooring Sites in the Southern Egyptian Red Sea. Produced for the EEAA and DNP. USAID and Winrock International, Hurghada.

Rouphael, B. A. & Inglis, G. J. 1995. The Effects of Qualified Recreational Scuba Divers on Coral Reefs. CRC Reef Research Centre. Technical Report No. 4. Townsville. 39 pp.

Saenger, P. 2002. Rehabilitation, Conservation and Disturbance: Ecological Assessment of Mangroves in Egypt. Ministry of Agriculture and Land Reclamation, Ministry of State for Environment, and the Food and Agriculture Organisation of the United States. Report for FAO.

Said, R. 1990. The geology of Egypt. Balkema

Sheppard, C., Price, A. & Roberts, C. 1992. Marine Ecology of the Arabian region: Patterns and Processes in Extreme Tropical Environments. Academic Press, London.

Sidebotham, S. 2003. Report on the Archaeological Remains and their Management in the Wadi el-Gemal-Hamata Protected Area. Report for the PSU/EEPP.

Talge, H. 1990. Impact of recreational divers on coral refs in the Florida Keys. In: Jaap, W. C. (Ed.), Diving for Science 1990. Proceedings of the American Academy of Underwater Sciences Annual Scientific Symposium, Costa Mesa, California, pp. 365-372.

Uthicke, S. 2001. Nutrient regeneration by abundant coral reef holothurians. Journal of Experimental Marine Biology and Ecology. Vol. 265. pp. 153-170.

Weikert, H. 1982. The vertical distribution of zooplankton in relation to habitat zones in the area of the Atlantis II Deep, central Red Sea. Marine Ecological Progress Series. Vol. 8. pp. 129-143.

WHO, 1984. International standards for drinking water. Geneva, world health organization, 70P.

Zahran M. A. & A. J. Willis. 1992. The Vegetation of Egypt. Chapman & Hall, London, 424 pp.

Zahran M. A. 1993. Mangroves and shoreline development in Egypt. Journal of Environmental Sciences, Mansoura University, 5 1993. 119-140.

Appendix 1: Prime Ministerial Decree No. 143/2003

Translation from the original Arabic text

Prime Ministerial Decree

No. 143 for 2003

Establishing a Protected Area in the Wadi El Gemal – Hamata area in the Red Sea Governorate

The Prime Minister

After consulting the constitution,

And Law 102 for 1983 concerning Protected Areas,

And law 4 for 1994 concerning Environmental Protection,

And Prime Ministerial Decree no 264 for 1994 concerning the rules, regulations and procedures for activities taking place in Protected Areas,

And based on what the Minister of State For Environmental Affairs has provided,

It is decreed that:

(First article)

To be considered as a Protected Area, according to the provisions of Law 102 for 1983, is the area of Wadi El Gemal – Hamata in the Red Sea Governorate, indicated in the attached map and defined by the following coordinates:

Boundary Point	Latitude			Longitude		
	Degree	Minute	Second	Degree	Minute	Second
A	24	41	17.83	35	5	3.08
B	24	49	51.77	34	38	56.25
C	24	51	35.59	34	28	25.00
D	24	24	38.98	34	30	30.46
E	24	12	51.71	34	36	26.38

F	24	6	7.24	34	55	45.54
G	24	7	47.08	35	6	42.57
H	24	17	54.25	35	22	4.84
I	24	8	34.51	35	28	23.31
J	24	5	5.02	35	28	53.78
K	24	6	21.92	35	33	36.00
L	24	9	17.61	35	45	22.54
M	24	52	48.12	35	6	22.03
N	24	52	53.77	34	59	28.73

It includes two areas for the development of ecotourism according to the following coordinates:

The first area:

Boundary Point	Latitude			Longitude		
	Degree	Minute	Second	Degree	Minute	Second
O	24	36	4.85	35	8	4.29
P	24	35	41.88	35	6	48.17
Q	24	32	41.85	35	7	8.25
R	24	31	51.32	35	8	40.07

The second area:

Boundary Point	Latitude			Longitude		
	Degree	Minute	Second	Degree	Minute	Second
S	24	30	4.57	35	8	57.01
T	24	29	21.33	35	7	58.72
U	24	22	30.07	35	13	43.38
V	24	23	36.02	35	14	45.30

(Second article)

The Egyptian Environmental Affairs Agency will directly assume the responsibilities decreed in Law 102 for 1983 and Law 4 for 1994 with respect to the Protected Area.

(Third article)

It is forbidden to undertake actions, activities or procedures; which would lead to the destruction, damage or degrade the natural environment; or harm terrestrial, marine or plant life; or detract from its esthetic quality in a Protected Area. It is specifically prohibited to undertake the following:

Hunting, transporting, killing or disturbing living terrestrial and marine organisms, or carrying out activities, which lead to their extermination or limiting the growth of these terrestrial and marine organisms or affecting their genetic properties or damaging their habitats.

Damaging or transporting plants found in a Protected Area.

Damaging or destroying geographic or geologic formations, or archeological monuments and inscriptions in the Protected Area.

Introducing alien species into of animals, plants or minute organisms to the Protected Areas.

Polluting the soil, water or air of the Protected Areas in any manner as well as area adjacent to the Protected Area and, which affect it.

Spilling or disposing of liquids, chemicals, oils, waste or radioactive material of all kinds, or any foreign material in the Protected Area or its adjacent areas, which could lead to damaging the Protected Area or detract from its aesthetic quality, biological diversity or the genetic character of the organisms inhabiting the Protected Area.

Erecting buildings, constructing roads, operating vehicles, or practice any agricultural, industrial or commercial or tourism activities in the Protected Area and the adjacent areas; without the permission of the Egyptian Environmental Affairs Agency, according to conditions, rules and procedures specified by Prime Ministerial Decree no 264 for 1994.

(Fourth article)

It is possible to declare other areas as Protected Areas or to increase the area of declared Protected Areas if necessary environmental studies are available.

(Fifth article)

The Governor of the Red Sea will supervise the execution of what has been stated in this decree in coordination with concerned authorities.

(Sixth article)

This law is to be published in the official Egyptian journal.

Prime Minister

Dr. Atef Ebeid

Issued at the Cabinet of Ministers on 17 Ze Al Qeda 1423,

corresponding with 20 January 2003.

Appendix 2: Listing of Existing Mining and Building Materials in WGHPA

Metallic Iron Ore Group

Material	Location	E	N	Concession	Company	Economic value
Iron Oxide	Um El Abas	35o 05’ 00	24o 33’ 00	active	Individual	Low
Ilmenite	W. Abu Ghalaka	35o 03’ 30	24o 21’ 23	active	Company	High
	W. Abu Ghusoon	35o 04’ 07	24o 21’ 18	active	Company	High

Metallic Non-Iron Ore Group

Material	Location	E	N	Concession	Company	Economic value
Copper	Hamata-El Atshan	35o 11’ 00	24o 15’ 00	stopped	--	Very low
Leed & Zinc	W. Ranga	35o 13’ 00	24o 22’ 00	stopped	--	Low
Tantalum	Um Rasheed	34o 46’ 00	24o 37’ 00	stopped	--	Low
Gold	Gulan El Atshan	35o 11’ 00	24o 15’ 00	stopped	--	Low

Non-Metallic Ore Group

Material	Location	E	N	Concession	Company	Economic value
Feldspars	Um Khyam	34o 32’ 09	24o 46’ 17	stopped	Individual	Low
	W. El Gemal	34o 42’ 00	24o 31’ 00	stopped	company	Low
	Hafafet	34o 40’ 00	24o 35’ 08	active	Individual	Low

Material	Location	E	N	Concession	Company	Economic value
	Abu Had	34o 40’ 30	24o 35’ 30	active	Individual	Low
	Abu Had	34o 37’ 45	24o 36’ 56	stopped	Individual	Low
	Abu Had	34o 36’ 42	24o 37’ 30	continue	company	Low
		34o 43’ 00	24o 31’ 00	stopped	company	Low
	Kab Marfoa	34o 37’ 04”	24o 31’ 22	stopped	company	Low
Quartz	W. El Gemal	35o 02’ 00	24o 38’ 00	stopped	----	Low
	Um Sweih	34o 53’ 00	24o 28’ 00	stopped	company	Low
	W. Raadi	35o 14’ 00	24o 14’ 00	stopped	Individual	Low
	W. Zabara	34o 43’ 44	24o 48’ 20	stopped	Individual	Low
	W. El Gemal	35o 01’ 46	24o 37’ 31	stopped	Individual	Low
Asbestos	Hafafet	34o 30’ 00	24o 49’ 00	stopped	---	Low
Talc	W. El Atshan	35o 11’ 00	24o 15’ 00	stopped	Individual	Low
	G. ElAgzia	34o 57’ 00	24o 18’ 00	stopped	---	Low
	W. Raadi	35o 17’ 00	24o 13’ 00	stopped	company	Low
	W. Zabara	34o 43’ 44	24o 48’ 20	stopped	company	Low
	W. El Lawy	34o 47’ 44	24o 46’ 09	stopped	company	Low
Vermiculite	Hafafet	34o 30’ 00	24o 49’ 00	active	company	Low
	Hafafet	34o 40’ 00	24o 38’ 00	active	Individual	Low

Building Materials

Material	Location	E	N	Concession	Company	Economic value
Gravel	W. El Gemal	35o 04’ 00	24o 40’ 00	stopped	--	Low

Decoration Stones

Material	Location	E	N	Concession	Company	Economic value
White Granite	G. El Abyad	34o 54’ 00	24o 25’ 00	active	Individual	Moderate
		34o 51’ 12	24o 27’ 20	active	Individual	Moderate
		34o 51’ 57	24o 26’ 16	active	Individual	Moderate

Material	Location	E	N	Concession	Company	Economic value
		34o 52’ 03	24o 25’ 47	active	Individual	Moderate
		34o 52’ 34	24o 24’ 56	active	Individual	Moderate
		34o 53’ 38	24o 24’ 32	active	Individual	Moderate
		34o 54’ 44	24o 24’ 20	active	Individual	Moderate
Black Granite		34o 59’ 32	24o 23’ 17	active	Individual	Moderate

Precious Stone Group

Material	Location	E	N	Concession	Company	Economic value
Beryl	Sikait	34o 47’ 00	24o 40’ 00	stopped	--	Low
	Nugrus	34o 47’ 00	24o 37’ 00	stopped	--	Low
	Um Rasheed	34o 45’ 00	24o 39’ 00	stopped	--	Low
	Um Lasaf	34o 43’ 23	24o 46’ 26	stopped	--	Low

Appendix 3: Results of a Preliminary Survey of Mining and Quarrying Activities, March 2003

Talc mine (abandoned) at Wadi Qulan El Atshan (Lat: 24o 16’ 00”, Long: 35o 13’ 00”) destroys the whole landscape of two large areas. A lot of excavations and embankments of remaining materials occur everywhere in the area. Some wadis completely dammed with the remaining materials. Remains of housing, machines and iron materials are distributed in the area. However, the quality and quantity of the ore does not deserve this destruction.

An abandoned talc mine lies nearby the quartz mine at Wadi Zabara (Lat: 24o 48’ 20”, Long: 34o 43’ 44”). Some excavations distribute in the area.

Talc mines of Wadi El Lawy (abandoned) (Lat: 24o 46’ 09”, Long: 34o 47’ 44”). All mines are in a small tributary of Wadi El Lawy. Excavations with some remnants of rock fragments are widely distributed in the area. Some remnants of old dwellings still remain nearby the abandoned mines.

Vermiculite mine (still active) at Gabal Hafafet (Lat: 24o 49’ 00”, Long: 34o 30’ 00”) along Sheikh Salem – Sheikh Shazly road (Road mark 78km). Excavations widely distributed in a large area between Gabal Meghef and Gabal Hafafet. Remains of housing, machines and garbage distribute in the area. Only a few peoples are still working in the mining area.

Ilmenite mine at Wadi Abu Ghalaka - Wadi Abu Ghsoon (still working) (Lat: 24o 21’ 18”, Long: 35o 04’ 07”): The ore occurs as large lenses (a few meters long in metavolcanic rocks. Piles of the ore and overburden materials widely distribute in the nearby wadis.

Quartz mine at Wadi Zabara (Lat: 24o 48’ 20”, Long: 34o 43’ 44”) (abandoned): Quartz fragments widely distribute in the wadi around the mine. Quartz occurs as a vein in metavolcanic rocks. A few excavations are distributed in the area.

Quartz mine at Wadi El Gemal (Lat: 24o 37’ 31”, Long: 35o 01’ 46”) (abandoned): Quartz occurs as a quartz vein in metavolcanic rocks. Torrents have removed all quartz fragments from the wadi and deposited them in a sheltered area behind the mine.

Feldspar mines at Hafafet (still working). The ore occur as small veins in granite rocks. Excavations and remaining materials are widely distributed in the area. The ore

and its remaining dam some wadis. The bad quality of the ore does not deserve the area destruction.

Feldspar mines at the historic site of Wadi Ghazal (abandoned). Few excavations distributed north of large historic (Roman) site. Remnants of feldspar and quartz rock fragments still remain around the excavations.

Feldspar mines at Kab Marfoaa (abandoned) at the northern side of Wadi El Gemal (Lat: 24o 31’ 22”N, Long: 34o 37’ 04”E). Feldspar occurs as a small vein rich with quartz in granite rocks. A few excavations are distributed in the area. The abundance of quartz in the vein makes it unsuitable for feldspar mining. With the exception of the bad view of the excavations the landscape of the area is fascinating. The site lies between Gabal Museraibe in the south and Gabal Mukhatata in the eastern side. Moreover, a historic Roman site is close to the site of feldspar mines.

Beryl mines at Gabal Nugrus (Lat: 24o 36’ 58”, Long: 34o 46’ 34”). It is a historic mine just at Nugrus Roman village. Remnants of the Roman village distribute on the mountain. Beryl Mines are distributed as excavations in the area surrounded by rock fragments and the remaining materials. Unfortunately, white spots probably used for ore evaluation covered the whole historic area. However, the authority of nuclear materials is evaluating the ore in the area and has a large camp close to this site.

Beryl mines at Wadi Seket (Lat: 24o 39’ 35”, Long: 34o 47’ 41”). Similar to those at Gabal Nugrus, these mines are historic ones and lie close to Seket Roman village and temple. Beryl Mines are distributed as excavations and big holes in the area surrounded by rock fragments and the remaining materials. Unfortunately, the white spots, similar to those found at Nugrus mines also occur but with lesser amounts.

Beryl mines of Gabal Zabara at Wadi Um Lasaf (Lat: 24o 46’ 26”, Long: 34o 43’ 23”). Similar to those at Gabal Nugrus and Seket, these mines are historic ones and lie close to the Roman village in the area. Beryl Mines are distributed as excavations and big holes in the area. Rock fragments of the excavations are piled at the foot of the mountain. Some peoples are looking for beryl in these piles. Unfortunately, the white spots, similar to those at Nugrus mines also occur but with lesser degree.

Granite quarries at Gabal El Abyad: (some of them are still working): A lot of white granite quarries of Gabal El Abyad widely distributed along Wadi Shawab. They destroy the whole landscape of the area along the track of Wadi Shawab. The quarries are recorded in the following sits (Lat: 24o 27’ 20”, Long: 34o 51’ 12”), (Lat: 24o 26’ 16”, Long: 34o 51’ 57”), (Lat: 24o 25’ 47”, Long: 34o 52’ 03”), (Lat: 24o 24’ 56”, Long: 34o 52’ 34”), (Lat: 24o 24’ 32”, Long: 34o 53’ 38”), (Lat: 24o 24’ 20”, Long: 34o 54’ 44”). They use primitive and destructive ways for quarrying and therefore a lot of rock fragments remain behind and lost a lot of granite. Red bricks, remnants of machines and garbage distribute in the area.

Black granite quarry at the end of Wadi Shawab: Most granite of Gabal El Abyad is white granite except for this site (Lat: 24o 23’ 17”, Long: 34o 59’ 32”) for black granite. This black granite constitutes only small part in the area (less than 100m wide). Blocks of granite distribute at the foot of the mountain.

Appendix 4: Marine Algae Reported from WGHPA

Latin name	Latin name
Acanthophora nagadiformis	*Gelidium pusillum*
Actinotrichia fragilis	*Graciarlia cacalia*
Amphiroa fragiissima	*Gracilaria arcuata*
Caulerpa racemosa	*Halimeda macroloba*
Caulerpa serrulata	*Halimeda opuntia*
Centroceras clavulatum	*Herposiphonia tenella*
Ceramium gracillimum	*Hydroclathrus clathrus*
Ceramium nayalii	*Hypnea cornuta*
Chaetomorpha aerea	*Jania rubens*
Chaetomorpha linum	*Laurancia papillosa*
Champia irregularis	*Leveillea jungermannioides*
Chondria collinsiana	*Liagora farinosa*
Cladophora crystallina	*Lobophora variegata*
Cladophora dalmatica	*Lyngba sp.*
Cladophoropsis zollingeri	*Padina pavonica*
Crouania attenuata	*Peyssonelia rubra*
Cystoseira myrica	*Polysiphonia figariana*
Cystoseira trinoides	*Polysiphonia gorgoniae*
Dictyospheria cavernosa	*Porolithon onkodes*
Dictyota dichotoma	*Rockyivularia polyotis*
Digenea simplex	*Spermothamnion investiens*
Endosiphonia clavigera	*Spridia filamentosa*
Enteromorpha clatherata	*Trichogloea requienii*
Enteromorpha flexuosa	*Turbinaria elatensis*
Erythrotrichia carnea	*Turbinaria triquetra*
Fosliella farinosa	*Valonia aegagropila*
Galaxaura cylindrica	*Valonia macrophysa*
Galaxaura rugosa	*Valonia ventricosa*
Gelidiella acerosa	
Laurancia obtusa	

Appendix 5: Terrestrial Flora Recorded in WGHPA

Perennial Plant Species

Latin name	الأسم العربي	Status
Acacia ehrnbergiana	سلم	c
Acacia mellifera	خشب	rr
Acacia raddiana	طلح	c
Achillea fragrantissima	جيسوم	c
Adiantum capillus-veneris	كزبرة البير	rr
Aeluropus lagopoides	حنجنين	c
Aerva javanica	طرف	c
Arthrocnemum macrostachyum	خريزه	c
Atriplex farinosa	حوا/ هندال	c
Avicennia marina	شورى / مانجروف	r
Balanites aegyptiaca	اللالوب / الهجليج	c
Calligonum polygonoides	أرطا	rr
Calotropis procera	عشار	c
Capparis decidua	تندب	r
Capparis spinosa	لصف	c
Caylusea hexagyna	دينبان	c
Chozophora tinctoria	غبيرة	r
Citrullus colocynthis	حنظل	c
Cleome amblyocarpa	سمو	r
Cleome droserifolia	عفين	c
Convolvulus hystrix	شيريم	rr
Cotula cinerea	أربيان	
Crotalaria aegyptiaca	نتش	r
Cyperus conglomeratus	سعد	c

Latin name	الأسم العربي	Status
Erodium laciniatum	أبو مصفى	c
Euphorbia granulata	البينة	r
Fagonia sp.	شوكه	cc
Farsetia aegyptia	جرايي	cc
Farsetia longisiliqua	دهيان	r
Ficus palmata	حماط	rr
Ficus salicifolia	ام سيسي	rr
Forsskaolea tenacissima	لساك	r
Heliotropium strigosum	مكور	r
Hyphaene thebaica	نخيل الدوم	c
Juncus rigidus	سمر	c
Kickxia nubica	---	rr
Launaea spinosa	قداد	r
Leptadenia pyrotechnica	مرخ	r
Limonium axillare	شليل	c
Lindenbergia abyssinica	منهه هندي	rr
Lontononis platycarpa	حربيت	r
Lotus deserti	---	r
Lycium shawii	عوجز	c
Maerua crassifolia	سرحه	rr
Moringa peregrina	اليسار	rr
Neurada procumbens	لزيق	r
Nitraria retusa	غردق	c
Ochradenus baccatus	قرضي-تنبان	c
Panicum turgidum	أبو ركبة	c
Pergularia tomentosa	غلق	r
Phoenix dactylefra	نخيل البلح	c
Phragmites australis	بوص / غاب	c
Pulicaria crispa	قصوم	c
Pulicaria incisa	ربل	r
Rhus oxycantha	زعرور	rr
Rumex cyprius	حمض	r

Latin name	الأسم العربي	Status
Salvadora persica	الأراك	r
Schismus barbatus	بمه	c
Senecio glaucus	مرار	r
Senna alexandrina	سنامكي	c
Solenostemma argel	حرجل	r
Stipagrostis ciliata	حميرة	r
Stipagrostis plumosa	حشيش	r
Sueda monoica	سويدة / عسل	r
Tamarix aphylla	أثل	cc
Tamarix nilotica	طرفة	cc
Tephrosia purpurea	نفل	r
Trichodesma africana var. homotrichum	شوك الضب	r
Zilla spinosa	سيلا	cc
Ziziphus spina-christi	النبق / السدر	c
Zygophyllum album	رطريط	cc
Zygophyllum berenicense	---	rr
Zygophyllum coccineum	بطباط	cc

cc=very common, c=common, r=rare, rr=very rare

Ephemeral plant species

Latin name	الأسم العربي	Status
Aizoon canariense	الدع	r
Arnebia hispidissima	فيي	c
Asphodelus fistulosus	بصل ابليس	r
Astragalus eremophilus	مجد	r
Astragalus vogeli	قرن	c
Filago spathulata	---	r
Ifloga spicata	خريشه الجدي	r
Malva parviflora	خبيزه	cc
Neurada procumbens	لسيق	c
Plantago ciliate	حلاوه البدن	c
Schouwia thebaica	مهد	cc

Latin name	الأسم العربي	Status
Senecio desfontainei	قريص	cc
Senecio flavus	حدحديد	c
Spergula fallax	---	r
Spergularia diandra	قيلقيلة	c
Spergularia marina	---	c
Trainthema crystallina	ارارىب	rr
Tribulus longipetalus	قتوب	c
Tribulus orientalis	دريس	r
Tribulus pentandrus	---	c
Trichodesma crystalline	---	r
Zygophyllum simplex	رطريط	c

cc=very common, c=common, r=rare, rr=very rare

Appendix 6: Species of Stony Coral Reported in WGHPA

Latin name	Latin name
Acanthastrea maxima	*Leptastrea inaequalis*
Acropora clathrata	*Leptastrea transversa*
Acropora cytherea	*Leptoseris explanata*
Acropora digitifera	*Leptoseris hawaiiensis*
Acropora eurystoma	*Lobophyllia corymbosa*
Acropora granulosa	*Millepora dichotoma*
Acropora hemprichii	*Millepora exaesa*
Acropora humilis	*Millepora platyphylla*
Acropora hyacinthus	*Montastrea curta*
Acropora pharaonis	*Montipora aequituberculata*
Acropora robusta	*Montipora danae*
Acropora squarrosa	*Montipora informis*
Acropora valida	*Montipora monasteriata*
Alveopora spongiosa	*Montipora tuberculosa*
Alveopora tizardi	*Oulophyllia crispa*
Astreopora myriophthalma	*Oxypora lacera*
Blastomussa merleti	*Pavona cactus*
Ctenactis echinata	*Pavona diffluens*
Cycloseris patelliformis	*Pavona duerdeni*
Cyphastrea serailia	*Pavona maldivensis*
Diploastrea heliopora	*Platygyra daedalea*
Echinophyllia aspera	*Platygyra Phrygia*
Echinopora fruticulosa	*Plerogyra sinuosa*
Favia favus	*Pocillopora damicornis*
Favia laxa	*Pocillopora verrucosa*
Favia stelligera	*Podabacia crustacea*
Favites complanata	*Porites lobata*
Favites flexuosa	*Porites lutea*
Favites peresi	*Porites nodifera*
Fungia (Danafungia) horrida	*Psammocora explanulata*
Fungia (Fungia) fungites	*Psammocora haimeana*
Fungia (Pleuractis) scutaria	*Seriatopora hystrix*

Latin name	Latin name
Galaxea fascicularis	*Siderastrea savignyana*
Gardineroseris planulata	*Stylocoeniella guentheri*
Goniopora columna	*Stylophora pistillata*
Goniopora somaliensis	*Stylophora wellsi*
Goniopora stokesi	*Symphyllia erythraea*
Herpolitha limax	*Tubastraea coccinea*
Hydnophora exesa	*Tubastraea micranthus*
Hydnophora microconos	*Tubipora musica*

Appendix 7: Soft Coral Species Reported in WGHPA

Latin name
Heteroxenia sp.
Nephthya albida
Nephthya sp.
Parerythropodium fulvum
Sarcophyton eherenbergi
Sarcophyton sp.
Sinularia sp.
Xenia faraunensis
Xenia impulsatilla
Xenia macrospiculata
Xenia sp.

Appendix 8: Gastropod Species Reported in WGHPA

Latin name	Latin name
Acanthopleura haddoni	*Nassarius aurcularius*
Anadra antiquata	*Nassarius coronatus*
Barbatia helblingi	*Nassarius protrusidens*
Brachidontes variabilis	*Nembrotha affinis*
Brechites attrahens	*Nerita albicilla*
Cardila verigata	*Nerita polita*
Cellana eucosmia	*Nerita polita*
Cerithium caerculeum	*Nerita undata*
Cerithium erythraeonense	*Octopus vulgaris*
Chama pacifica	*Patella species*
Chicoreus virgineus	*Pinctada margaritifera*
Chiton species	*Pinctada radiata*
Chromodoris annulata	*Pleuroploca filamentosa*
Chromodoris fidelis	*Polinices tumidus*
Circe corrugatta	*Rockyhinoclavis fasciatus*
Circentia arabica	*Sanhaliotus pustulata*
Clanculus pharoanis	*Sanhaliotus varia*
Conus arenatus	*Sepia pharoans*
Conus frigidus	*Sepioteuthis lessoniana*
Conus namocanus	*Spondylus histrix*
Conus taeniatus	*Spondylus marisrubri*
Conus tessulatus	*Stomata auricula*
Conus textile	*Stomata nigra*
Conus vigro	*Streptopinna saccata*
Ctena divergens	*Strombus decorus*
Cypraea carneola	*Strombus fasciatus*
Cypraea grayana	*Strombus fusiformis*
Cypraea nebrites	*Strombus gabberulus*
Cypraea pantheriana	*Strombus mutabilis*
Cypraea pluchra	*Stylocheilus species*
Dendropoma maxima	*Tectus dentatus*
Drupa ricinus	*Tectus varigatus*

Latin name	Latin name
Engina mendicaria	*Tellina inflata*
Fusus polygonoides	*Tellinella staurella*
Gafrarium pectinata	*Terebra affinis*
Harpa amouretta	*Terebra consobrina*
Hiatula rupelliana	*Terebra crenulata*
Hyotissa hyotis	*Thais savigyni*
Hyotissa numisma	*Tonna perdix*
Lambis triuncata	*Tridacna maxima*
Latirus turritus	*Tridacna sp.*
Littorina scabra	*Tridacna squamosa*
Lunulicardia auricula	*Trochus maculatus*
Modulus auriculatus	*Turbo pustulatus*
Monodonta canilifera	*Turbo radiatus*
Morula granulata	*Vasum turbinellus*
Murex tribulus	*Vermetus species*
Muricodurpa fiscellum	*Volema pyrum*

Appendix 9: Echinoderm Species Reported in WGHPA

Latin name	Latin name
Acanthaster planci	*Holothuria lecuospilota*
Actinopyga mauritiana	*Linckia guildingi*
Actinopyga plebeja	*Linckia multifora*
Asterina burtoni	*Macrophiothrix galateae*
Astropyga radiata	*Oligometra serripinna*
Bohadschia cousteaui	*Opheodesoma kamaranensis*
Bohadschia steinitizi	*Ophiactis savignyi*
Capillaster multiradiatus	*Ophiocoma erinaceus*
Chaetodiadema granulatum	*Ophiocoma pica*
Diadema savignyi	*Ophiocoma scolopendrina*
Diadema setosum	*Ophiocoma valenciae*
Echinaster purpureus	*Ophiodaphne scripta*
Echinometra mathaei	*Ophiolepis cincta*
Echinosterophus molaris	*Ophiomastix variabilis*
Echinothrix calamaris	*Ophionereis porrecta*
Echinothrix diadema	*Ophiopeza fallax fallax*
Eucidaris metularia	*Ophiura kinbergi*
Fromia monilis	*Prionocidaris baculosa*
Heterocentrotus mammillatus	*Stichopus variegatus*
Holothuria arenicola	*Synapta maculata*
Holothuria atra	*Tripneustes gratilla*
Holothuria difficilis	

Appendix 10: Fish Species Reported in WGHPA

Latin name	Latin name
Abudefduf saxatilis	*Grammistes sexlineatus*
Acanthopagras bifasciatus	*Halichoeres nebulosus*
Acanthopagrus berda	*Hemigymnus fasciatus*
Acanthurus nigricans	*Hemiramphus far*
Acanthurus nigrofuscus	*Heniochus diphreutes*
Acanthurus sohal	*Heniochus intermedius*
Adioryx ruber	*Istiblennius edentulus*
Adiotyx diadema	*Istiblennius periophthalmus*
Aethaloperca rogaa	*Istigobius ornatus*
Amblyeleotris sungami	*Lutjanus bohar*
Amphiprion bicinctus	*Lutjanus ehrenbergi*
Anthias squamipinnis	*Lutjanus fulviflamma*
Arothron diadematus	*Lutjanus Kasmira*
Arothron hispidus	*Megaprotodon trifascialis*
Atherinomorus lacunosus	*Monodactylus argenteus*
Bothus pantherinus	*Mulloides flavolineatus*
BothusBothus pantherinus	*Naso lituratus*
Caesio lunaris	*Naso unicornis*
Caesio suevicus	*Odonus niger*
Carangoides fulvoguttatus	*Oxycirrhites typus*
Caranx melampygus	*Paraglyphidodon melas*
Carcharhinus wheeleri	*Pardachirus marmoratus*
Carngoides bayad	*Parupeneus cyclostoma*
Cephalopholis hemistiktos	*Parupeneus cyclostomus*
Cephalopholis miniata	*Parupeneus forsskali*
Cetoscarus bicolor	*Pempheris vanicolensis*
Chaetodon auriga	*Platax orbicularis*
Chaetodon austriacus	*Plectorhynchus gaterinus*
Chaetodon fasciatus	*Pomacanthus maculosus*
Chaetodon paucifasciatus	*Pseudochromis flavivertex*
Cheatodon auriga	*Pterois radiata*
Cheilinus sp.	*Pterois volitans*

Latin name	Latin name
Cheilinus undulatus	*Pygoplites diacanthus*
Cheilnus fasciatus	*Restrelliger kanagurta*
Cheilodipterus macrodon	*Rhabdosargus sarba*
Chromis caerulea	*Rhinecanthus assasi*
Chromis dimidiata	*Rhinobatus sp*
Chrysiptera annulata	*Scarus psittacus*
Conger cinereus	*Scarus sordidus*
Crenimugil crenilabis	*Scorpaenopsis barbatus*
Ctenochaetus striatus	*Scorpaenopsis diabolus*
Ctenogobiops maculasis	*Siganus rivulatus*
Ctenogobiops maculosis	*Siganus stellatus*
Dascyllus aruanus	*Synodus variegatus*
Dascyllus marginatus	*Taeniura lymma*
Dascyllus trimaculatus	*Terapon jarbua*
Diodon hystrix	*Thalassoma purpureum*
Fistularia commersonii	*Trachyrhamphus bicoarctatus*
Flammeo sammara	*Tylosurus Choram*
Gerres oyena	*Zebrasoma desjardinii*
Gnatholepis anjerensis	*Zebrasoma veliferum*
Gomphosus coeruleus	*Zebrasoma xanthurum*

Appendix11: Reptile Species Recorded in WGHPA

Latin name	الاسم العربي	English name
Cyrtopodion scabrum	برص خشن	Rough scaled Gecko
Hemidactylus robustus	برص البحر الأحمر	Somali Plain Gecko
Hemidactylus turcicus	برص تركي	Turkish Gecko
Pristurus flavipunctatus	برص الشجر	Yellow-spotted Semaphore Gecko
Ptyodactylus hasselquistii	برص أبو كف	Hasselquest's Fan-toed Gecko
Ptyodactylus siphonorhina	برص أبو كف	Anderson's Fan-toed Gecko
Stenodactylus sthenodactylus	برص أبو عين واسعة	Elegant Gecko
Tarentola annularis	برص مصري	Egyptian Gecko
Tropiocolotes bisharicus	برص بشاري قزم	Bishari Pygmy Gecko
Tropiocolotes steudneri	برص تحت الحجر	Steudner's Pygmy Gecko
Agama spinosa	حردون البحر الأحمر	Spiny Agama
Pseudotrapelus sinaitus	حردون سيناء	Sinai Agama
Uromastyx ocellata	ضب مزوق	Ocellated Dab Lizard
Acanthodactylus boskianus	سحلية بوسك	Bosc's Fringe-toed Lizard
Acanthodactylus scutellatus	سحلية	Nidua Lizard
Mesalina guttulata	سحلية صغيرة النقط	Small-spotted Lizard
Mesalina rubropunctata	سحلية حمراء النقط	Red-spotted Lizard
Varanus griseus	ورل صحراوي	Desert Monitor
Chalcides ocellatus	سقنقور منقط	Ocellated Skink
Coluber rhodorhachis	سف رمادي	Jan's Racer
Psammophis aegyptius	أبو السيور الصحراوي	Saharn Sand Snake
Psammophis schokari	أبو السيور المخطط	Schokari Sand Snake
Spalerosophis diadema	أرقم أحمر	Clifford's Snake
Malpolon moilensis	ثعبان	Moila Snake

Latin name	الاسم العربي	English name
Telescopus dhara	ثعبان جداري	Cat snake
Cerastes cerastes	طريشة	Horned viper
Echis coloratus	أفعى منشارية	Carpet Viper
Chelonia mydas	السلحفاة البحرية الخضراء	Green Turtle
Eretmochelys imbricata	السلحفاة الصقرية	Hawksbill Turtle

Appendix 12: Breeding Bird Species Recorded in WGHPA

Latin name	الاسم العربي	English name
Phaethon aethereus	رئيس البحر	Red-billed Tropic Bird
Sula leucogaster	أطيش	Brown Booby
Egretta gularis	بلشون الصخر	Western Reef Heron
Ardea goliath	بلشون جبار	Goliath Heron
Butorides striatus	بلشون أخضر	Striated Heron
Platalea leucorodia	أبوملعقة	Spoonbill
Buteo rufinus	صقر حوام	Long-legged Buzzard
Hieraaetus fasciatus		Bonelli's Eagle
Pandion haliaetus	عقاب نسارية	Osprey
Neophron percnopterus	رخمة مصرية	Egyptian Vulture
Gypaetus barbatus		Lammergeyer
Torgos tracheliotus	نسر أذون	Lappet-faced Vulture
Falco biarmicus	صقر حر	Lanner Falcon
Falco concolor	صقر الغروب	Sooty Falcon
Ammoperdix heyi	حجل الصخر	Sand Partridge
Pterocles lichtensteinii	قطا نوبي	Lichtenstein's Sandgrouse
Pterocles coronatus	قطا متوج	Crowned Sandgrouse
Pteroceles senegallus	قطا أنقط	Spotted Sandgrouse
Streptopelia senegalensis	يمام بلدي	Palm Dove
Streptopelia decaocto	يمام مطوق	Collard Dove
Streptopelia roseogrisea	يمام وردي	Pink-headed Dove
Columba livia	يمام جبلي	Rock Dove
Larus hemprichii	نورس أسحم	Sooty Gull
Larus leucophthalmus	نورس عجمة	White-eyed Gull
Sterna repressa	خطاف أبو بطن	White-cheeked Tern
Sterna caspia	خطاف أبوبلحة	Caspian Tern

Latin name	الاسم العربي	English name
Sterna bengalensis	خطاف متوج	Lesser Crested-Tern
Sterna anaethetus	خطاف أسحم	Bridled Tern
Charadrius alexandrinus	قطقاط أسكندرى	Kentish Plover
Burhinus oedicnemus	كروان صحراوي	Stone Curlew
Cursorius cursor	جليل	Cream-coloured Courser
Strix butleri	بومة بتلر	Hume's Tawny Owl
Bubo ascalaphus	بعفة الصحراء	Pharao's Eagle Owl
Ammomanes cincturus	قنبرة صحراوية موشمة الذيل	Bar-tailed Desert Lark
Ammomanes deserti	قنبرة صحراوية	Desert Lark
Alaemon alaudipes	مكاء	Hoopoe Lark
Hirundo obsoleta	خطاف الصخر	Rock Martin
Oenanthe lugens	أبلق حزين	Mourning Wheatear
Oenanthe monacha	أبلق أبو قلنسوة	Hooded Wheatear
Oenanthe leucopyga	أبلق متوج	White-crowned Black Wheatear
Hippolais pallida		Olivaceous Warbler
Lanius meridionalis	دفناش البادية	Southern Grey Shrike
Corvus ruficollis	غراب نوحي	Brown-necked Raven
Emberiza striolata	بلبل الشعير المخطط	House Bunting
Rhodopechys githagina	زمير مصري	Trumpeter Finch

Appendix 13: Mammal Species Recorded in WGHPA

Latin name	الاسم العربي	English name
Taphozous perforatus	خفاش المقابر	Tomb Bat
Taphozous nudiventris	خفاش	Egyptian Sheath-tailed Bat
Asila tridens	خفاش	Trident Horseshoe Bat
Otonycteris hemprichii	خفاش طويل الأذن	Hemprich's Long-eared Bat
Tadarida aegyptiaca	خفاش حر الذيل	Free-tailed Bat
Paraechinus aethiopicus	قنفذ صحراوي	Desert Hedgehog
Lepus capensis	أرنب بري	Cape Hare
Gerbillus pyramidum	بيوضي	Greater Gerbil
Gerbillus gerbillus	بيوضي	Lesser Gerbil
Sekeetamys calurus	جرذ ريشي الذنب	Bushy Tailed Jird
Dipodillus henleyi	بيوضي	Henley's Dipodil
Meriones crassus	جرذ	Silky Jird
Acomys cahirinus	فأر شوكي	Egyptian Spiny Mouse
Mus musculus	فأر المنزل	House Mouse
Jaculus jaculus	جربوع	Lesser Jerboa
Felis margarita	قط الرمال	Sand Cat
Felis caracal	أم الريشات	Caracal
Vulpes rueppelli	ثعلب الرمال	Ruepelle's Sand Fox
Hyaena hyaena	ضبع مخطط	Stripped Hyena
Dugong dugon	عروس البحر	Dugong
Capra nubiana	تيتل نوبي	Nubian Ibex
Procavia capensis	وبر	Hyrax
Ammotragus lervia	كبش ألروي	Barbary Sheep
Gazella dorcas	غزال مصري	Dorcas Gazelle
*Delphinus delphis**	دولفين	Common Dolphine
Tursiops truncatus	دولفين	Bottel-nosed Dolphine

Latin name	الاسم العربي	English name
Stenella longirostris	دولفين	Spinner Dolphine
*Grampus griseus**	دولفين	Risso's Dolphine

.* Species expected to be found

Appendix 14: Archaeological Sites in and around WGHPA.

Modern Name	Ancient Name	Period	Coordinates	Brief Description
Dweig	Falacro	early Roman	24° 44.15' N 34° 25.57' E	road station near juncture of ancient Berenike-Edfu and Berenike-Koptos roads
Umm Gariyeh/ Umm Ushra	unknown	early Roman and probably Ptolemaic	24° 40.56' N 34° 32.61' E	road station on ancient Berenike Edfu/Koptos road
Wadi Gemal	Apollonos	1–6C. AD	24° 32.11' N 34° 44.15' E	major fort on ancient route from Berenike to Nile (at Edfu and Koptos)
between Wadi Gemal and Gelli/Wadi Gemal South	unknown	early and late Roman	24° 31.42' N 34° 44.20' E	cemetery probably serving both Wadi Gemal and Gelli/ Wadi Gemal South
Gelli/Wadi Gemal South	unknown	1–2 and 5C. AD & Islamic	24° 31.25' N 34° 44.41' E	major settlement of unknown function a few km south of Apollonos
Sikait*	Senskis/ Senskete	1–5C. AD & possibly Ptolemaic	24° 37.95' N 34° 47.73' E	major beryl/emerald mining settlement
Middle Sikait*	unknown	1–2, 4C. AD	24° 39.45' N 34° 48.30' E	beryl/emerald mining center
North Sikait*	unknown	5–6C. AD	24° 39.84' N 34° 47.50' E	beryl/emerald mining settlement
Umm Hieran	unknown	Late 4– early 6C. AD	24° 34.64' N 34° 51.67' E	about 190 structure site of unknown function, perhaps Christian laura settlement
Umm Harba*	unknown	early & late Roman	24° 38.53' N 34° 49.59' E	beryl/emerald mining settlement
Kab Marfu'a/ Wadi Gemal North	unknown	1–2, 4–5C. AD	24° 32.61' N 34° 44.22' E	perhaps beryl/ emerald processing center
Nugrus*	unknown	early and late Roman	24° 37.19' N 34° 46.39' E	major beryl/ emerald mining settlement

Modern Name	Ancient Name	Period	Coordinates	Brief Description
Nugrus West	unknown	Late 4, early 6C. AD	24° 37.14’ N 34° 46.04’ E	about 70-80 structures on site of unknown function, possibly Christian laura settlement
Abu Rushaid*	unknown	early Roman	24° 38.33’ N 34° 45.88’ E	beryl/emerald mining settlement
Umm Kabu*	unknown	early Roman on, perhaps Ptolemaic	24° 35.35’ N 34° 53.57’ E	beryl/emerald mining site
Gebel Zabara*	unknown	Roman, Islamic	24° 46.27’ N 34° 43.08’ E	beryl/emerald mining settlement
Wadi Duba’*	unknown	Late 1C. BC to early 1C AD	24° 34.65’ N 34° 53.93’ E	beryl/emerald mining settlement
Abu Hegilig North	unknown	Late 4–6C. AD	24° 25.22’ N 34° 55.46’ E	road station on ancient route from Berenike to Nile (at Edfu/Koptos)
Abu Hegilig South	unknown	early Roman, perhaps late Roman, perhaps Ptolemaic	24° 23.94’ N 34° 59.48’ E	road station on ancient route from Berenike to Nile (at Edfu/Koptos)
Abu Ghalqa	unknown	5–6C. AD	24° 20.95’ N 35° 04.19’ E	road station on ancient route from Berenike to Nile (at Edfu/Koptos)
Qabr Rijm/ Shea’leq/ MkBea’/ Abu Ghurbon	unknown	early & late Roman	24° 07.00’ N 35° 16.34’ E	stop on Berenike- Nile road
Lahmi	unknown	Ptolemaic, 1, 2, 4C. AD	24° 09.92’ N 35° 21.81’ E	small fort
Juncture-Wadi Gemal Wadi Nugrus	unknown	unknown	24° 34.47’ N 34° 49.45’ E	animal tethering lines
Wadi Gemal East	unknown	Mid 2–4C. AD	24° 34.02’ N 34° 48.97’ E	road station & settlement w/ animal tethering lines
off ancient Via Hadriana	unknown	early Roman	24° 26.70’ N 35° 04.63’ E	cemetery west of ancient Via Hadriana
Bir Rada	unknown	late Roman	24° 15.67’ N 35° 14.49’ E	well and cemetery of about a dozen + tombs/graves

Modern Name	Ancient Name	Period	Coordinates	Brief Description
Mweillah	unknown	Ptolemaic-early Roman	24° 13.33’ N 35° 03.98’ E	gold mining settlement
Wadi al-Ghadir (1)	Unknown	Late 4–6C. AD	24° 48.30’ N 34° 50.52’ E	gold mining settlement
Wadi al-Ghadir (2)	unknown	probably Roman	24° 47.95’ N 34° 50.49’ E	ancient tombs/ graves
Umm Ud	unknown	early 20C. British/ possibly ancient	24° 48.71’ N 34° 41.63’ E	gold mines
Helan	unknown	early & late Roman	24° 37.53’ N 34° 34.92’ E	settlement off ancient Berenike-Nile road
Hangaliya	unknown	Ptolemaic-Roman	24° 50.32’ N 34° 35.89’ E	gold mining settlement
Khashir	Novum Hydreuma	unknown	24° 11.06’ N 35° 14.02’ E	station on ancient Berenike-Nile road
Abu Ghusoon	Cabalsi (?)	Late 4–5C. AD	24° 23.24’ N 35° 02.87’ E	station on ancient Berenike-Nile road
mouth of Wadi Ghadir	unknown	probably late Roman & modern Bedouin	24° 49.02’ N 34° 59.73’ E	cemetery of about37-40 graves
Umm Kebash	unknown	1–4/5C. AD	24° 42.85’ N 34° 28.20’ E	stop on ancient Berenike-Nile road
Kurdumay	unknown	Roman	24° 52.53’ N 34° 41.58’ E	gold mining settlement of about60 structures, also modern British reworking
Seyhrig	unknown	Ptolemaic-early Roman& Islamic	24° 45.79’ N 34° 18.90’ E	station on ancient Berenike-Edfu road

*Sites in this region collectively known as Mons Smaragdus (“Emerald Mountain”) to the Romans.

Appendix 15: Status of Archaeological Sites in WGHPA

Modern Name	Relative Significance	Status	Condition and Threats
Dweig	important fort at juncture of ancient Berenike-Edfu/ Koptos roads	surveyed/ plan drawn	very well preserved/ vandalism/ antiquities robbing
Umm Qariyeh/ Umm Ushra	important fort on ancient Berenike-Edfu/Koptos roads	surveyed/ plan drawn	very well preserved/ vandalism/antiquities robbing
Wadi Gemal	remains of largest Roman military fort in Eastern Desert	surveyed/ plan drawn	mediocre, most of two walls washed away/ vandalism/ antiquities robbing/ flooding
between Wadi Gemal and Gelli/ Wadi Gemal South	cemetery of minor importance	not surveyed, no plan drawn	mediocre/vandalism/ antiquities robbing/ vehicular traffic
Gelli/Wadi Gemal South	major and very large settlement	not surveyed, planned or excavated	very good/vandalism/ antiquities robbing/ vehicular traffic
Sikait	major site in this zone, several hundred buildings, rock cut temples	surveyed/ plan drawn/ excavations begun	very good to excellent/ robbing/uncontrolled tourism/flooding
Middle Sikait	important site with large ancient ramps, mining shafts, buildings	partially surveyed	very good/robbing/ uncontrolled tourism/natural erosion
North Sikait	important site with numerous buildings and mine shafts	surveyed/plan drawn	very good/vandalism/ robbing
Umm Hieran	site of secondary importance	surveyed/plan drawn	good/vandalism/ robbing
Umm Harba	important site (less so than Sikait, more so than Umm Hieran)	sketch plan drawn	excellent/vandalism/ robbing/uncontrolled tourism
Kab Marfu'a/ Wadi Gemal North	major site with numerous well preserved buildings, temple on side of mountain	partially surveyed and partial plan drawn	excellent/vandalism/ robbing/ uncontrolled tourism/natural erosion

Modern Name	Relative Significance	Status	Condition and Threats
Nugrus	major site in this zone with about two dozen buildings in superb condition, hundreds of others in ruins	partially surveyed and partial plan drawn	excellent/vandalism/robbing uncontrolled tourism/modern beryl mining/natural erosion
Nugrus West	minor site of secondary important	not surveyed, no plan drawn	good/vandalism/robbing
Abu Rushaid	site of secondary importance	not surveyed, no plan drawn	good/vandalism/robbing
Umm Kabu	site of secondary importance	not surveyed, no plan drawn	good/vandalism/robbing
Gebel Zabara	important site	not surveyed, no plan drawn	good/vandalism/robbing/ uncontrolled tourism
Wadi Duba’	site of minor importance	not surveyed, no plan drawn	poor/no real threats likely
Abu Hegilig North	site of secondary importance	surveyed, plan drawn	excellent/vandalism/robbing/ uncontrolled tourism
Abu Hegilig South	important site	surveyed, plan drawn	excellent/vandalism/robbing/ nearby modern quarrying/ uncontrolled tourism
Abu Ghalqa	minor site	surveyed, plan drawn	poor/no real threats likely
Qabr Rijm/ Shea’leq/ Mkbea’/ Abu Ghurbon	minor site, ancient camp, no real structures here	not surveyed, no plan drawn	poor/no real threats likely other than natural erosion
Lahmi	important site	surveyed, plan drawn	very good/vandalism/ robbing/uncontrolled tourism
Juncture Wadi Gemal-Wadi Nugrus	site of secondary importance	surveyed, plan drawn	good/flooding/vehicular traffic
Wadi Gemal East	important site	surveyed, plan drawn	excellent/vandalism/ robbing/uncontrolled tourism/flooding/vehicular traffic
off ancient Via Hadriana	minor site	not surveyed, no plan drawn	good/vandalism/robbing
Bir Rada	minor site	not surveyed, no plan drawn	mediocre/vandalism/ robbing
Mweilah	site of secondary importance	sketch plan drawn	good/vandalism/robbing
Wadi al-Ghadir (1)	site of secondary importance	not surveyed, no plan drawn	good/vandalism/robbing

Modern Name	Relative Significance	Status	Condition and Threats
Wadi al-Ghadir (2)	site of secondary importance		good/vandalism/robbing
Umm Ud	site of secondary importance as an antiquity, but interesting example of early 20th c. gold mine	not surveyed, no plan drawn	good/no real threats likely
Helan	site of secondary importance	surveyed, sketch plan drawn	mediocre/vandalism/robbing
Hangaliya	important ancient gold mining settlement in this zone	not surveyed, no plan drawn	good/vandalism/robbing
Khashir	site of secondary importance	surveyed, plan drawn	mediocre/no real threats likely
Abu Ghusoon	site of secondary importance in very poor state of preservation	surveyed, plan drawn	poor/nearby modern mining activity
mouth of Wadi Ghadir	site of minor importance	not surveyed, no plan drawn	mediocre/vandalism/ robbing
Umm Kebash	site of minor importance, ancient camp, no standing structures	not surveyed, no plan drawn	poor/natural erosion
Kurdumay	site of secondary importance	not surveyed, no plan drawn	mediocre-good/vandalism/ robbing
Seyhrig	important secondary site	surveyed, plan drawn	good/vandalism/robbing/ natural erosion

Appendix 16: Proposed Access to Archaeological Sites

Site	Proposed Access for Visitors
Dweig	restricted
Umm Qariyeh/ Umm Ushra	restricted
Wadi Gemal	open
Between Wadi Gemal and Gelli/Wadi Gemal South	open
Gelli/Wadi Gemal South	restricted
Sikait	restricted
Middle Sikait	restricted
North Sikait	restricted
Umm Heiran	open
Umm Harba	closed
Kab Marfu'a/Wadi Gemal North	restricted
Nugrus	restricted
Nugrus West	open
Abu Rushaid	restricted
Umm Kabu	open
Gebel Zabara	restricted
Wadi Duba'	open
Abu Hegilig North	restricted
Abu Hegilig South	restricted
Abu Ghalqa	open
Qabr Rijm/Shea'leq/MkBea'/Abu Ghurbon	open
Lahami	restricted
Juncture Wadi Gemal- Wadi Nugrus	restricted
Wadi Gemal East	restricted
Off ancient Via Hadriana (cemetery)	open
Bir Ria'da	open
Mweillah	restricted
Wadi al-Ghadir (1)	restricted
Wadi al-Ghadir (2)	restricted
Umm Ud	open
Helan	restricted
Hangaliya	restricted

Site	Proposed Access for Visitors
Khashir	open
Abu Ghusoon	restricted
Mouth of Wadi Ghadir	open
Umm Kebash	open
Kurdumay	restricted
Seyhrig	restricted

Management Recommendations

It is recommended to have controlled access to all the sites listed above under sensitivity as restricted, which would include fences, signs and guards. The highest level of protection for sites listed above IN BOLD (under sensitivity). These latter sites should have restricted access to vehicular traffic, posted markers, designated paths from which visitors should not stray and alert, omnipresent, alert and well-informed guards. Floodwater diversion schemes should also be established for some of these sites.

It is recommended that these sites have detailed, architect-quality measured plans and elevations of the most important structures drawn as soon as possible. In addition, it is essential that architectural consolidation/conservation/restoration be undertaken to arrest the effects of human and natural depredations at those sites listed in BOLD.

The proposed status of the sites is NOT permanent, but should be adjusted so that most become more accessible once site plans, architectural elevation drawings, limited excavation and suggested architectural conservation/restoration and the requisite protection have been completed/provided. The status of each of these sites may also be altered once protective measures have been instituted.

Appendix 17: Staffing Plan and Requirements for WGHPA

Job title	Position	Target number	Distribution over Management Sectors			Brief job description
			North	South	Inland	
PA Manager	PA Manager	1	1			Overall responsibility for the coordination of WGHPA management, ensuring that PA objectives are met and policies applied. Responsible for PAMU administration and performance; and plays a major liaison role with local government agencies and other local stakeholders. Reports to Red Sea PA manager.
PA Sector Manager	Senior Ranger	3	1	1	1	Responsible for daily management of the three Management Sectors; assists, reports to and delegates for PA manager; responsible for patrol schedules, equipment maintenance, communications, public relations/awareness, visitor management EIA enforcement etc.
Accountant	Ranger / Junior Ranger	1	1			Responsible for financial planning, control and reporting, payment schedules, PAMU inventories, and various office management and administrative duties.

Job title	Position	Target number	Distribution over Management Sectors			Brief job description
			North	South	Inland	
Office Administrator	Ranger / Junior Ranger	1	1			Assistant to PAMU manager, office administration, general secretarial duties (file and office register system) present incumbent to assist on legal affairs.
Legal Officer	Ranger / Junior Ranger	1	1			Report violations to police and follow up prosecutions. Organize permit and licensing system for the PA.
IT/GIS Specialist	Ranger / Junior Ranger	1	1			Development and maintenance of PAMU GIS database in coordination with Hurghada GIS unit, document spatial development (urban, quarries, tracks, etc.) in and around the PA and assist with EIAs.
Civil Engineer	Ranger / Junior Ranger	1	1			Planning and supervision of PA infrastructure development and maintenance, track maintenance, monitoring of urban development, ecolodge development, waste management and assist with EIAs.
Marine Biologist	Ranger / Junior Ranger	4	2	2		Will have responsibility for general and specific status surveys of target species and ecosystems; implementing biodiversity and ecological monitoring and management interventions, assist with EIAs in the marine and coastal environments.

Job title	Position	Target number	Distribution over Management Sectors			Brief job description
			North	South	Inland	
Terrestrial Biologist	Ranger / Junior Ranger	6	2	2	2	Will have major responsibility for general and specific status surveys of target species and ecosystems; implementing biodiversity and ecological monitoring and management interventions, assist with EIAs in the terrestrial environments.
Geologist	Ranger / Junior Ranger	1			1	Planning and monitoring quarrying and mines, monitoring water quality and supplies, supervise well maintenance, wildlife water points, infrastructure ground engineering, flood risk.
Medical Doctor	Ranger / Junior Ranger	1	1			Emergency service for visitors and PAMU staff, health services for Bedouin communities.
Veterinarian	Ranger / Junior Ranger	1	1			Veterinary treatment for domestic stock, control of disease transmission to wildlife, eradication of feral animals, treatment of injured wildlife.
Community Liaison Officer	Ranger / Junior Ranger	1	1			Liaison with local communities, community guards, promotion of participatory management, facilitating and monitoring of community projects etc.

Job title	Position	Target number	Distribution over Management Sectors			Brief job description
			North	South	Inland	
Education Expert	Ranger / Junior Ranger	2	1	1		Responsible for developing and implementing a PAMU public awareness/environmental education strategy, visitor surveys, production of materials and maintenance of Visitor Center exhibits etc.
Lab Technician	Junior Ranger	1	1			Technical field and laboratory support.
Ticket Collectors	Junior Ranger	3	1	1	1	Collection of entrance fees, distribution and sale of materials and guarding of PAMU property.
Community Guard	Communit y Guard	15				Reporting on general conservation and monitoring activities (wildlife, tourism, quarries etc) guiding and assisting Rangers on patrol, trail maintenance, cleaning, restoring areas, promoting conservation in local communities etc.
Equipment Operator	Technician	1	1			Operation and maintenance of PAMU heavy equipment.
Boat Operator	Technician	3	2	1		Operation and maintenance of PAMU boats.
Mechanic	Technician	2	1	1		Maintenance of PAMU vehicles and boats.

Appendix 18: Basic Equipment for PAMU Staff

Item	Target /Description
Transport	
4 X 4 Vehicles	6
Patrol boats	4
Heavy Machinery	
Soil moving equipment	1
Communications	
Radio network	Complete network covering WGHPA
Satellite phones	3
Mobile phones	Made available until radio network established
Data Management	
Computers, software, statistical packages	6 work stations, 2 laptops
Patrolling Equipment	
Binoculars	10
Scopes	3
Cameras, lenses	2 regular, 2 digital, 2 underwater
Camping Equipment	4 complete sets
Diving Equipment	10 complete sets
Navigation Equipment	
GPS, compasses	5
Maps	3 complete 1-50,000 sets
Altimeter	3
Monitoring Equipment	
Traps, camera traps, rope, measuring tapes	To be determined
First Aid Kits	3 complete kits
Lab Equipment	1 complete kit

Appendix 19: Maps

Map 1 Boundary of Wadi El Gemal – Hamata Protected Area

Map 2 Wadi El Gemal – Hamata PA: Distribution of mangrove

Map 3 Wadi El Gemal – Hamata PA: Terrestrial floral communities

Map 4 Wadi El Gemal – Hamata PA: Distribution of coral reefs and sea grass

Map 5 Wadi El Gemal – Hamata PA: Recent records of terrestrial reptiles

Map 6 Wadi El Gemal – Hamata PA: Recent marine turtle nesting sites

Map 7 Wadi El Gemal – Hamata PA: Recent distribution of breeding seabirds

Map 8 Wadi El Gemal – Hamata PA: Recent records of terrestrial birds

Map 9 Wadi El Gemal – Hamata PA: Recent records of terrestrial mammals

Map 10 Wadi El Gemal – Hamata PA: Recent records of Dugong

Map 11 Wadi El Gemal – Hamata PA: Archaeological sites and historical routes

Map 12 Wadi El Gemal – Hamata PA: Quarries and mines

Map 13 Wadi El Gemal – Hamata PA: Tourism resources map

Map 14 Wadi El Gemal – Hamata PA: Human activity and settlements

Map 15 Wadi El Gemal – Hamata PA: Zoning scheme

Map 16 Wadi El Gemal – Hamata PA: management sectors and PAMU infrastructure

Map 1 Boundary of Wadi el-Gemal–Hamata Protected Area

Ellie, you'll have to get Khaled Hanafy (?) to reduce the size of Sherif's maps, which are all at about 50 MB, and then place them following the captions.

Map 2 Mangrove Distribution in WGMPA

Map 3 Terrestrial Floral Communities, WGHPA

Map 4 Coral Reefs and Sea grass, WGHPA

Map 5 Recent Records of Terrestrial Reptiles, WGHPA

Map 6 Recent Marine Turtle Nesting Sites, WGHPA

Map 7 Recent Distribution of Breeding Seabirds, WGHPA

Map 8 Recent Records of Terrestrial Birds, WGHPA

Map 9 Recent Records of Terrestrial Mammals, WGHPA

Map 10 Recent Records of Duogong, WGHPA

Map 11 Archaeological Sites and Historical Routes, WGHPA

Map 12 Quarries and Mines, WGHPA

Map 13 Tourism Resources, WGHPA

Map 14 Human Activity and Settlements, WGHPA

Map 15 Zoning Scheme, WGHPA

Map 16 Management Sectors and PAMU Infrastructure, WGHPA