# Status of marine protected areas in Egypt

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**Abstract**

*Status of marine protected areas in Egypt*.— Egypt has sought to protect its natural resources and marine biodiversity by establishing a network of six MPAs that are generally located in the Gulf of Aqaba and the Red Sea; most of them include interconnected marine and terrestrial sectors based on conserving coral reefs and accompanying systems. We assessed the present status of MPA networks that showed a set of important results manifested in some strengths (*i.e.* proper selection according to specific criteria, management plans, etc.), and also some weaknesses (*i.e.* a relatively small protected proportion of the Egyptian marine territorial waters, significant pressures mainly by tourism activities, etc.). Finally, some recommendations are proposed from this work (*i.e.* incorporate more habitats that are not well represented in the network, especially on the Mediterranean Sea; establishing a touristic carrying capacity of each area; etc.) to improve the current situation.

Key words: Marine reserves, Fishing, Tourism, Conservation, Sustainable development, Egypt.

**Resumen**

*Estado de las áreas marinas protegidas en Egipto*.— Egipto ha establecido una red de seis áreas marinas protegidas (AMPs), situadas principalmente en el Golfo de Aqaba y el mar Rojo para proteger sus recursos naturales y su biodiversidad marina. La mayoría incluyen sectores terrestres y marinos interconectados con el fin de conservar los arrecifes de coral y otros sistemas acompañantes. El estado actual de la red de AMPs se manifiesta mediante algunos puntos fuertes (selección basada en criterios apropiados, existencia de planes de gestión, etc.) y también algunos puntos débiles (protección de una proporción relativamente pequeña de las aguas territoriales egipcias; presiones significativas de algunas actividades, principalmente el turismo, etc.). Finalmente, se proponen algunas recomendaciones (incorporación de más hábitats que no están bien representados en la red actual, particularmente en el Mediterráneo; establecimiento de una capacidad de carga turística para cada área; etc.) para mejorar la situación actual.

Palabras clave: Reservas marinas, Pesca, Turismo, Conservación, Desarrollo sostenible, Egipto.

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## Introduction

Marine biodiversity is important to conserve for many reasons. It allows the environment to adapt to changing conditions, it is a source of food and raw materials, and marine ecosystems are the most important elements controlling global climate (Norse, 1993). Preserving marine biodiversity for the sake of knowledge itself is also important. Generally, the greatest levels of marine biodiversity are found in tropical countries which are developing (Gray, 1997). However, being poorer than their developed country counterparts in general, they have fewer facilities, equipment, trained staff and resources available to devote to marine biodiversity conservation (Gray, 1997).

The Egyptian waters have great biodiversity. There are more than 5,000 species, including 800 species of seaweeds and seagrasses, 209 species of coral reefs, more than 800 species of molluscs, 600 species of crustacean and 350 species of echinodermata (NCS, 2007, 2009). The Egyptian marine environment is distinguished by specific habitats and threatened species, especially coral reefs, mangrove trees, seagrasses, marine mammals (17 species), marine turtles (four species), sharks (more than 20 species), sea cucumber, bivalves, and many birds (white–eyed gulls, sooty falcons, ospreys) (NCS, 2007, 2009).

Over the past few years, Egypt has paid special attention to issues of natural resources protection and signed many international conventions related to natural protection. It has also established a system and legislation for conservation of natural heritage, environment and natural resources for the benefit of the present and next generations (NCS, 2005). Nature conservation in Egypt is the responsibility of the Ministry of State for Environmental Affairs (MSEA). Specifically, the Egyptian Environmental Affairs Agency (EEAA) and the Nature Conservation Sector (NCS) are the governmental bodies that are responsible for establishing and managing the National Protected Area Network in Egypt (EcoConServ, 2004; NCS, 2006a, 2006b).

Since Egypt sought to fulfil its own natural conservation goals and the international convention signed by the country, it was necessary to establish legislation and a legal framework to begin the process of protecting its habitats. Law 102/1983 provides the legislative framework for establishing and managing protected areas in Egypt, which are defined as 'any area of land or coastal or inland water characterized by special flora, fauna and natural features having cultural, scientific, tourism or aesthetic value' (NCS, 2006b). Furthermore, Law No. 4/1994 for Environment is supportive to Law No. 102/1983, especially in the areas outside the declared protected areas. Although Law No. 4/1994 is focused mainly on pollution issues, many provisions have implications for nature conservation and hunting management in Egypt (Hanafy, 2005).

To date, 28 protected areas (PAs) have been declared since the passage of Law No. 102/1983 and the declaration of Ras Mohammed National Park (the first PA in Egypt in 1983). The present network covers almost 14.5% of the country's land and marine areas and physiographic regions, along with other sites of importance such as biodiversity hot spots, cultural heritage sites, geological formations and landscapes of outstanding natural beauty (Fouda et al., 2006; NCS, 2006b; Ghazali & GEPA MU Staff, 2008). The 28 PAs were selected according to specific criteria including biological value, habitat representation, structural/geologic value, cultural heritage value, importance to traditional cultures, research opportunity, educational opportunity, recreational value, economic value, urgency for protection (condition of area), degree of threat, management concerns (relationship with other programmes or parties) and enforcement potential (Baha El Din, 1998; NCS, 2006b). These criteria assess the degree to which each area contributes to the fulfilment of the objectives of the Protected Area network (Baha El Din, 1998; NCS, 2006b). Other considerations include location, size and shape determination, as well as the spatial relationship between individual Protected Areas (Baha El Din, 1998; NCS, 2006b). Based on the major sensitive habitats, the strategy categorized the Egyptian protected areas into four categories: Marine Protected Areas (six areas), Wetland Protected Areas (eight areas), Desert Protected Areas (10 areas) and Geological Protected Areas (four areas) (Hanafy, 2005; NCS, 2005).

With regard to the economic benefits of marine biodiversity, the revenues of marine activities and tourism, including diving, snorkelling and other activities, are more than € 3 billion per year (NCS, 2007, 2009). The economic benefits of coastal–marine tourism in Egypt go well beyond the direct revenue generated by the dive clubs and the snorkelling operators. Hotels and resorts prosper from diver–related tourism, as do other service industries like bars, cafes, launderettes and Internet cafes. Therefore, calculating the total economic benefits of coral reefs from the tourism industry involves much more than simply adding up the number of reef–related tourists and the value–add of the dive and snorkel industry (Herman, 2003). Additionally, the indirect benefits provided as ecosystem services should be considered (Costanza et al., 1997).

The importance of conserving marine biodiversity of Egypt prompted this study that was undertaken to analyse the status of Marine Protected Areas in Egypt, including both coasts of the Mediterranean and the Red Sea. For each MPA, taken into consideration are the general parameters (size, year of establishment, etc.), regulation and zoning, management resources, monitoring, education programs, problems and threats and socio–economic activities. Finally, general and specific recommendations are made for the management of the Egyptian MPAs that would help to improve the situation. Furthermore, an objective of this work was to analyse the total Egyptian marine surface protected. Additionally, as all the information that exists about the Egyptians MPAs is scattered, conflated and inconsistent and there is not a detailed database or document, another objective of this work was to collect, in one document, all the essential and current information about the Egyptians MPAs.

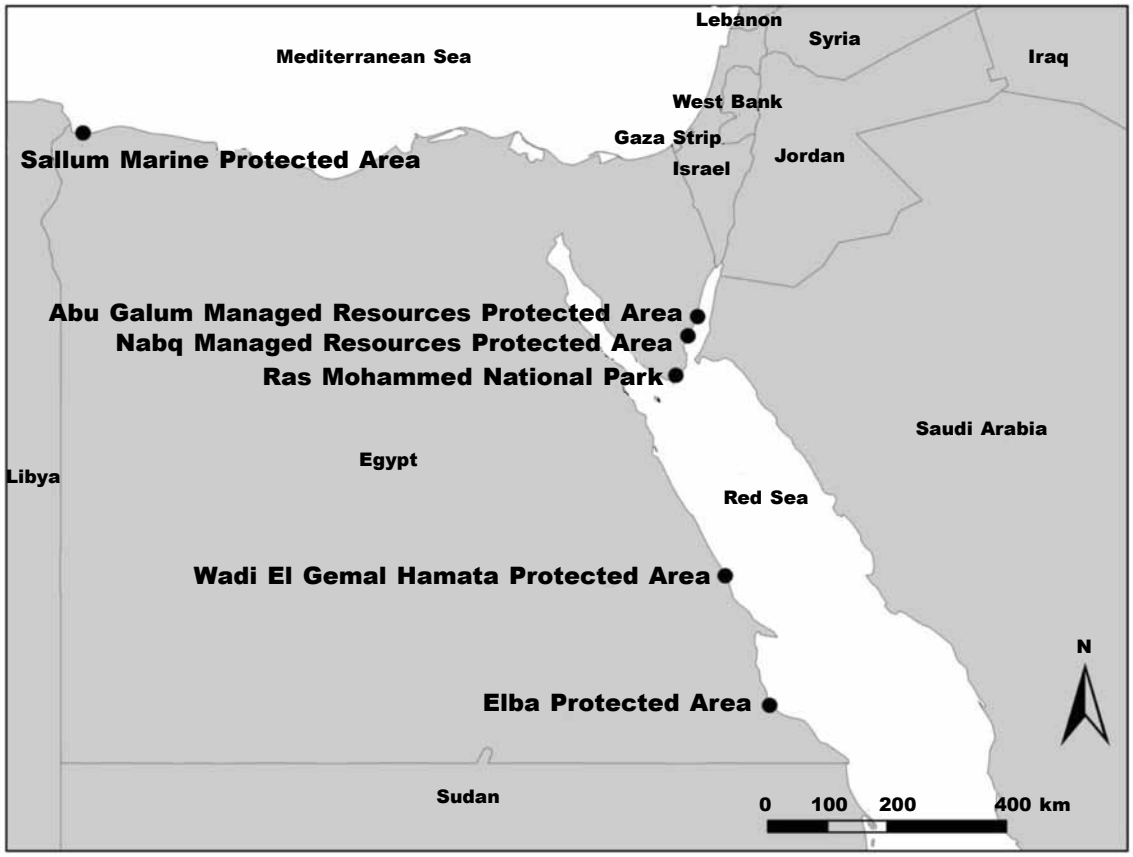


Fig. 1. Marine areas currently protected in Egypt.

*Fig. 1. Áreas marinas actualmente protegidas en Egipto.*

## Material and methods

### The study area

The study focused on the marine portion of the current protected areas (PAs) that are located within the Egyptian territorial waters, including the Mediterranean and the Red Sea. Other coastal protected areas that are located on the Egyptian Mediterranean coast (lagoons at the end of the Nile delta) were excluded; they are classified according to the EEAA as wetland protected areas as long as they are interior brackish waters and are only connected to the Mediterranean by narrow inlets.

To date, there are six MPAs in Egypt (fig. 1): Ras Mohammed National Park, Nabq Managed Resources Protected Area (including Dahab), Abu Galum Protected Area in South Sinai Governorate (in the Gulf of Aqaba), Gebel Elba Protected Area (including the Red Sea islands), Wadi El Gemal–Hamata Protected Area (in the Red Sea Governorate) and the recently declared Sallum Marine Protected Area, which is the first Egyptian MPA on the Mediterranean Sea coast (Herman, 2003; EcoConServ, 2004; Hanafy, 2005; NCS, 2005). They include interconnected marine and terrestrial sectors based on conserving coral reefs and accompanying systems, marine biome, mangrove bushes, marine islands and adjacent mountain and desert areas.

### Data collection

The study was mainly based on revision of bibliography (books, documents, articles, reports and other grey literature) to collect, for each MPA considered, the information about general description of the area (location, size, year of establishment, etc.), zoning and uses regulation, management resources, monitoring, problems and threats in the PA, socio–economic activities and benefits from the PA.

In spite of all the bibliographic data collected, some specific information of some MPAs was missing (i.e. current number of staff, current budget, etc.). This information was not published in any previous work, so it was necessary to conduct interviews with the directors and/or managers of some PAs. The interviews were different from one area to another depending on

the missing information. However, the main questions concentrated on the actual management resources. These interviews were carried out by phone or by email.

Spatial analysis

The surface of the marine portion of the PAs and of the closed areas/no–take zones (NTZs) of most of the protected areas studied were not specified in any of the consulted bibliography nor in the interviews, therefore they were estimated. The maps with the limits of each PAs were georeferenced in a geographic information system. Afterwards, the surfaces of the PAs and of the closed areas/NTZs were estimated.

## Results

Ras Mohammed National Park (RMNP, Red Sea)

Ras Mohammed National Park is the oldest and the best–known protected area of Egypt (NCS, 2006b, 2009). It was established as a National Park (IUCN Protected Area Category II) in 1983 by the Law No. 102 of 1983, decree 1068/1983, and adjusted by prime ministerial decree 2035 for 1996 with a total area of 836 km² (land portion: 239 km²; marine portion: 597 km², in which three closed areas cover 2.99 km²) (Fouda, 1984; Baha El Din, 1998; Pearson & Shehata, 1998; Shehata, 1998; Herman, 2003; PERSGA, 2004; NCS, 2006b, 2009). Coral reefs fringe Ras Mohammed from all directions and descend to 100 m into the sea (Baha El Din, 1998; Smith & McMellor, 2005; NCS, 2006b). Littoral habitats include a mangrove *Avicennia marina* community, salt marshes, intertidal flats and seagrass beds, as well as a diversity of shoreline configurations (Baha El Din, 1998; Hegazy et al., 2002; NCS, 2006b).

Fishing is prohibited in inshore areas, around Sharm El Sheikh and within the Ras Mohammed National Park. However, other recreational activities (such as diving, snorkelling and water sports) are allowed in the PA except in the three closed areas where only the scientific research is allowed (Wood, 2007; Sayed Abu Bakr, pers. comm.). Many monitoring programmes are conducted by the protected area staff including: coral reef, fishes, invertebrates and birds.

There are a total staff of 22 people in the PA, varying from a manager to researchers and ticket collectors. Moreover, the PA have the necessary infrastructures and equipment to conduct essential surveillance, monitoring programmes, scientific research and basic services and guidance for visitors such as: a visitor centre, a diving centre, a workshop, four laboratories, an experimenting hatchery, toilets, dry toilets, guiding and informational signs in all parts of the PA, maps on the main gate and visitor centre, also two patrolling boats, a research boat and a (4 × 4) car. However, the infrastructures are somehow old and need supporting and updating. On the other hand, the area receives about € 87,500/year from the government. All the income generated by the PA (approximately € 1,952,000/year) comes from entrance fees (about € 4 for foreign visitors and € 0.8 for Egyptians), collection of penalties and sanctions of any violation (Sayed Abu Bakr, per comm.). However, this finance generation goes to the central fund of the NCS.

Although all efforts are made, some problems and threats are still ongoing mainly from the tourism pressure on the area and direct physical impacts on the reefs caused by the visiting divers and snorkellers. Tourism activity in and around the Ras Mohammed National Park is intense, and several studies have estimated the carrying capacity of Red Sea reefs in this area (Hawkins & Roberts, 1994; Smith & McMellor, 2005), with the most prominent suggesting a carrying capacity of around 6,000 to 8,000 dives per year (Hawkins & Roberts, 1994). Even the sites receiving the lowest numbers of visitors exceed this by almost 100%, while the heavily dived sites exceed the recommended levels by over 10 times (Smith & McMellor, 2005). Kotb et al. (2004) reported major indirect threats from tourism in the form of landfills, dredging and sedimentation, sewage discharge and effluent from desalination plants, all associated with continued coastal development. Pollution caused by tourism boats including waste, garbage, plastic bags and water bottles, also forms a source of the problem. Furthermore, anthropogenic impacts on coral reefs can be assumed to be cumulative, with natural impacts causing coral deterioration in the area (Smith & McMellor, 2005).

Some benefits from the protection were detected within the PA, such as the higher abundances of several commercial species, particularly among the groupers (Roberts & Polunin, 1992). On other hand, Tawfik (2004) estimated that the recreational value of the coral reefs in only Ras Mohammed National Park amounted to about € 113 to € 152 million per year; this excludes the value of the many ecological services provided by coral reefs, and nor does it take into account the employment opportunities arising from tourism, such as recreational activities which the Ministry of Tourism estimated create about 200,000 jobs for every million visitors (Borhan et al., 2003; Tawfik, 2004).

Abu Galum Managed Resources Protected Area (AGMRPA, Red Sea)

The PA has been established as a Managed Resource Protected Area (IUCN PA management category VI) in 1992 by Law No. 102 of 1983, prime ministerial decree 1511 for 1992 declaration of the area, and adjusted by decree 33 for 1996 declaration of the whole Gulf of Aqaba (Egyptian Side) Natural Protectorate (Baha El Din, 1998; Herman, 2003; NCS, 2006b, 2009). The area has a total surface of 458 km² (land portion: 337 km²; marine portion: 121 km², in which four NTZs cover 52.72 km²) (Baha El Din, 1998; Herman, 2003; NCS, 2006b, 2009). The area includes a remote and pristine stretch of beach along the Gulf of Aqaba coast fringed by rich coral reefs and many adjoining marine and coastal habitats: seagrass, lagoon, spawning areas, rock and sand shores (Goodman & Meininger 1989; Ibrahim, 1993; Baha El Din, 1998; Herman, 2003; NCS, 2006b, 2009).

All recreational activities are allowed in the marine portion, while artisanal fishing is allowed only for local people (Bedouins). However, fishing is prohibited in 4 NTZs (Wood, 2007; Khaled El Haddad, per. comm.). Many monitoring programmes are conducted by the protected area staff and include coral reefs, bivalves, flora, fauna, and Bedouin settlement.

There is a total staff of 15 people in the PA, varying from a manager to researchers and ticket collectors. Moreover, the infrastructures and equipment in the area are considered poor to conduct the essential surveillance, monitoring programmes, scientific research and basic services and guidance for visitors. For instance, the area does not have its own patrol boat. The boat used for patrolling is owned by a NGO. They are expecting a new research boat from the government in the next few months. However, the area contains some infrastructures and equipment that could help in the meantime until sooner updates, such as a visitor centre and a house for staff with solar energy system and water tanks, toilets, shelters, garbage boxes, dumping site, cafeterias, a cabin car, computers, GPS. On the other hand, the area receives about € 7,000/year from the government (exceptionally about € 636,320 from the government for 2010/2011 to support the old infrastructures). All the income generated by the PA that comes from entrance fees (about € 2.4 for foreign, € 0.8 for Egyptian and camping € 8) and collection of penalties and sanctions of any violation (Khaled El Haddad, per. comm.) goes to the central fund of the NCS.

Fishing and tourism are the main socio–economic activities in the PA. With regard to fishing, landing sites are mainly in El–Rasasah, Hasat El–Hagar, El–Reheibat, El–Hebeisha, Om Faey, Makser Ayed and El–Sokhna area, where each place is about 1 km along the coast. The mean number of fishermen is about 10 fishermen/day; they use hand lines, nets and sometimes shell collecting. Catches are composed mainly of parrot fishes, some species from surgeon groupers, snapper, jacks, sweet lips, spangled emperor, sky emperor and big–eye emperor. Furthermore, the area has good tourism potentiality (400 visitors/day) in forms of diving, snorkelling and camping. The mean number of divers is 75–100 per day, while the mean number of campers is about 10 per day.

## Nabq Managed Resources Protected Area (NMRPA, Red Sea)

The Nabq Managed Resources Protected Area (NMRPA) was established as a Managed Resource Protected Area (IUCN PA management category VI) in 1992 by the Law N. 102 of 1983, prime ministerial decree 1511 for 1992 declaration of the area, and adjusted by decree 33 for 1996 establishing Dahab Marine Protected Area as part of NMRPA and declaration of the whole Gulf of Aqaba (Egyptian Side) a natural protectorate (Herman, 2003; Mabrouk, 2007; NCS, 2009). The area has a total surface of 586.5 km² (land portion: 464.6 km²; marine portion: 121.9 km², in which five closed areas cover 97.27 km²) (Mabrouk, 2007; NCS, 2009). The PA includes a variety of marine habitats, having one of the northern–most mangrove *Avicennia marina* communities in the world, coral reefs and seagrass (Ibrahim, 1993; Mabrouk, 2007; NCS, 2009; Riegel & Luke, 1997a).

The marine portion of NMRPA (excluding Dahab MPA) falls under four management zones of varying protection levels: strict natural zone, no–take zone, recreational zone and multiple use zone (Mabrouk, 2007). The strict natural zone (marine 91.27 km²) includes a scientific reserve for about 15 km of the coastline where all activities are prohibited except scientific research (Mabrouk, 2007). While four NTZs (marine 6 km²) cover about 5 km of the coastline where all fishing is prohibited, recreational activities (boating, scuba diving, snorkelling, reef walking), and scientific research are permitted (Benzoni et al., 2006; Mabrouk, 2007). Activities in Dahab MPA are not regulated. Many monitoring programmes are conducted by staff at the protected area. These programmes include: coral reefs, mangrove rehabilitation, flora, fauna, and Bedouin settlement (Mabrouk, 2007).

There are a total staff of 19 people in the PA, varying from a manager to researchers and ticket collectors. However, infrastructures and equipment to conduct the essential surveillance, monitoring programmes, scientific research are poor. For instance, the area has only one boat and one car for patrolling. Nevertheless, it has infrastructure and equipment for staff accommodation, basic services and guidance for visitors such as a visitor centre and 3 houses for staff, solar energy system and water tanks, toilets, shelters, two hand craft workshops for Bedouin products. The area receives around € 7,000/year from the government, while finance generation goes to the central fund of the NCS. The income generated by the NMRPA comes from entrance fees (about € 4 for foreign, € 0.8 for Egyptian), collection of penalties and sanctions of any violation (Khaled El Haddad, pers. comm.).

Although all efforts are made, some problems and threats still remain, generally by tourism, pollution and fishing (Mabrouk, 2007). Pollution in the form of solid wastes (mainly plastic bags and bottles) comes from tourists and the Bedouin community (Mabrouk, 2007). Also ships that pass the Gulf discharge the ballast water and generate pollution that drafts to the shore of the PA (PERSGA, 2001; Mabrouk, 2007). Physical contact by anchors and anchor chains of tourism boats and yachts are potential sources of coral reef damage (Mabrouk, 2007). Fishing in Dahab MPA is not regulated and causes a conflict with other recreational activities like diving and snorkelling (Ashworth & Ormond, 2005; Mabrouk, 2007). Moreover, local Bedouin women harvest invertebrates daily on shallow reef flats using a traditional metal spear (Ashworth & Ormond, 2005; Mabrouk, 2007). Finally, dugong and turtles are being caught as by–catch and hit by fast moving boats (Mabrouk, 2007).

Fishing and tourism are the main socio–economic activities in the PA. The fishermen village, El Ghargana, is the only settlement of Bedouin on Nabq coast and is the main landing place of all fishermen. The

number of permanent fishermen is around 20, but increases up to 40 in summer time, with a total yield from each fishing site that ranges between 1.9 and 6.2 t $km^{-2}$ $yr^{-1}$ (Mabrouk, 2007). Catch is composed of Scaridae, Siganidae, Acanthuridae, Lethrinidae, Mugilidae, Kyphosidae, Haemulidae, Labridae and Serranidae (Mabrouk, 2007).

Some benefits from the protection were detected within the PA. Since 1995, fishery has been regulated, and after five years of protection the abundance of the main target fish families was found to be significantly greater (Galal, 1999; Galal et al., 2002). However, 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. Moreover, the high diversity of the area gives it tourism potential with an average of 18,000 visitors/year (Mabrouk, 2007). The area depends on three main recreational activities: diving, snorkelling and wind surf.

Wadi El Gemal–Hamata Protected Area (WEGHPA, Red Sea)

Wadi El Gemal–Hamata Protected Area (WGHPA) has been established as National Park (IUCN Protected Area Category II) in 2003 by the Law No. 102 of 1983, and prime ministerial decree 134/2003 (Baha El Din, 2003). It has a total area of 7,450 km² (land portion: 5,850 km²; marine portion: 1,600 km², in which three NTZs cover 305.57 km²) (Baha El Din, 1998, 2003; Herman, 2003; Mansour, 2003; NCS, 2009). The shores of the region are heterogeneous in nature, encompassing rocky, sandy and muddy beaches (Baha El Din, 1998, 2003; Mansour, 2003). The marine part of the protected area encompasses a strip of marine waters of an average width of 15 km along 110 km of the coast. This marine portion includes all the important coral reefs in the region, as well as marine islands, seagrass meadows, mangrove stands, intertidal pavement with algae, intertidal sand (Baha El Din, 1998, 2003; Mansour, 2003).

The marine area falls under four management zones of varying protection levels: Strict natural zone, No–take zone, Recreational zone and Multiple use zone (Baha El Din, 2003). All fishing forms are prohibited in the three NTZs, while the recreational activities (boating, scuba diving, snorkelling, reef walking) and scientific research are permitted (Baha El Din, 2003). Many monitoring programmes are conducted by the protected area staff including coral reefs, mangrove rehabilitation and mooring maintenance, which are performed by a NGO called HEPCA (Hurghada Environmental Protection and Conservation Association) (USAID/Egypt, 2008).

There is a total staff of 50 people in the PA, varying from a manager to researchers and technicians. Moreover, the area contains good infrastructures and equipments to conduct the essential surveillance, monitoring programmes, scientific research, accommodation for staff, basic services and guidance for visitors such as: a central administration office, a conference hall, a visitor centre, houses for staff, toilets, kitchen, also seven (4 x 4) vehicles, four patrol boats, heavy machinery (two soil–moving equipment, one truck), communications (three satellite phones, three mobile phones made available until radio network established), computers… (Baha El Din, 2003; USAID/Egypt, 2008). Furthermore, the area is funded from a combination of sources: the government (EEAA) (that provides 28% of the budget that is dedicated to salaries of permanent staff), the Samadai Fund of the Red Sea Governorate (36%) and USAID (The United States Agency for International Development) funding from the LIFE Red Sea Project (28%). In addition, the park receives in–kind support for mooring maintenance at dive sites from a NGO (HEPCA) (8%) (Baha El Din, 2003; USAID/Egypt, 2008). The total budget provided by the previous funding sources in 2008 was about € 131,750, while the income generated by the PA in 2007 was about € 2,959,595. This revenue comes from fees (for tour boats and diving operators about € 1.5 per person), collection of penalties and sanctions of any violation (USAID/Egypt, 2008), and goes to the central fund of the NCS.

Ongoing problems and threats are generally due to tourism, pollution and fishing (Baha El Din, 2003). In areas without buoy moorings, many boat crews temporarily moor their vessels to reefs using steel that is a potential source of coral reef damage (Baha El Din, 2003). Many forms of pollution are impacting the PA, including solid waste (mainly plastic bags and bottles) coming from tourists and the Bedouin community. In addition, there are no approved sewage outfalls in the PA (Baha El Din, 2003). On the other hand, Barrania & Ibrahim (2003) reported that non–indigenous fishermen in the PA have introduced gill nets named 'sabeeb' that have a smaller mesh size than that legally permitted. They also use ring nets on corals that can lead to physical destruction. Riegel & Luke (1997b) also reported that a very small number of fishermen may still use explosives. Furthermore, dugong and turtles are being caught and hit by fast moving boats.

Fishing and tourism are the main socio–economic activities in the PA. Generally, fishing is not a traditional activity of the local people. However, two groups target fishery resources in the PA: local fishermen (the Ababda tribe is the only tribe that has fishing traditions among the local people) and migratory fishermen from other governorates (Baha El Din, 2003). The principal fishing methods used by the traditional fishermen are hand lines, gill nets and trammel nets, while the new settler fishermen are replacing the traditional fishermen, and have less knowledge about the local ecology and sustainable fishing practices, and use some illegal fishing tactics (Baha El Din, 2003; Barrania & Ibrahim, 2003). The main target species by both fishermen groups are: groupers, snappers and grunts (Baha El Din, 2003). There are three main landing sites in the PA: Sharm El Luli (11 boats/55 fishermen), Qulan Village (four boats/20 fishermen) and Hamata Harbour (10 boats/50 fishermen) (Baha El Din, 2003; Barrania & Ibrahim 2003). On the other hand, the area has potential tourism activities concentrated mainly in the marine environment, with only 10% in the terrestrial environment. In 2007, the total

number of visitors was 69,860 with the most important activities being diving (27,631 divers) and snorkelling (23,357 snorkellers) (Mohammed Besar & Mohammed Abbas, pers. comm.). Dive boats regularly visit the reefs in the area and the numbers of boats and visitors are increasing in correlation with the establishment of new hotels (USAID/Egypt, 2008; Mohammed Besar & Mohammed Abbas, pers. comm.).

Elba PA (including Red Sea Islands PA) (EPA, Red Sea)

The Elba Protected Area was established as a managed resources protected area (IUCN PA management category VI) in 1986 by the Law No. 102 of 1983, prime ministerial decree 450 for 1986 declaration of the area, and adjusted by prime ministerial decree 1186 for 1986 and prime ministerial decree 642 for 1995 (Ghazali & GEPA MU Staff, 2008; NCS, 2009). The area has a total surface of 26,500 km² (land portion: 24,500 km²; marine portion: 2,000 km², closed area surface could not be estimated) (Marchetti & Genena, 2002; USAID/Egypt, 2007; Ghazali & GEPA MU Staff, 2008; NCS, 2009). The coast and the 22 islands included within the PA support a diverse terrestrial flora and fauna, as well as a rich marine ecosystem including: rocky shoreline, sandy shores, tidal flats, lagoons, salt marsh, mangroves, extensive fringing reefs and seagrass beds (Goodman, 1985; Arnold, 1997; Baha El Din, 1997a; 1997b, 1998; Mekki, 1997; Marchetti & Genena, 2002; USAID/Egypt, 2007; Ghazali & GEPA MU Staff, 2008).

The marine area falls under four management zones of varying protection levels: Strict natural zone, No–take zone, Recreational zone and Multiple use zone (Ghazali & GEPA MU Staff, 2008). Many monitoring programmes are conducted by protected area staff, and include: coral reefs, mangrove rehabilitation, flora, fauna, Bedouin settlement (Usama El Ghazali, pers. comm.).

There is a total staff of 59 people in the PA, varying from a manager to researchers and technicians. Although the area contains good infrastructures and equipment such as: a visitor centre, a field station, five outputs/control unit, six (4 x 4) vehicles, three patrol boats, they are considered somewhat poor because of the vast surface area which needs more infrastructure and equipment to conduct the essential surveillance (Ghazali & GEPA MU Staff, 2008). The area receives about € 28,000/year from the government, in addition to USAID/LIFE Project that currently involves in developing some activities in GEPA, including handicrafts, solid waste management and public awareness (Marchetti & Genena, 2002; Ghazali & GEPA MU Staff, 2008). Finance generation comes from entrance fees, collection of penalties and sanctions of any violation and the sale of PA products such as handicrafts (Marchetti & Genena, 2002; Ghazali & GEPA MU Staff, 2008). As in all PAs, all the income generated goes to the central fund of the NCS.

Some problems and threats continue in the PA, caused generally by fishing, tourism and pollution. Fishing activities in the region are unsustainable because of the illegal fishing techniques and equipment (the case is the same as WGHPA) (Marchetti & Genena, 2002; Ghazali & GEPA MU Staff, 2008). In addition, as the PA currently does not have potential tourism, it is perceived not to have economic value, thus there is little incentive for decision makers to embrace and support protection of the area (Jameson et al., 1999; Marchetti & Genena, 2002). Finally, pollution in the form of haphazard disposal of solid waste of urban settlements remains a problem because there are no solid waste management systems and waste is thus dumped haphazardly (Marchetti & Genena, 2002; Ghazali & GEPA MU Staff, 2008).

Fishing is the main socio–economic activity in the PA. However, it is not a traditional practice of the local tribes as most do not consume fish as part of their diet. Most fishing is done by the Ababda tribe, which is the only tribe that has fishing traditions, and by commercial fishing boats that come from outside the region (Marchetti & Genena, 2002; Ghazali & GEPA MU Staff, 2008).

Sallum MPA (SMPA, Mediterranean Sea)

Sallum is the first Egyptian MPA on the Egyptian Mediterranean coast, established in March 2010 by Law No. 102 of 1983 and prime ministerial decree 533 for 2010 declaration of the area. It has total area of 1064.2 km² (land portion: 80 km²; marine portion: 984.2 km²) (Environics, 2009). The area encompasses marine and coastal habitats including tidal flats, coastal plains, seagrass meadows, and shallow and intermediate depth marine habitats (Environics, 2009). Three zones have been proposed: core, buffer, and transition as a management zoning scheme for the recently declared area (Environics, 2009).

Many criteria were used for Sallum to be declared as a marine protected area: i) the uniqueness and rarity of the protected area that entails unique habitats and geographical features, as mentioned previously; ii) its biological diversity (over 160 species of resident and migratory avifauna, 30 species of reptiles and amphibians, 57 species of macrobenthic organisms and at least 55 commercial marine species including molluscs, crustaceans and fish) and its importance for threatened, endangered and declining species (over 30 species of mammals, some of which are endangered, five marine species of special and global concern, in addition to 11 terrestrial species listed in the Red list of the IUCN 2008); iii) its representativeness of marine and coastal environments, habitats and species of the Mediterranean Sea; iv) the connectivity that it provides, as it is associated and geographically closely linked with similar environments in the countries of the Mediterranean region, which qualifies the area to be a part of the Mediterranean Sea network of marine protected areas; and v) it will replicate similar zones that will be declared at the local level: El Shuwaila and Ras El Hekma, which are proposed within the plan of the Egyptian protected areas network (Environics, 2009).

Fishing and tourism are the main socio–economic activities in the PA. Fishermen are the most important category of users of the marine resources of the Gulf of Sallum, and they depend on these resources as a

Table. 1. Marine habitats represented in the marine protected areas network, and habitats recommended to be incorporated in the future: RMNP. Ras Mohammed National Park; AGPA. Abu Galum Protected Area; NMRPA. Nabq Marine Resources Protected Area; WEGHPA. Wadi El Gemal Hamata Protected Area; GEPA. Gabal Elba Protected Area; SMPA. Sallum Marine Protected Area.

*Tabla 1. Hábitats marinos representados en la red de áreas marinas protegidas y hábitats que se recomienda incorporar en el futuro. (Para las abreviaturas, ver arriba.)*

| | Red Sea | | | | | Med. Sea |
|---|---|---|---|---|---|---|
| Habitats | RMNP | AGPA | NMRPA | WEGHPA | GEPA | SMPA |
| Coral reefs | X | X | X | X | | |
| Reef Fringing | X | | | | X | |
| Seagrass meadows | X | X | X | X | X | X |
| Mangrove stands | X | | X | X | X | |
| Sandy shores | X | X | | X | X | |
| Muddy shores | | | | X | | |
| Rocky shores | | X | | | X | |
| Tidal flats | | | | | X | X |
| Intertidal flats | X | | | | | |
| Intertidal sand | | | | X | | |
| Intertidal pavement with algae | | | | X | | |
| Subtidal sand | | | | X | | |
| Salt marshes | X | | | | X | |
| Lagoons | | | | | X | |
| Coastal plains | | | | | | X |
| Islands | X | | | X | X | |
| Pelagic habitats | | | | X | | |
| Shallow marine water | | | | | | X |
| Intermediate marine water | | | | | | X |
| Detritic bottoms | | | | | | |
| Coralligenous | | | | | | |
| Bathyal sands | | | | | | |
| Bathyal muds | | | | | | |

major source of income (Environics, 2009). According to the statistics of 2007, most of the 49 licensed fishing boats (few are powered and most are sailed) are currently registered in the Department of Matrouh. However, there are another 30 boats registered in the East Port of Alexandria that were fishing in the region of Matrouh to Sallum (Environics, 2009). The main fishing gears used are fishing nets, long lines and some bottom trawls. There is no service to the industry such as refrigerators; even the process of selling and marketing the catch depends on the fish market in the east port of Alexandria (Environics, 2009). The total number of commercial species in the Gulf was 55 (five molluscs, three crustaceans, five cartilaginous fish and 42 bony fish) (Environics, 2009). With regard to tourism, the town is the western entrance to Egypt and receives about 7,000 tourists yearly in the winter and 10,000 tourists in the summer, mostly from North African neighbours such as Libya, Tunisia and Algeria (Environics, 2009).

## Discussion

Assessment of the present status of MPAs showed a set of important findings manifested in some strengths and weaknesses in the network of the Egyptian MPAs. Generally, MPAs in Egypt are meeting some of their conservation objectives despite the many difficulties that they have. They also have been properly selected according to many criteria that are listed by several authors (Kelleher & Kenchington, 1992; Day

Table 2. Allocation of staff and budget in the marine protected areas. (For abbreviations, see tble 1.)

*Tabla 2. Asignación de personal y presupuesto en las áreas marinas protegidas. (Para las abreviaturas, ver tabla 1.)*

| | RMNP | AGPA | NMRPA | WEGHPA | GEPA |
|---|---|---|---|---|---|
| Annual budget | € 87,500 | € 7,000 | € 7,000 | € 37,000 | € 28,000 |
| Number of staff | 22 people | 15 people | 19 people | 50 people | 59 people |
| Area km² | 836 km² | 458 km² | 586.5 km² | 7,450 km² | 26,500 km² |
| Annual budget/100 km² | € 10,466 | € 1,528 | € 1,193 | € 497 | € 105 |
| Person/100 km² | 2.6 people | 3.3 people | 3.2 people | 0.7 people | 0.2 people |

& Roff, 2000), such as their biological value, habitat representation, geologic value and recreational value. These criteria allowed the objectives of the Protected Area network to be met. The good selection is clearly evident in the MPAs networks of the Red Sea, which are well located and have a good connection since the whole Gulf of Aqaba is protected with south Sinai MPAs (Ras Mohammed, Nabq and Abu Galoum) and the south of the Red Sea MPAs (Wadi el Gemal and Elba including Red Sea islands). Even the newly created Sallum MPA is well located, taking into account the adjacent Ras El Hekma and El Shuwaila proposed areas, which are planned for the near future (around 2014) (Environics, 2009).

Monitoring programmes in the MPA network are adequate for assessing the status of protected habitats and existing resources, and the PA Management Unit staff's technical skills are generally good. Furthermore, as it is a serious concern to prepare a management plan for all MPAs to track effective management or develop a business plan (Kelleher & Kenchington, 1992; Thomas & Middleton, 2003), management plans are already available for four MPAs (Ras Mohammed NP, GEPA, NMRPA and WGHPA) out of the six MPAs. Additionally, an advanced business plan is already available for WGHPA.

The MPAs in Egypt had many international initiatives to promote marine protection including international and regional programs (*e.g.* UNDP, GEF, etc.), projects (*e.g.* a project to assess the coastal area of Sallum to be declared as MPAs carried in 2009 under association with IUCN, also currently ongoing since 2008 the Life Red Sea project in both WGHPA and GEPA), organization (*e.g.* IUCN, PERSGA, etc.) and cooperation with other countries (Egyptian–Italian's cooperation in the form of BioMap project in the end of nineties) (Marchetti & Genena, 2002; PERSGA, 2004; NCS, 2006b; USAID/Egypt, 2007, 2008). The managers, rangers and staff members at MPAs have taken advantage of the involvement in such initiatives (courses, workshops, conferences, campaigns for evaluation of resources and biodiversity, etc.) and many of them have received training in Egypt or abroad, others have obtained PhDs or master's degrees (NCS, 2006b).

In the last 20 years, the network of MPAs of Egypt has achieved a good reputation and has attracted tourism as one of the best and most important spots for diving and recreation all over the world (Borhan et al., 2003; Tawfik, 2004; Mabrouk, 2007; USAID/Egypt, 2008). During this time, Egypt has increasingly been seen as a regional model for other Arab states and Middle Eastern countries in terms of protected–area management and biodiversity protection.

From another perspective, the Egyptian MPAs network has some negative and weak points. Egypt has protected about 5,424.1 km² of the 56,981 km² of Egyptian marine territorial waters, a relatively small proportion (only 9.5%), which is under the 10% to 20% recommended by IUCN and others (Ballantine 1991; Kelleher et al., 1995; Roberts & Hawkins, 2000; Sánchez Lizaso et al., 2000). In addition, the total area of NTZs (which reflect the real protection) is about: 1,052.55 (without considering GEPA and Sallum PA) of the 56,981 km² of the Egyptian marine territorial waters, a very small proportion (only 1.85%). Moreover, the MPA network protects a disparity representation of Egyptian marine habitats and ecosystems, concentrated on the Red Sea coast, and still has only one MPA (Sallum MPA) on its Mediterranean coast protecting about 984.2 km² of the 26,125.8 km² of Egyptian Mediterranean territorial waters (only 3.77%) (table 1). Many other habitats still need to be more represented inside the MPAs of Egypt (*e.g.* rocky habitats, bathyal habitats and pelagic habitats). Therefore, it is recommended to incorporate more habitats into the network, especially the Mediterranean Sea habitats that are not yet protected (detritic bottoms, coralligenous, bathyal sands and bathyal muds) (table 1). On the other hand, adding these habitats will raise the proportion of the protected territorial water taking into account to close more area as NTZs inside the MPAs.

Most of MPAs in Egypt are under–resourced, far below the norm for developing countries or even for Africa. The main limitations to effective management

are considered to be the very low levels of government funding, the fewer staff than needed and a disparity allocation of both funding and staff (table 2). Inadequate management resources and poor infrastructure facilities are also important constraints. Moreover, the income of each MPA goes to a central fund in the NCS that subsidises other PAs in the whole Egyptian PAs network that do not generate funds. The five MPAs (of the Red Sea) can sustain themselves through tourism income, while the money reinvested in each MPA is less than 10% of what it generates. For instance, Ras Mohammed Marine Park generated about € 1,538,752 in finance year 2004–2005, of which only about € 156,060 was reinvested in the park (Harper, 2006). Governments should provide core support to their MPAs for essential requirements (Kelleher, 1999; Roberts & Hawkins, 2000). Hence, there is an urgent need to increase funding of Egypt's MPA network, and to ensure that it is addressed by the government of Egypt in a sustained long term manner. Also, the involvement of NGOs and the private sector, 'Friends of Parks', corporate sponsorships and private donations are viable approaches in declining budgets and worsening economic situations and have a good experience of success in many countries (Kelleher, 1999; Riedmiller, 1998, 2003; Mulongoy & Chape, 2004). There is also the need to move away from external funds, such as funding by donors, which is primarily on a project–by–project basis and for a relatively short period of time. Finally, entrance fees to these MPAs are significantly lower than fees for comparable natural attractions in other developing countries. It is therefore recommended to increase entrance fees for each MPA to be equivalent to their comparable developing countries. The MPAs should have a good sea–going capacity, with offshore research and monitoring facilities. Also a comprehensive staff audit should be undertaken in the near future to review the disposition of staff in the PA system.

At the beginning of this decade, there were some initiatives to evaluate different services provided by marine ecosystems. These included both management and exploitation costs (*e.g.* user investment, stakeholders, such as diving centres, other recreational activities, etc.), especially evaluation of coral reefs and mangrove areas in the Red Sea as they are considered the most important ecosystems in the Egyptian waters (Herman, 2003).

These studies showed that by far the most important use for reefs is as tourist attractions, although the reefs do have value for fishing, shoreline protection, research and other uses. Because the reefs are such an important component of nature–based tourism, and because such tourism is a crucial component of Egypt's strategy for sustainable tourism development, it is vital that the reefs be protected from overuse and abuse that would undermine a key asset for Egypt and its economy. Results of these studies indicate that investing in reef protection will prove profitable, as the reefs are a key part of Egypt's tourism development strategy. Protecting Egypt's world–class reefs would mean that, year after year, the Red Sea would continue to attract the diving community, who spend significantly more money for their vacations than do average tourists (Herman, 2003).

These studies provided decision–makers with a potent piece of information that supports the fundamental principle that, in the long run, investing in protecting and managing the environmental and natural resource base that supports tourism in the Red Sea will be good for Egypt's economy. Recently, the NCS has realized the importance of the economic issue (cost–profit management) and an advanced business plan is already available for WGHPA awaiting the preparation of such plans for the rest of MPAs (Herman, 2003; USAID/Egypt, 2008).

Although all efforts are made by the NCS to protect the marine biodiversity and marine resources of Egypt, there are four major threats that are still impacting MPAs in Egypt: recreational use, coral reef deterioration, pollution and illegal fishing. These activities will continue to threaten the resources within PAs until some actions are taken to go ahead to solve these issues.

It is obvious that the continued development of the tourism industry is the major and most threatening pressure on MPAs in Egypt (Baha El Din, 2003; Smith & McMellor, 2005; Mabrouk, 2007), since it is a common cause of all other threats such as pollution caused directly by tourists (littering) or indirectly from landfills, dredging and sedimentation, sewage discharge and effluent from desalination plants (Baha El Din, 2003; Kotb et al., 2004; Mabrouk, 2007; Ghazali & GEPA MU Staff, 2008). Also coral reef deterioration by physical impacts on the reefs caused by divers, snorkellers and anchor chains in coral reef areas (Baha El Din, 2003; Smith & McMellor. 2005; Mabrouk, 2007). Therefore, to mitigate the problem it is necessary to establish a tourism capacity for each area, and limit the number of tourists, although this will affect the income of these PAs since it comes mainly from tourism. The conservation and management of coral reefs is a priority issue in Egypt, since it is the most important source of income to MPAs through tourism and diving activities. A certain number of diving activities per day according to the carrying capacities of each area and coral reef cover should be implemented. Direct anchoring should be prohibited on coral reefs.

Pollution within PAs is made up of two sources: tourism (in the form of littering, solid wastes and sewage), and oil spills (made by vessels passing through the Red Sea) (PERSGA, 2001; Bashat, 2003). Hence, some actions should be taken such as: the implementation of on the spot fines for littering and solid wastes; no discharge of sewage into the sea or on land and no discharge of liquid or solid waste should be allowed from vessels in or adjacent to the PA; in addition, all sewage should be treated and sludge can be used as fertilizer; finally, the protected area management unit should conduct regular patrols to ensure that vessels operating in the PA do not dispose of liquid or solid waste and do not produce oil discharge.

Illegal fishing mainly consists of artisanal fishing either by local Bedouins or the non–indigenous fis-

hermen coming from outside the area (Baha El Din, 2003; Mabrouk, 2007; Ghazali & GEPA MU Staff, 2008). The relationship and communication between MPA rangers, responsible authorities and Bedouin should be fostered. Moreover, increasing patrols, especially at night, would help to alleviate this problem, as boats of non–indigenous fishermen were often fishing in the early hours of the morning while there is no surveillance. All fishermen active in each PA should receive a license from the EEAA and be registered by the Protected Area Management Unit (PAMU). If any violation occurs, deterrent fines and sanctions should be implemented.

Egyptian MPAs are individually vulnerable as a result of poor law enforcement. The PAMU can detect violations, but then the law is not applied because they have to rely on the police and the judiciary to carry it through. In addition, the low support from the local communities elevates the problem because they do not respect the MPA regulation. The NCS should take an active role in discussions and agreements with the police and judiciary, at local and national levels, to ensure the detection of violations and the application of law. Also, the community outreach programmes should be improved in all PAs to ensure that local stakeholders benefit from support and participate in the PA's management. Finally, regular consultations should be maintained with indigenous community representatives, such as tribal leaders (sheikhs).

## Conclusion

The network of MPAs of Egypt is generally good, having the principal bases such as a sufficient legal framework, good selection of PAs, protection of essential habitats and resources, well trained staff, management plans, and a very high attraction of tourism providing a high income. All these aspects are conducive to aiding a good environment for effective management and protection of the natural resources and marine habitats. However, some constraints need to be addressed for the correct management of these PAs: mainly the lack of management resources and funding, and some impact problems. Finally, once the current problems are solved and by the declaration of the proposed PAs in the near future (the Egyptian Red Sea coast will be totally protected, and two new MPAs on the Mediterranean Sea coast, will increase the proportion protected over the 10% recommended by the IUCN), the Egyptian MPA network might become a good example of coastal management.

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