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UNESCO Region:

SITE NAME: **Wadi Al-Hitan (Whale Valley)**

DATE OF INSCRIPTION: 15th July 2005

STATE PARTY: EGYPT

CRITERIA: N (i)

DECISION OF THE WORLD HERITAGE COMMITTEE:

Excerpt from the Decisions of the 29th Session of the World Heritage Committee

Criterion (i): Wadi Al-Hitan is the most important site in the world to demonstrate one of the iconic changes that make up the record of life on Earth: the evolution of the whales. It portrays vividly their form and mode of life during their transition from land animals to a marine existence. It exceeds the values of other comparable sites in terms of the number, concentration and quality of its fossils, and their accessibility and setting in an attractive and protected landscape. It accords with key principles of the IUCN study on fossil World Heritage Sites, and represents significant values that are currently absent from the World Heritage List.

BRIEF DESCRIPTIONS

Wadi Al-Hitan, Whale Valley, in the Western Desert of Egypt, contains invaluable fossil remains of the earliest, and now extinct, suborder of whales, the archaeoceti. These fossils represent one of the major stories of evolution: the emergence of the whale as an ocean-going mammal from a previous life as a land-based animal. This is the most important site in the world for the demonstration of this stage of evolution. It portrays vividly the form and life of these whales during their transition. The number, concentration and quality of such fossils here is unique, as is their accessibility and setting in an attractive and protected landscape. The fossils of Al-Hitan show the youngest archaeocetes, in the last stages of losing their hind limbs. They already display the typical streamlined body form of modern whales, whilst retaining certain primitive aspects of skull and tooth structure. Other fossil material in the site makes it possible to reconstruct the surrounding environmental and ecological conditions of the time.

1.b State, Province or Region: Faiyum Governorate

1.d Exact location: N30 11 00.0 E29 20 00.0

Arab Republic of EGYPT
Ministry of Higher Education
Egyptian National UNESCO Commission
Egyptian National MAB Committee

NOMINATION FILE

For the Inscription of

WADI AL-HITAN

(WHALE VALLEY),

THE WESTERN DESERT

OF EGYPT

On the Natural World Heritage List

Cairo, Jan. 2004

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1. Identification of Property

a. Country

Arab Republic of EGYPT

b. State, Province or Region

The Western Desert of Egypt, Faiyum Governorate

c. Name of Property

WADI AL-HITAN (WHALE VALLEY)

d. Exact location on map and indication of geographical coordinates to the nearest second

Note on the Geographic situation of Whale Valley (Egypt)

The proposed site is defined in the Nomination File by four sets of coordinates, labelled Points 1-4.

Point	Long. E ° ' "	Lat. N ° ' "
1	30 11 00	29 20 00
2	30 11 00	29 13 00
3	30 01 00	29 13 00
4	30 01 00	29 20 00

e. Maps and/or plans showing boundary of area proposed for inscription and of any buffer zone

Fig. 1 – Map produced of satellite image of Wadi Al-Hitan (Whale Valley), Wadi El-Rayan Protected Area, Faiyum Governorate, proposed World Heritage Site showing approved boundaries of core area (red rectangle) and buffer zone (yellow rectangle). The boundaries of the Wadi Al-Rayan Protected Area (WRPA) are shown by a green line. Original scale 1:100,000, annexed to Nomination File. Scale of A4 reduction: ~ 1:579,000. Map prepared by EGSMA (Egyptian Geological Survey and Minerals Authority).

2 – Egyptian Survey, Geographical Map Section. Topographic map. Qaret Gahannam, sheet 72/48, 1945. Scale 1:100,000, annexed to Nomination File.

Fig. 3a –Satellite image: Whale Valley within a 15x15 km area in WRPA. Scale; 1:600,000, showing some of the threatened sites and a 15x15 km area where whale fossils are concentrated (courtesy of Mr. J. Dolson). This area *is not* the proposed area for the World Heritage Site.

Fig. 3b – Enlarged part of previous map, scale 1:120,000, showing the well developed desert road from park entrance past Gebel Gahannam, position of some whale skeletons, and approximate location of whale and sirenian (sea cows) skeletons (courtesy Mr. J. Dolson).

Fig. 4 – Location map of Wadi Al-Hitan in relation to Cairo (courtesy Mr. J. Dolson).

Fig. 5 – Map of WRPA. The fossil whale area shown is approximately 35 km west of the entrance to the park, but the road winds for about 45 km (courtesy Egyptian-Italian Environmental Programme, EIEP).

Fig. 6 – Map of 38 whale skeletons and location of heavily mangrove rooted ancient shoreline within the core area. Numbers for location are eastings and northings in meters (after Dolson *et al.* 2002).

f. Areas (ha) and perimeters (km) of property proposed for inscription and proposed buffer zone

Core Area: 200.15 km² (20,015 ha)
Buffer Zone: 58.85 km² (5,885 ha)

2. Justification for Inscription

Note 1:

This Nomination File for the inscription of Egypt's Wadi Al-Hitan (Whale Valley) on the Natural World Heritage List is to be considered as an Egyptian initiative to implement the Decisions of the 25th Session of the World Heritage Committee, Helsinki, Finland, December 2001, Concerning Desert Landscapes (see p. 61), the Recommendations of the World Heritage meeting on desert landscapes, in Kharga Oasis, Egypt, of 2001 and the UNESCO Ghardaia meeting in Algeria of 19-21 April 2003, on the role of desert landscapes in promoting ecotourism and the alleviation of poverty.

Note 2:

Very recently, Egypt announced that the official name of Fayoum should be spelt as "Faiyum" and Wadi el-Rayyan as "Wadi El-Rayan". We nevertheless follow in this text the spelling "Fayoum", for purposes of concordance with older literature, but retain the use of the spelling "Rayan". Moreover, the Arabic words Gabal, Gebel, Jabal, and Jebel (= mountain) are used according to how they are written on maps.

Note 3:

The naming of Wadi Al-Hitan passed through three phases. It was first named Zeuglodon Valley by its discoverer Beadnell (1905), after the whale genus *Zeuglodon* was found there. Because *Zeuglodon* was later renamed *Basilosaurus*, the name Zeuglodon Valley had to be abandoned, but it is still used in some non-scientific writings, just as nostalgia. When Philip Gingerich came in the late 1980's he called it Whale Valley. A few years later the Arabic translation of that name, Wadi Al-Hitan, was officially adopted by the Egyptian Government as well as by foreign researcher workers.

a. Statement of significance

The main area of significance in accordance with the principles of the World Heritage Convention, for the inscription of Egypt's Whale Valley is that the fossil species give us a lot of useful information about how the environments of these sites looked like millions of years ago, and hence give us an indication of an important part of the history of the earth, the Age of Whales, and how life evolved on Earth, following water courses of ancient rivers, and wetlands of the ancient coastlines. With more intensive studies, if the sites are protected, we can perhaps find answers to the riddle of how mammals went into the sea.

Continuity is important for tracing evolutionary lineages through geological time. Modern Odontoceti and Mysticeti can be traced backward in time to Eocene Archaeoceti, and before them to mesonychian Condylarthra. Within this shared continuum, the origin of Archaeoceti and the origin of Cetacea is marked by the first indication of a derived evolutionary transition-in-grade from terrestrial to aquatic life characteristic of later cetaceans. Archaeocetes are known from many fossil localities in Eocene marginal marine and shallow marine strata on six continents. These range in age from Priabonian (late Eocene; ca. 36 Ma) through late Ypresian (late early Eocene; ca. 49.5 Ma), a 13.5 my. time range, and they are widely distributed in North America (18 sites), Europe (5 sites), Asia (8 sites), Africa (8 sites), Australia (New Zealand; 2 sites), and Antarctica (1 site). Forty-two sites can be considered statistically-independent records.

The large number of whales of various species at Wadi Al-Hitan does not only reveal stages in their anatomical evolution, but also indicates that they had already become masters of the seas and had developed their habits and their social behaviour and had explored the world's oceans so well as to where were the best calving grounds, and what was the best season to migrate there, followed by their whale predators. It must have been a ritual that had lasted for several million years.

b. Possible comparative analysis (including state of conservation of similar sites)

It is not possible of course to give a comprehensive comparison of the Wadi Al-Hitan Site with all other fossil sites in the world, so only glimpses of the most important will be treated here.

b.1 – Comparison inbetween Egyptian Sites

The other site in Egypt giving a similar multi-epoch sequence is Gebel Qatrani (Bown *et al.* 1982). A Nomination File for its inscription on the World Heritage List in Danger is to be submitted shortly. It will be submitted separately for inscription on the World Heritage List in Danger because it is exposed to more serious threats than the four Oases under discussion, and for another obvious reason, that it is not an oasis, and hence cannot be included in the Northern Oases Serial Nomination.

b. 2 - The comparative formation of Egypt's Whale Valley:

Sampsell (2003) gave a concise history of the formation of Egypt's Whale Valley. A new hypothesis that answers questions about both timing and mechanism has been proposed on the basis of data obtained by space satellites. Radar has detected the remains of all drainage channels (the so-called Radar Rivers) that are now buried by sand sediments to such an extent that they are invisible to observers on the ground. Using this knowledge, Issawy and McCauley (1992) proposed that the Depressions were formed in conjunction with two ancient drainage systems that operated during the Tertiary Period over a period from 40 to 6 million years ago. These drainage systems not only formed the Depressions, they also removed hundreds of meters of the rock layers that formerly covered huge areas of the southern Western Desert.

It is recalled that Egypt was submerged by the Tethys Sea intermittently throughout the Palaeozoic, Mesozoic, and Early Tertiary Periods. During phases of submergence, many layers of sedimentary rocks were formed one atop another; from oldest to youngest these layers included the Nubia sandstone, the Cretaceous limestones and shales, and the Eocene limestones. The land of Egypt was eventually lifted above sea level, but the rise was gradual, so that the north part of the country remained submerged and continued to accumulate sediments longer than the southern part. The uplift began in the southwestern corner of Egypt – the site of Gebel Uweinat and the Gilf Kebir Plateau – tilting the rock layers toward the north and producing cracks and joints in the surface rocks.

By the beginning of the Oligocene Epoch, or about 37 million years ago, the sea had receded northward to the latitude of Siwa and Fayoum, exposing a vast plateau of limestone over the southern part of the country. A humid climate produced intense precipitation and rapid weathering of the exposed rocks. Rainwater also seeped into the jointed limestone, forming underground channels and caverns. Runoff from the highlands of the Uweinat/Gilf area flowed north along the down-dipping strata. This gave rise to a river system that Issawy and McCauley called the Gilf River, which reached the receding Tethys Sea near Siwa (Figs. 7-10).

The remains of the earlier river system of the Gilf River, has almost been obliterated: its channel was filled with sediment deposited by ephemeral streams during the Pliocene and Pleistocene Epochs' Pluvials and with wind-blown sand. The presence of the Radar Rivers has been confirmed by investigation on the ground.

Wadi Al-Hitan (Whale Valley) is unusual in having such a large concentration of fossil whales (406 fossil skeletons) in a relatively small area. They are accompanied by sirenian fossil skeletons as well. This concentration may be due to excellent exposure of fossil-bearing strata, and it is possible that other whale fossils lie under those exposed. It is not exactly known whether these whales died here during a storm or they died annually after giving birth to young. Or was it mass suicide?

The whales lie at different stratigraphic levels. In Fig. 6 (from Dolson *et al.* 2002) is clearly shown the estuarine nature of the area. It is certain that these were popular calving grounds in shallow estuaries south of the deep water Mediterranean sea. Modern whales seek out estuaries like the Baha bay in Mexico for calving, due to abundant food and sheltered waters. There will be tens of thousands of skeletons back in those cliffs and the ones found are only the surface exposures. The remains represent millions of years of occupation of the estuaries. That is why there are so many skeletons!

b. 3 – Comparison with similar sites outside Egypt

b.3.a – Comparison with sites inscribed on the World Heritage List

i – Monte San Giorgio, Switzerland

This is the most recent fossil site inscribed on the World Heritage List (World Heritage Center 2003). It is described as a Mid-Triassic succession resting unconformably on older Permian volcanic rocks and overlain by Upper Triassic and Lower Jurassic rocks. It records life in a tropical lagoon environment, sheltered and partially separated from the open sea by an offshore reef. This is an environment similar to those of the Egyptian Oases at the time of deposition of the fossil animals found in. Comparison of the Monte San Giorgio fossil site in Switzerland with the Egyptian Whale Valley can give us a useful comparative analysis of the different successive stages in the history of the Tethys Sea and the evolution of the marine and estuarine biota, in its northern shores (MSG) and southern African shores at Wadi Al-Hitan (Whale Valley).

ii – Messel Pit Fossil Site, Germany

It is an ancient lake bed lying on deposits of 270 to 290 million years old, spanning the Cenozoic Era, the Tertiary Epoch, and the Eocene Period, above Old Red sandstone. The Eocene Lake Messel appears to have had a tropical to subtropical climate. Fossils include crocodiles, marsupials, pangolins, anteaters, hedgehogs, early horses, odd-toed ungulates, bats, and a rodent. It therefore no similarity to Wadi Al-Hitan, as its fauna is mostly terrestrial.

iii – Grand Canyon National Park, USA

Exposed horizontal geological strata in the Canyon span some 2,000 million years of geological history, providing evidence of the 4 major geological Eras, from the Late Precambrian to the Cenozoic. The first fossil evidence appears in the Late Precambrian Limestone with remains of early plant forms. Subsequent strata dating

from the Palaeozoic Era catalogue the sequence of local history, with both marine and terrestrial fossils demonstrating the periods in the distant past when the whole region was alternately submerged and raised. Here are however few fossil remains of Mesozoic reptiles (in the nearby Navajo Indian reservation) or mammals from the Cenozoic. The Canyon is 447 km long. Despite its great size, the Grand Canyon is poor in reptilian and mammalian faunas, and especially has no whales.

b.3.b. Comparison with sites not inscribed on the World Heritage List.

i – Gebel Qatrani, Fayoum, Egypt

Gebel Qatrani is rich in fossils that include some whales, but their numbers and species are much limited. It is more important, however, for a super-rich assemblage of fossils of 27 other mammalian Orders.

ii - *Basilosaurus* fossils in Alabama.

http://www.archives.state.al.us/emblems/st_fossil.html

There are several fossil sites in North America. Notable among them is the *Basilosaurus* site in Alabama. In 1834 a skeleton of a basilosaur (king of the lizards) was found on a plantation in southwestern Alabama. Staff of the Philadelphia Academy of Natural Sciences studied the skeleton and said it was not a lizard, but a carnivore whale. Because of this they renamed it *Zeuglodon* (Genus *Basilosaurus*). They estimated it to be over forty-five million years old (Eocene period). *Zeuglodon*s averaged from fifty-five to seventy feet long and had tails up to forty feet long. Fossil remains of this gigantic whale were first found in Clarke County in about 1833; bones were later discovered in Choctaw and Washington Counties. Fossil remains of the *Basilosaurus cetoides* may not be removed from the state without prior written approval of the Governor. The ancient whale fossil is most abundant in Alabama and many *Zeuglodon* skeletons have been found here. One was found in 1982 near Washington County and is now displayed at the McWane Center in Birmingham. Another was found in Alabama and sent to the Smithsonian Institution in Washington, DC. These are the two most comprehensive *Basilosaurus cetoides* skeletons ever found. In 1984 the legislature made the *zeuglodon* the state fossil by Act no. 84-66. It can be seen that the *Basilosaurus* fossils of Alabama are sparse and scattered, no way to compare with the 406 skeletons all in one place, of different species, and telling many stories, as those of Wadi Al-Hitan.

c. Authenticity/Integrity

The Wadi Al-Hitan (Whale Valley), lies within the Wadi El-Rayan Nature Protectorate declared by Prime Minister's Decree number 2954/1997, and is managed under the regulations of Law 102/1983, on Nature Protectorates (Nature Reserves). The Nature Conservation Sector (NCS) of the Egyptian Environmental Affairs Agency (EEAA), is responsible for the management, protection and conservation of the entire site.

Wadi El-Rayan until 1970 was a dry depression not raising any interest except for a few Coptic hermits in the early centuries of Christianity in Egypt. It was abandoned for a long time until some other hermits came to settle in one of the caves of the area in the mid 20th century. Geologists were interested in it since the early 20th century to study it as part of the general survey of Egypt. This revival attracted some ecologists to study the area. Irrigation engineers were interested in it as a potential area in which to either use the Depression as a reservoir, similar to what had been the case for Lake

Qaroun in Ancient Egyptian times, or alternatively as an outlet for the agricultural drainage water of Fayoum. The second option prevailed and finally a canal was dug in the early 1970's to connect it to the Fayoum agricultural lands to drain one third of the drainage water of Fayoum into the Wadi El-Rayan Depression. Thus the Wadi El-Rayan Lakes came into existence as a man-made wetland. In the 1980's, a group of Egyptian scientists started studying the ecology of this new brackish man-made lake, and pointed out its importance as an exceptional feature of desert ecology, so that it was finally declared a Nature Reserve in 1997. Since then it became a very popular picnicking attraction for Cairenes, aided by TV shows, especially on the weekend Fridays. Very few of these visitors venture into Wadi Al-Hitan area. A visitor center has been established however in Wadi El-Rayan just on the shores of the Lake, in order to sensitize these visitors to the unique wealth of their country.

On the other hand, Gingerich (*cf.* Gingerich and Uhen 1996) came also in the 1980's to study the fossil whales nearby. His discoveries attracted more geologists and hence they advised the EEAA to annex the Whale Valley to the Wadi El-Rayan Protected Area in order to ensure its protection, which was done in good time. Nevertheless, this spot also became an important tourist attraction, but for those who can come to it with 4-wheel drive cars. These are either foreign visitors, or well-to-do Egyptians. In spite of this limitation, the number of visitors is nevertheless too high for such an extremely fragile area, where the fossil skeletons are exposed on the surface of the ground and the fossil mangrove remains crumble at the mere touch of fingers.

The Buffer Zone

Wadi Al-Hitan (Whale Valley), proposed as a Natural Heritage Site with boundaries shown as a red line on the map (Fig. 1), is surrounded by an effective buffer zone (boundaries shown as a yellow line on the map), that is the distance between the inner boundaries of the proposed World Heritage Site. The outer boundaries of the Nature Reserve are shown by a green line.

Figures 2-6 give more clarification of the features of Wadi Al-Hitan and show its geographic relations to adjacent areas.

The rules of the Management Plan apply to the entire area, but there are more restrictive rules for the proposed Wadi Al-Hitan World Heritage Site, such as restriction of visits except by prior permission and in the company of a Park Ranger, in a Park 4x4 vehicle, and along a prescribed trail (shown in Fig. 3).

d. Criteria under which inscription is proposed (and justification for inscription under these criteria)

Criterion N(1)

To apply Criterion N(1), the sites must “Be outstanding examples representing major stages of the earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features”.

The Whale Valley site corroborates a Nomination on the World Heritage List by the application of **critterion N(1)** as it:

- Represents a major stage of the evolution of whales, a major phenomenon in the history of mammalian evolution from land to sea, matched nowhere else in

the world, showing the stage by stage trophy of hind limbs, as well as their change of function from walking to mating.

- With at least 4 species discovered so far and there are certainly possibilities for more species to be discovered. We have: *Basilosaurus isis*, *Dorudon atrox*, known earlier as *Zeuglodon isis*, *Prozeuglodon atrox*, and an additional whale recently described from Wadi Hitan is *Ancalocetus simonsi* (Gingerich and Uhen, 1996, Abed and Attia, 2001, El-Bedewey and Dahroug, 2001). Wadi Al-Hitan is unusual in having such a large concentration of fossil whales in a relatively small area. These are some more details about these species:

1 - *Basilosaurus isis* (Beadnell): formerly *Zeuglodon isis*; it was found and named by Beadnell then published in Andrews, 1904 (p.214).

2 - *Prozeuglodon atrox* Andrews: This species was named by Andrews, based on a type skull and a lower jaw collected by Beadnell.

3 - *Dorudon osiris* (Dames), formerly *Zeuglodon osiris*, is the largest species of *Dorudon* in Egypt.

4 - *Ancalocetus simonsi* Gingerich, 1996.

- The site has the largest number of fossil Eocene whales anywhere in the world (exceptionally high diversity both in number of species and in number of individuals).
- Besides whales, the site has fossil sirenians and other vertebrate fossils, as well as fossil mangrove and apparently palm trees, showing the biotic assemblage of Eocene times.
- The Whale Valley also exhibits significant ancient geomorphic and physiographic features (Figs. 4, 11 and 12), indicative of past geographical, geological and ecological features, *e.g.*, estuarine habitats and coastal lagoons.

The fossil whale site represents a major stage in the evolution of life on earth as well as depicting the palaeogeography and palaeogeomorphology of the southern shorelines of the ancient Tethys Sea and its estuaries and coastal lagoonal lakes. The fossil animals (sirenians) and plants (mangrove) associated with the 406 whale skeletons indicate the climate and vegetation at the time the whales stranded on the shore. Research on the site for identification of microfossils can reveal still more accurate data about palaeoclimate. This large number of skeletons also indicates the communal habits and behaviour of whales at their early stages of evolution. It appears that the estuary was a meeting point for female whales to give birth to their young, because a large number of the skeletons is of baby whales. The site may have been an ideal choice for annual whale migration and birthing.

This is not a mass burial site from one point in geological time. Some of the local skeletons in pairs of 3-6 may represent this, but the site is that of an estuary with repeated annual calvings. Mass extinctions don't make sense when the details of the various levels that the whales are found at the site are examined. There are possibly as many as five species of fossil archaeocete whales present in Wadi Al-Hitan, but only two are well known. One of them is the very large *Basilosaurus isis*, with well developed five-fingered flippers on the forelimbs and surprisingly the presence of hind legs, feet, and toes, not known previously in any archaeocete. (The name *Basilosaurus* was given to it because it was first thought to be a dinosaur). The other species is *Dorudon atrox*, a small whale with a more compact dolphin-like body. Besides whales, three species of early sirenians, one partial skeleton of the primitive proboscidian *Moeritherium*, early mammals, lower vertebrate remains, three kinds of sawfish, bony fishes, several kinds of turtles (including a sea turtle), sea snakes, and

crocodiles, are also present. The fossils of *Basilosaurus* and *Dorudon* of Wadi Al-Hitan are found in the Eocene deposits of the Gulf of Mexico and the Atlantic coast of North America, showing that they were widely distributed. In Wadi Al-Hitan, several *Dorudon* juveniles have bite marks across their skulls, indicating they were bitten by a predator, probably the much larger *Basilosaurus*. This proves that the whale skeletons at Wadi Al-Hitan have more secrets to reveal than elsewhere in the world.

Fossil sea cows in Wadi Al-Hitan are very similar to modern ones, further evidence that the site was part of a shallow protected embayment. Abundant mangrove and several crystal logs of beached shipworm-bored wood reinforce the embayment theory.

3. Description of Property

Situated in a remote desert region in the western section of Wadi El-Rayan Nature Protectorate, south of Fayoum Oasis, is the area of fossil whales. About forty to thirty-seven million years ago, Wadi El-Rayan was under a great ocean, and this site was a beach and a lagoon with mangrove vegetation. Due to geological upheavals, the ocean retreated leaving the remains of marine animals trapped in the sediments. Fossilized skeletons of primitive early species of whales, sharks, mollusca, and remnants of other marine life can be found there. Not less than 406 visible whale skeletons, the last ones to have functioning feet, lie exposed on the surface. The present-day limited numbers of flora and fauna species in Wadi Al-Hitan or in the larger area of Wadi El-Rayan, are not of special significance, except in showing how plants and animals can survive under extreme ecological conditions (extremophiles).

a. Natural History

a.1 Geology

Geological history of the area

The paper of Issawi and McCauley (1992), suggested that Egypt had been drained by a succession of at least three different river systems since the Tethys regression in the late Eocene (Figs. 7-10) and that a single master stream (the "Protonile") did not exist during the Tertiary. These newly described drainage systems flowed from the Red Sea highlands in the east to the western desert depressions in the west, and competed with one another for survival and the rivers with the overall gradient advantages replaced, over time, the earlier less efficient systems. Competition took place in response to tectonic uplifts, sea level changes and climate variations. The present landscape of Egypt was produced by the combined geomorphic effects of these old drainage systems. The modern Nile in Egypt, that is, a north-flowing river connected to the Ethiopian highlands, dates only from the very late Pleistocene, 250,000 years ago, and is made up locally of parts of the prior rivers and it is neither an antecedent nor a superimposed stream, and it is not the descendant of the imaginary "Protonile."

McCauley *et al.* (nd) conclude that the fifteen year period of SIR investigations in Northeast Africa has led to a much improved understanding of the geomorphic evolution of the Western Desert of Egypt and the relatively minor role of the Nile in this history. The non-redundant SIR-C coverage of Egypt shows convincingly that collected runoff in rivers, streams, and local lakes, was the principal agent of erosion that produced the major elements of the Egyptian landscape. The present-day eolian sand sheets and dunes of various types are only a thin blanket dating mostly to the Late Pleistocene and Holocene Epochs. Although southwestern Egypt lies within the most arid part of the Earth, and has a powerful and persistent wind regime, the radar shows the eolian landscape to be superficial.

Geomorphology

This Wadi is characterized by its magnificent and peculiar geomorphological features due to the severe action of wind erosion on the sedimentary rocks of different resistances. Isolated hills, hillocks of peculiar shape sculptured by the wind action, earth pillars and the curious huge globular masses possessing internal concentric bandings, enveloped by larger ones, so-called *battikh* (water melon). One of the

geomorphological landmarks in the Valley is Al-Akhawat Al-Talata (three sisters), which is a hill with its top divided into 3 little summits.

Stratigraphy

The sequence of rocks in Wadi Al-Hitan indicates that the oldest rocks are related to Gahannam Formation of Eocene age (Bartonian or Priabonian, about 40 to 41 million years ago, consisting of white marly limestone and gypseous clay. Like the lower part of the Birket Qaroun Formation (Upper Eocene), it is of particular interest in yielding many skeletons of the marine archaeocetes, shark teeth, chelonians, and crocodilians. The youngest formation in Wadi Al-Hitan is the Qasr El-Sagha Formation of Late Eocene age (Upper Priabonian, about 39 million years ago), with *Carolia placunoides* at its base. This Formation is exposed in some top parts in the Valley, and due to its richness in marine invertebrate fauna, it indicates a shallow marine environment.

Note: The following account is excerpted from Dolson *et al.* (2002).

Geological Setting and Prior Work

Jurassic rifting and Syrian Arc inversion were the dominant tectonic events shaping the current geometry of the Fayoum Basin. The basin is in excess of 6000 meters deep and is flanked to the northwest by a prominent Syrian Arc inversion structure known as the Kattaniya Horst. The Bahariya Oasis, formed by another large Syrian Arc structure, bounds the basin to the southwest.

The Greater Fayoum Basin holds a rich heritage of palaeontological, archaeological and geological exposures. The Qasr El Sagha (or Temple of the Crocodile), Wadi Rayan and Wadi Al-Hitan (Whale Valley) sites are the primary points of interest in the area.

The location, within a 1½-hour drive from Cairo's 16 million inhabitants (Fig. 4), makes this an area of high potential for eco-tourism and scientific discovery. However, the growing awareness of the scenic, recreational and scientific value, coupled with roads created for seismic and oil well drilling exploration, has now placed this fragile area in jeopardy of becoming damaged by uncontrolled visitation.

This description touches upon major facets of the area's natural science with a focus on:

- 1) learnings from petroleum exploration in the offshore Nile Delta
- 2) the palaeo-ecology of the Eocene and Oligocene vertebrate palaeontological sites
- 3) human history
- 4) the potential for eco-tourism and need for strong conservation measures (under tourism)

Egypt's tectonic history

Egypt's tectonic history can be summarized in eight major events (Dolson *et al.*, 2001).

1. Palaeozoic craton
2. Jurassic-Early Cretaceous rifting
3. Cretaceous passive margin
4. Syrian Arc inversion (84 MA-50 MA) and foreland transgression
5. Oligo-Miocene Gulf of Suez rifting
6. Late Miocene Red Sea breakup
7. Messinian salinity crisis
8. Plio-Pleistocene delta progradation

Outcrop exposures

1) (a) The Middle Eocene Gahannam and Lower Qasr El Sagha Formations at Whale Valley: shallow water lagoonal and shoreline facies capped by marine shales, extensive vertebrate graveyard of whales and sea cows, (b) exposures of large scale basinal thickening northward into the Fayoum Basin.

2) a. Temple Member of the Qasr El Sagha Formation: (a) Coarsening upward parasequences of tidal flat and beach horizons interbedded with lagoonal and marine shales, (b) Giant foreset beds of a palaeo-estuary in the Dir Abu Lifa member of the Qasr El Sagha Formation.

The area is currently under the protection of the Egyptian Environmental Affairs Agency (EEAA).

The Fayoum Basin was formed initially along the Tethyan margin in Jurassic time. Its current shape is from subsidence that terminated in late Eocene time. The basin is largely below sea level.

Natural breaks in the levee of the Nile River have caused repeated flooding of the basin. Ancient Lake Moeris was much more extensive than the current Lake Qaroun. Egypt's climate 8500-4000 years ago was significantly wetter, and this large natural lake with its abundant wildlife and surrounding fertile soils, attracted very early human occupation. The basin has seen continuous human habitation from Neolithic time to present.

In Pharaonic times, Egyptians built an extensive network of canals, locks and irrigation systems, designed to maintain the level of Lake Moeris. During Roman occupation, the level of the Lake was dropped to make room for more irrigable land and the present Lake Qaroun is only a fraction of its former size.

The most definitive work on the Eocene and the palaeo-ecology of the *Basilosaurus* and Sirenia (sea cows or manatees) is that of Gingerich (1992).

Web page hotlinks to geological information on the Fayoum Basin

Topic	Web hotlink
Granger 1907 expedition	http://www.nh.ultranet.com/~granger/FaiyumInstall4.html http://www.nh.ultranet.com/~granger/
<i>Zeuglodon</i> palaeontology, (<i>Basilosaurus</i>)	http://www.unmuseum.org/zeuglodo.htm http://www.archives.state.al.us/emblems/st_fosil.html http://www.strangemag.com/nessie.home.html http://www.zoomwhales.com/subjects/whales/classification/Whalefossils.shtml
Syrian Arc Event	http://www.geosociety.org/pubs/geology/0799geo.htm#S14
IUCN (World Conservation Union)	http://wcpa.iucn.org/region/mideast/mideast.html
AAPG activities	http://www.aapg.org

Egyptian
Environmental Affairs
Agency (EEAA)

<http://www.eeaa.gov.eg/>

What do the vertebrate fossils found in Wadi Al-Hitan tell us about the environment where they lived?

The fact that both *Basilosaurus* and *Dorudon* are found in Eocene deposits of the Gulf and Atlantic coasts of North America shows that they were widely distributed, fully marine, and probably highly mobile. Their teeth are sharp (Figs. 13 and 16), indicating that they were predators. The larger *Basilosaurus* is represented by about 97 partial skeletons in Wadi Al-Hitan, of which only one is a juvenile (1%). *Dorudon atrox* is represented by about 82 partial skeletons, of which 63 have been classified as adult and twenty-six (41%) as juvenile. The fact that so many juvenile *Dorudon* are found in Wadi Al-Hitan reinforces the idea that it represents a protected embayment or inland sea rather than open ocean. It also suggests that Wadi Al-Hitan was probably a favoured calving ground for *Dorudon*. Whales today seek warm, sheltered embayments and lagoons to give birth. Thus *Basilosaurus* and *Dorudon* are present in approximately equal numbers in Wadi Al-Hitan, but they have very different population structures. Several juvenile specimens of *Dorudon* have bite marks across their skulls indicating that they died when bitten by a predator. The predator could have been a large shark, but these are relatively rare. It seems more likely that *Basilosaurus* was the predator preying on young *Dorudon*. Wadi Al-Hitan is unusual in having such a large concentration of fossil whales in a relatively small area.

There are several possible explanations for this. First, the area was sheltered and seemingly favourable for *Dorudon* calving. This would encourage these whales to return generation after generation. The presence of calving *Dorudon* females might have attracted larger predators like *Basilosaurus*, further increasing the diversity of whales. Second, if the proto-Nile or other large river system debouched into the embayment, this may have provided nutrients supporting a large biomass including fish, which would have attracted whales. The presence of sea cows might have attracted whale predators (though the whales greatly outnumbered such potential prey). In all, the rich concentration of fossils may be due to excellent exposure of fossil-bearing strata.

Sirenians (or sea cows), living today, inhabit sheltered estuaries and feed on seagrass meadows growing in shallow coastal waters (maximum 30 m water depth). Fossil sea cows known from Wadi Al-Hitan are so similar to modern Sirenians in skeletal form, with tusked skulls, compact bodies, forelimb flippers, dense expanded ribs neutralizing their buoyancy, reduced hind limbs, and fluked tails, that we can safely infer that they lived like their modern relatives do. This is further evidence that Wadi Al-Hitan was part of a shallow protected embayment. The only land mammal found in Wadi Al-Hitan is one partial skeleton of the amphibious early proboscidean *Moeritherium*. This may indicate that the shoreline was nearby, but the *Moeritherium* may also have been caught and transported some distance from shore by *Basilosaurus* or another predator.

Abundant mangrove and several crystal logs of beached shipworm-bored wood reinforce evidence from vertebrates that the fossils in Wadi Al-Hitan accumulated during a time of relatively low sea stand in a shallow embayment or inland sea.

How did the Wadi Al-Hitan whales die?

The presence of a large number of whales dying in the same area is reminiscent of the beachings or strandings of whole groups or pods of extant whale species on modern beaches. There is no question that multiple skeletons are found on single bedding planes, and multiple skeletons are found on steep vertical escarpments. However, the skeletons are almost always found separated from each other spatially and stratigraphically, and, with one or two possible exceptions, whales are not found in the close single-species associations expected of strandings.

One final observation in Wadi Al-Hitan is interesting. Adult skeletons of *Dorudon atrox* are fossilized in circles (Figs. 13 and 14), as if they were attempting to stretch backwards and bite their tails. This is undoubtedly due to desiccation of the powerful back and tail muscles in salt water, which caused the skeleton to curl backwards into a circle before it was buried and fossilized. However, when an adult *Basilosaurus isis* skeleton is found it is always straighter and never curled back in the same way. This indicates that the two were differently muscled, which is not surprising, given their greatly differing body lengths and vertebral proportions.

Of interest here, the orientation of *Basilosaurus* skeletons has the potential to tell us something about the environment of accumulation. In the course of studying *Basilosaurus*, the bearing of the head relative to the rest of the body was recorded for 14 individuals scattered across the whole of Wadi Al-Hitan.

The rose diagram of orientation of the skeletons of fossil whales is clearly bimodal (Fig. 15), with four of the 14 skeletons oriented with their heads in the North octant and four oriented with their heads in the South octant. The remaining six skeletons fall in four of the remaining octants, and two octants are empty. The probability of eight of 14 skeletons being oriented in opposing octants is only about 0.04, and this is thus not likely to have happened by chance alone. Orientation could reflect alignment with prevailing sea floor currents, but then we would not expect equal numbers of heads in the opposing octants. Alternatively, orientation might reflect alignment with the ancient shoreline determined by the ebb and flow of tidal currents.

Some skeletons have been partially reconstructed, but many vertebrae and other bones have been stolen over the years, leaving only partial skeletons at each site. Many complete skeletons remain to be excavated, preserved and reconstructed.

Whale Feet

(Excerpted from Philip Gingerich home page, see below)

Many scientists believe that whales were once land bound animals because of the hoofed fossils that have been discovered. The oldest whale fossil discovered to date, dates back forty million years. However, it is believed that whales have been around for sixty million years. It is reported that "No fossil has yet been found, however, that links the land-living ancestors and the early cetaceans, and the reasons for a mammal's return to the sea are also not known." But, Dr. Holly Smith, a seasoned fossil hunter affiliated with the University of Michigan, would not agree with this claim. Holly and her husband, Dr. Philip Gingerich, discovered the remains of a whale with hind legs in Egypt's Zeuglodon Valley (now Wadi Al-Hitan), in 1989. Not only did they discover hind legs, they also found an ankle bone and what appear to be toe joints.

Once whales moved to the sea, their bodies began to adapt to its new environment. It is believed that the whales front limbs evolved into flippers and their back legs "were

lost." Whale flippers have a bone structure "reminiscent of jointed limbs and digits. The modern whale has two "numbs of bone" where the ancient whales had hind limbs". It is reported that today only 1 whale out of 100,000 has a slightly protruding stub of a hind limb."

Theoretically, there are many reasons why the ancient whales took to the seas. They might have needed more space or more food, both of which were found in the sea. The adaptation to the sea's environment took place gradually through natural selection.

Smith and Gingerich believe the evolutionist theory that the land bound whales were forced into the sea by predators. Then they adapted to the sea environment through natural selection. The whale fossil that Smith and Gingerich found is the species *Basilosaurus isis*. This species "lived 10 million years after the transition from land to sea had occurred." Dr. Gingerich was surprised that they still had "functioning hind legs."

Evolutionists point to this whale discovery as evidence of evolutionary transitions. Creationists are still not convinced by the evolutionists arguments and theories.

<http://www.dc.peachnet.edu/~pgore/students/f95/shuff/whales.htm>

Basilosaurus therefore may represent the whales having the last hind limbs visible enough to be recognized as "legs". But they were not used for walking. It is believed they were used instead for mating, like the appendages of male sharks or the claspers of the aquatic oligochaete worm *Alma nilotica*. *Basilosaurus* also represents the stage in whale evolution in which they became fishlike, with a streamlined fusiform body, a long and powerful tail, forelimbs turned into flippers, and a terminal tail fin.

Whales and hippos are close kin

<http://www.geocities.com/egenews/sep1/>

As long ago as 1950, scientists using immunological methods on material from living animals came to the surprising conclusion that whales are most closely related to artiodactyls. In the early 1990s in Egypt, University of Michigan palaeontology Prof. Philip Gingerich found *Basilosaurus*, a 42-million-year-old fossil whale with leg, foot and toe bones, but its ankle bones were too rudimentary and its feet were useless for walking. In the last few years, 15 or 20 DNA studies have come out supporting the connection of artiodactyls to whales. Gingerich's team found in Pakistan fossil whales with sheep-like ankle bones in the very same skeletons, which was some 5 million years older than the whales Gingerich found in Egypt. Artiodactyls have ankle bones unlike those of any other living or extinct animals, so comparing fossil whale feet with those of artiodactyls provides the crucial clues to their relationship. Whales seem to have evolved from early ancestors of sheep, deer and hippopotami and may be hippos are the closest living relatives of whales. Thus *Basilosaurus* of Egypt with its toe bones represents one more step in the evolution of whales into fully aquatic animals, thereby completing the chain that led from sheep to modern day true whales.

a.1.2 Palaeontology

a.1.2.a Fossil Flora

The Fossil Mangrove

In present day mangroves, trees grow singly on slightly raised ground in nearshore swamps. El-Saadawi (*in litt.* 2003) says that although fossil whales at Wadi Al-Hitan were known to science since 1904, the exposed fossil mangrove bed of the Wadi (Figs.17 and 18), more conspicuous than the whales, was not identified until 80 years ago (*cf.* Gingerich 1992). This mangrove bed lies in the “Camp White Layer” at the top of the Gahannam Formation (Late Middle Eocene), Bartonian, and/or Priabonian). The bed shows, according to the geological literature, a succession of vertical pneumatophores (respiratory roots) dissected by wind erosion and capped by an extensive hard limestone resistant to erosion. So far, no palaeobotanical work has been done on this fossil mangrove.

Fossil Palms

A very long tree trunk lies in Wadi Al-Hitan covered by what has been explained as worm borings (Fig. 19). During the recent visit of the Scientific Team to Wadi Al-Hitan on 19 Dec. 2002, Prof. W. El-Saadawi collected a fossil plant specimen at the main mangrove site (29° 16' 15" N and 30° 01' 26" E) which closely resembles an old dichotomized rhizome of *Nypa fruticans* (Palmae), illustrated by Tomlinson (1994), but is 10 times smaller in size. *N. fruticans* does not occur in Egypt now, but is found in South and Southeast Asia and northern Australia. Its present occurrence in these tropical countries indicates that the climate of this part of Egypt at Late Eocene times was similar, *i.e.*, tropical and humid.

It is worth mentioning that fossil fruits of *Nypa* and remains of other plant genera known to have species that grow in association with mangroves, have been reported from nearby sites in the Egyptian deserts. Therefore, an at length palaeobotanical study of this mangrove site and its plant remains is worthwhile. Plant species whose logs (or other remains) are abundant in the nearby deserts might be identified in the Wadi Al-Hitan mangrove site; particularly that it is known that these logs do not occur in growth position, but lying on the ground. Sedimentologic evidence indicates that most of them were transported a short distance, probably from such mangrove sites, prior to burial.

The detailed palaeobotanical study is hoped also to throw more light on two points referred to in the geological literature:

- 1) The 1.5 m tall isolated block of the Camp White Layer which is lying in Wadi Al-Hitan at 29° 16' 15" N and 30° 01' 25" E, quite near the above mentioned main mangrove formation, and having the same structure. Is it a broken block (as mentioned in the literature)? Or is it an unbroken one?
- 2) The 18 m long, entirely worm-bored petrified tree (as described in the literature), located at 29° 16' 18" N and 30° 01' 30" E, along a palaeo-shoreline in Wadi Al-Hitan. Is it, in fact, an entirely worm-bored tree in which borings have been filled with celestine (as mentioned in the literature)? Or is it a fossil palm with adventitious roots that decayed and their piths filled with another mineral? More sound proof is really needed in favour of or against this idea.

a.1.2.b Fossil Animals

Characteristic Animal Fossils

Description:

The Faiyum Province is one of the most attractive and very interesting areas, not only in Egypt, but in the whole world, owing to its valuable vertebrate fossils that date back to more than 40 million years ago, its variety of rocks of different geologic ages, some of which are of peculiar features, and also the presence of Lake Qaroun, with its historical value.

One of the most interesting sites in Faiyum is Wadi Al-Hitan (Whale Valley), located about 12 km WSW of the prominent hill Garet Gahannam (Hell's Cliff), in Wadi El-Rayan Protected Area (WRPA). It is known also as Zeuglodon Valley, but this name is now obsolete. This is the type locality known among palaeontologists for the Eocene whale *Prozeuglodon atrox*, described by Andrews in 1906. It is also the type locality of *Basilosaurus isis* (Fig. 20), described by Beadnell in the same year.

This Valley contains about 406 huge skeletons of prehistoric whales that lived in this region in the Middle Eocene Age about 40 million years ago. Many of these skeletons are almost complete and well preserved; some on the surface and others covered with sand. They are grouped in families which may one to think about a mass suicide like in modern whales. However, these Eocene whales are taxonomically different from modern ones and are placed in a separate sub-order, the Archaeoceti. Their bodies were very long, up to 21 m and apparently thinner than modern whales, suggesting a sea-serpent form, probably of low swimming efficiency. The skull is very long and the nostril was some way back. Teeth are very interesting in that they were of the normal mammalian number (44), and show some signs of the heterodont arrangement. The molars have sharp crenate edges, as is other fish-eaters. The animals were obviously carnivorous.

Beside the whales in Wadi Al-Hitan (*Prozeuglodon atrox*, *Basilosaurus isis*, *Dorudon osiris*, and *Ancalocetus simonsi*), there are also sharks (witnessed by fossil shark teeth), crocodylians, and chelonian remains.

Macro-invertebrate fossils are of significance in this area. The sedimentary rocks in the area are very rich in bivalves, like *Pycnodonte*, *Lucina*, *Tellina*, *Cardita*, and many other genera. *Turritella* and *Mesalia* are among the most prominent gastropods, while *Nautilus* represents the cephalopods. A peculiar hydrozoan called *Qerunia cornuta* and fossil crabs of the genus *Lobocarcinus* are also found. Plenty of the coin-like *Nummulites* are found scattered on the ground, and embedded inside the rock.

Moreover, the relics of an Eocene mangrove forest, dating back to about 40 million years ago, is found fossilized in some sedimentary strata in Wadi Al-Hitan, which can really be considered as an open display case in the desert.

The following is a detailed description of the outstanding fossil species in the area of Wadi Al-Hitan.

Notes on Whale Fossils in Wadi Al-Hitan

Class: Mammalia

Infraclass: Eutheria

Order: Cetacea Brisson 1763
Suborder: Archaeoceti Flower 1883
Family: Basilosauridae Cope 1868
Subfamily: Dorudontinae Miller 1924

Genus: *Dorudon osiris*

Synonym: *Zeuglodon osiris* Dames 1894

D. osiris is the largest species of *Dorudon* from Egypt. All are from Qasr El-Sagha Formation of Late Eocene age. It is one of three species of *Dorudon* recognized by Kellog (1936) from that Formation.

Genus: *Ancalocetus simonsi* Gingrich 1996

This is an advanced archeocete described from the Birket Qaroun Formation (earliest Priabonian, Late Eocene) of Wadi Al-Hitan. It is similar to *D. atros* in many ways but differs conspicuously in having fused elbows, other distinctive features of forelimb structure, and a more curved malleus within the middle ear. It appears to have a viable, if not a highly specialized evolutionary experiment, one that may have contributed nothing to subsequent evolution of cetaceans, but one nevertheless broadening our understanding of the morphological diversity of archeocetes.

Basilosaurids

Basilosaurids are the youngest group of archaeocete whales. By the late Eocene, all other groups of archaeocetes became extinct and only basilosaurids remained. Based on this observation and the sharing of many derived morphological features with early mysticetes and early odontocetes, basilosaurids are thought to have given rise to modern cetaceans. Basilosaurids all share the loss of the third upper molar, the presence of accessory denticles on their cheek teeth, a high number of lumbar vertebrae, highly reduced hind limbs that do not have a bony connection to the vertebral column, and dorsoventrally flattened tail vertebrae indicating the presence of a tail fluke.

The earliest basilosaurids are from the late middle Eocene of Pakistan. By the late Eocene, basilosaurids are virtually globally distributed with specimens known from New Zealand, Senegal, Europe, Jordan and common from Egypt and the southeastern United States.

Basilosaurids are divided into two groups, Basilosaurinae and Dorudontinae. Basilosaurines include the genera *Basilosaurus* and *Basilosterus*. Dorudontines include *Dorudon*, *Pontogeneus*, *Zygorhiza*, *Saghacetus*, *Ancalocetus*, and a new species yet to be named. Basilosaurines all have elongate posterior thoracic, lumbar, and anterior caudal vertebrae, a feature that dorudontines lack.

Basilosaurids have many anatomical features that indicate they were fully aquatic. Their hind limbs are extremely reduced and lack a bony attachment to the vertebral column. Their fore limbs are formed into flippers, with limited mobility at the wrist and elbow. They also have broad, fan-shaped scapulae like those of modern cetaceans. Basilosaurids have short necks, although all seven cervical vertebrae remain free and unfused, unlike many modern cetaceans where some of the cervical vertebrae are fused. Also, basilosaurids have their posterior caudal vertebrae dorsoventrally flattened. This feature is only found in modern mammals that have a tail fluke (cetaceans and sirenians) and the pattern of shape change along the vertebral columns

of dorudontines is very similar to the pattern seen in modern cetaceans.
<http://www.cdp1802.org/~muhen/CetRes.html>

The evolution of whales

Fossil representatives of these modern groups go back to the Oligocene epoch. Early members of these groups are more primitive than the modern representatives (odontocetes with primitive-looking teeth, mysticetes with teeth), but they are part of these modern groups. Prior to the Oligocene, during the Eocene epoch, there were no odontocetes or mysticetes, only Archaeocetes (ancient whales). Archaeocetes retain many features of more primitive mammals in their skulls, teeth, vertebral columns, and limbs relative to their modern descendants. Research has focused on archaeocetes from the middle and late Eocene, protocetid and Basilosaurids.

Notes on Invertebrate Fossils of Wadi Al-Hitan

Thousands of *Nummulites fraasi* and *N. beaumonti* are scattered on the Wadi ground beside many exposures of macro-invertebrate fossils, which characterize the three Formations found there: Gahannam, Birket Qaroun, and Qasr El Sagha. The macro-invertebrate fauna is usually found in three major rock types: shales, compact white limestone, and sandy hard brown limestone.

The mode of preservation of fossils varied widely in these types of rocks. In most cases, the specimens occur as molds obscuring their internal structure, but retaining, in most cases, their external features. In the limestone basal beds of Qasr El Sagha Formation, *Carolia* and oysters together, with few other genera, retain their original material and structure. In some other cases, in the upper beds of Gahannam Formation and the lower beds of Birket Qaroun Formation, the shells are replaced by celestite (strontium sulphate). *Carolia* characterizes the basal beds of Qasr El Sagha Formation. It is found in some exposures in the southern parts of Wadi Al-Hitan, where the basal parts of this Formation are exposed. These shells are found crowded and may even form a complete bed.

Bivalves

Suborder: Ostreinae

Superfamily: Ostreacea

Family: Gryphaeidae

Subfamily: Pycnodonteinae Stenzel 1959

Genus: *Pycnodonte* F. de Waldheim 1835

***P. gigantea* Soldner 1766**

This large shell (Fig. 1 a and b, Plate I) indicates a shallow water environment since such oysters live nowadays in shallow depths and near the shore. They are found in the basal beds of Qasr El Sagha Formation and also in the upper beds of Birket Qaroun Formation.

Family: Ostreidae

Subfamily: Ostreinae

Genus: *Ostrea* L. 1758

***O. elegans* Desch. var. *exogyroides* M-Eymar**

This species (Fig. 2 a and b, Plate I) is found in the same beds as the previous species. It has a characteristic shape and ornamentation.

Subfamily: Lophinae

Genus: *Nicaisolopha* Vyalov 1936

***N. clot-beyi* (Bellardi 1854)**

Members of this characteristic upper Eocene small oyster (Fig. 5, Plate I) are found in the same beds as the previous two species.

Order: Veneroidea

Superfamily: Lucinacea

Family: Lucinidae

Genus: *Lucina*

***L. fajumensis* (Oppenheim 1903)**

This species (Fig. 4, Plate I) was identified by Oppenheim from the Faiyum Province. It dates back to the late middle Eocene age and was found in both Gehannam and Birket Qaroun Formations.

Superfamily: Carditacea

Family: Carditidae

Genus: *Cardita*

***C. viquesneli* Oppenheim 1903**

This species (Fig. 3, Plate I) is characterized by numerous tripartite radial ribs. It is found abundantly. It is found in the same beds as *Pycnodonte gigantea* and *Ostrea elegans*.

Genus: *Vulsella* Lamarck

***V. crispata* Fischer**

This species (Fig. 12, Plate I) is found at many localities where oysters are less prominent. The vulsellas are the commonest variety in their group. They were collected from Gehannam and Birket Qaroun Formations in a good state of preservation.

Genus *Carolia* Cantraine 1838

***Carolia placunoides* Cantraine (Fig 13 a and b, Plate I)**

Gastropoda

Order: Mesogastropoda Thiele 1925

Family: Turritellidae Woodward 1851

Genus: *Turritella* Lamarck 1799

Subgenus: *Torquesia* Douville 1929

***T. (T.) carinifera* Deshayes 1824**

This upper Eocene species (Fig. 7, Plate I) is abundantly found in both Birket Qaroun and Qasr El Sagha Formations.

Species: ***T. (T.) pharaonica* Cossmann 1901**

Specimens of this upper Eocene turritellid (Fig. 6, Plate I) are mostly found in the same beds containing the previous *T. carinifera*.

Genus: *Mesalia* Gray 1824

***M. fasciata* Lamarck**

This species is characterized by its wide spire angle, wide whorls with numerous spiral ribs, of which the anterior second one is the most prominent. It is frequently found in Birket Qaroun Formation.

Family: Aporrhaidae

Genus: *Drepanocheilus* Meek 1864

D. wagihi Abbass 1963

This species (Fig. 10, Plate I) is found in Birket Qaroun Formation. It is characterized by its fusiform shape, convex whorls, undulating sutures, axial ridges, and short anterior canal.

Cephalopoda

Order: Nautiloidea

Genus: *Nautilus*

N. mokattamensis Oppenheim 1903

Specimens of this species (Fig. 11, Plate I) are rare remains of cephalopods in Egyptian Eocene rocks. They are found well preserved in Birket Qaroun Formation. They are indicative of normal marine salinity.

a.1.3 Biodiversity

(See Appendix for Lists of Species)

Extant plants and animals in the core area of the proposed Whale Valley Site are very sparse. Perhaps not more than a handful of plant species represented by very few individuals exist in it, and a slightly higher number of invertebrates and vertebrates. The larger area of WRPA, on the other hand, with its more than 30 years old brackish man-made lake, attracts a relatively large number of species. All the species that are found in WRPA, or are likely to be found, being known from the wider area of the Fayoum Governorate, are listed in the Appendix.

b. History and development

History of discovery

Situated in a remote desert region in the western section of Wadi El-Rayan Nature Protectorate, south of Fayoum Oasis, is the area of fossil whales. About forty to thirty-seven million years ago, Wadi El-Rayan was under a great ocean, and this site was a beach and a lagoon with mangrove vegetation. Due to geological upheavals, the ocean retreated leaving the remains of marine animals trapped in the sediments. Fossilized skeletons of primitive early species of whales, sharks, mollusca, and remnants of other marine life can be found there. Not less than 406 full whale skeletons, the last ones to have functioning feet, lie exposed on the surface. The present-day limited numbers of flora and fauna species in Wadi Al-Hitan or in the larger area of Wadi El-Rayan, are not of special significance, except in showing how plants and animals can survive under extreme ecological conditions (extremophiles).

The Fayoum region, is from where fossilized remains were first described by A. B. Orlebar in 1845. But the first fossil vertebrate discovery made in Fayoum at Gebel Qatrani area, was of whales by the, Schweinfurth, from the German-speaking part of Switzerland, in 1879. His find was published in 1882. In 1898, geologist Hugh J. L. Beadnell of the Egyptian Survey was sent to Fayoum and soon found more fossil vertebrates. Working on camel back and foot, the early maps of Beadnell actually contained navigation units in "camel hours" but were surprisingly accurate for their day. British Museum of Natural History palaeontologist Charles W. Andrews joined Beadnell in 1901 to help make the first extensive fossil collection from Fayoum. Andrews was appointed the first Keeper of the Egyptian Geological Museum. The

collection dug from the Fayoum in 1898 was sent to the British Museum in London for identification in 1899 and returned for display. The famous fossil collection of the Fayoum vertebrates was the first to be displayed in the new museum. The two geologists published their impressive results shortly thereafter and aroused world attention. Their collections continued to grow and become more varied with the increased number of field expedition and the different areas covered by field work.

A German team, led by Stuttgart's Eberhard Fraas and Richard Markgraf who had moved to the Fayoum, followed the British in 1905. A later American expedition was comprised of two parties consisting of the work party with Walter Granger as leader, assisted by George Olsen plus a group of Egyptian workers hired in Egypt; and the escort party of the Department of Vertebrate Palaeontology curator Henry F. Osborn. The Fayoum fossil site was reached in February 1907. Granger stayed until the end of May. Granger went on to discover the first dinosaur eggs in the world in the Gobi Desert in the 1920s. <http://www.touregypt.net/featurestories/grangerfayoumintro.html>

The area remained unexplored further for more than 70 years. Then the American Gingerich and his crew came first in 1983 and worked hard till they found tiny hind limbs belonging to a 60-foot-long sea snake-like *Basilosaurus* and the first evidence of cetacean feet. Earlier finds of *Basilosaurus*, a fully aquatic animal that slithered through the seas between some 40 million and 37 million years ago, preserved only a partial femur, which its early discoverers interpreted as vestigial. But the well-formed legs and feet revealed by this latter discovery hinted at functionality. Although at less than half a meter in length the diminutive limbs probably would not have assisted *Basilosaurus* in swimming and certainly would not have enabled it to walk on land, they may well have helped guide the beast's serpentine body during the difficult activity of aquatic mating. Whatever their purpose, if any, the little legs had big implications. Gingerich immediately thought that this was 10 million years after the *Pakicetus* he earlier discovered in Pakistan. If these things still had feet and toes, there would be 10 million years of history to look at.

History of protection

In the 1960s the Fayoum Province expanded rice cultivation and also other semi-aquatic plants like ornamental *Cyperus*. This resulted in the use of increased quantities of irrigation water, and consequently huge quantities of drainage water went in Lake Qaroun, the only outlet for drainage water of the entire Province at that time. The Lake level rose alarmingly, overflowing onto prime agricultural land, its water became saltier, and its fish stocks much deteriorated, and eventually collapsed. The Government thought of allowing another outlet into the Wadi Rayan Depression, which was a dry desert at that time. A canal was dug to drain one third of the drainage water of Fayoum into that Depression, which was terminated in 1972. Thus a brackish water lake was created in the middle of the dry desert, the Wadi Al-Rayan Lakes. In the 1980s, a team of Egyptian researchers started studying the new aquatic ecosystem created in this dry desert. They recommended declaring it a nature reserve representing a unique case of a man-made brackish water lake, complementing the famous Lake Nasser fresh water lake, and allowing significant comparisons between the two as regards the evolution and development of such ecosystems. Law 102/1983 came to the rescue, and the WRPA was eventually declared.

Declaration of this Protected Area attracted visitors and facilitated excursions into its surrounding areas of interest. While increasing the numbers of visitors to the lakes area was welcome, their pressure on the Wadi Al-Hitan was seen as serious threat to

the fragile fossils. It was agreed therefore that the nearby Wadi Al-Hitan should be within WRPA, and this was done, and that it needs special management measures within the management plan of WRPA.

c. Form and dates of most recent records of property:

(Information kindly provided by the Central Administration for Nature Conservation Sector (NCS) of the EEAA, State Ministry for Environmental Affairs.)

The Egyptian Environmental Affairs Agency (EEAA) is the agency representing the Government of Egypt in what regards environmental matters. In general, the lands of the protected areas within Egypt are governmental property, where each Protected Area Management Unit (PAMU) takes the legal reaction against any environmental or illegal land reclamation or violation.

The core area and buffer zone of Wadi Al-Hitan (Whale Valley) are completely inside the border limits of Wadi Rayan Protected Area (Fayoum Governorate), which is declared by the Prime Minister's Decree no. 943/1989, and later was enlarged to include W. Hitan by Prime Minister's Decree no. 2954/1997, to become about 1759 km²

d. Present state of conservation

The conservation of the Wadi Rayan is going on according to management plan as the protected area starts years ago with the support of Italian Government, but still some corrective measures has to be taken to prevent unmonitored visitors, because of unlimited four wheels drive cars entrance of the Wadi Rayan in general, and particularly Wadi Al-Hitan, the main corrective action is to recruit and train some community guards from the local people, for monitoring and tourists support.

e. Policies and programmes related to the presentation and promotion of the property

Tourist attractions in the greater Fayoum area are varied: the Lake provides tremendous recreational opportunities, bird watching, fishing, boating, etc. The countryside provides unusual sightseeing with the water wheels driven by the mere downward flow of water (without need for animal power, like elsewhere in Egypt). The spring at Ain Siliyyeen is also another unusual spot for national tourism, with its flour mill running by water energy alone. Fayoum is the theme of several guidebooks, in French and in English. The books are sold in selected bookstores in Cairo and can currently be obtained in Fayoum. Wadi Al-Hitan Administration provides interested persons with any material on the area. The Egyptian-Italian Cooperation has produced several wonderful publications in large numbers, ranging from attractive guidance and information brochures to serious scientific books, such as "Wadi Rayan: Gateway to the Western Desert."

General information on Wadi Al-Hitan is available in very attractive brochures, the website (<http://www.elrayan.org>), the Atlas and the Video of WRPA. They are all exhibited at the WRPA Visitor Center on the western side of the lake. In addition, a number of representative fossils are also exhibited in the Visitor Center, together with large explanatory maps and wall charts. And in order to attract visitors coming for recreation into the Visitor Center with a lecture room, a skeleton of a fossil whale has been transported from Wadi Al-Hitan and proudly displayed in front of the Center. Most hotels in Fayoum and the Tourism Authority have brochures, atlases or video

copies. The entrance gate of WRPA started to distribute brochures to visitors. The video and atlas are available in the Visitor Center at WRPA.

The Tourism Authority of the Governorate recently produced an information brochure in Arabic on the Governorate that contains a short paragraph on the Waterfalls area of Wadi Rayan. Also, a professional video on Fayoum Governorate has been produced, but has not been distributed yet. Much presentable English information material is available on Fayoum in general, and also on the geological, palaeontological and cultural heritage in particular. The website of the Fayoum Governorate (<http://www.Fayoum.8k.com/fayeng.htm>) contains information on tourism in general and on certain cultural sites in particular.

Chances and opportunities for information management and the tourism market

- ✓ Make better use of existing material: Develop an information distribution plan for e WRPA (even if limited) the Governorate information material and train park staff and Tourism Authority staff on basic information management, communication and presentation strategies on the implementation plan
- ✓ Train Governorate key employees from different departments on tourism management and marketing and facilitate the development of an integrated marketing strategy that involves also private sector stakeholders.
- ✓ Develop ecotourism attraction inventories in a systematic and categorized way, identifying focal, complementary and support attractions. These inventories should be the basis for promotional and marketing efforts.
- ✓ Hire specialists that identify important visitor target groups and develop custom target brochures and other information material who should professionalize the existing Governorate website and link it up with other existing websites on Fayoum.
- ✓ Develop and distribute best practices and information material for visitors, hotel owners, and tour operators.
- ✓ Train and assign a market researcher that provides key stakeholders with information on existing markets, on tourism related fairs and with general relevant information on the visited sites and on Fayoum.
- ✓ Institutionalize and participate in relevant tourism fairs.
- ✓ Take the interest and operational process of the private sector into account when developing and implementing a market strategy.
- ✓ Marketing should emphasize environmentally sound and socioculturally equitable behaviour on the part of the tourists and the tourism industry in general.

4. Management

General context

The Wadi Al-Hitan or “Valley of Whales”, located within the Wadi el Rayan Protected Area (WRPA), is considered a palaeontological site of international importance due to the presence of unique fossils of some of the earliest forms of whale discovered to date (Gingerich, 1992; Abed & Attia, 2001). Large numbers of skeletons of *Zeuglodon* (also known as *Basilosaurus*), dating from the Upper Eocene appear to be closely grouped on bedding planes, in what was perhaps a death assemblage of “beached” whales that may have died together along a paleo-shoreline (Dolson, 2001).

We are grateful for the NCS, EEAA, for providing us with the detailed Management Plan as well as the Monitoring Report (both attached) from which we extracted the information below.

The Wadi Rayan Protected Area (WRPA) covering a total area of 1,759 km² was instituted in 1989 by Prime Ministerial decree N. 943 (Fig. 1). The WRPA enjoys the highest number of visitors of any protected area in Egypt outside the South Sinai. Some 150,000 people visit it each year, the vast majority being Egyptians. Demand for the WRPA as a recreational destination is likely to continue to rise, given the crowded conditions prevailing in many urban areas in Lower Egypt. Greater Cairo, with an estimated population of 16 million, is one of the world’s largest cities and is situated less than 100 kilometres away. Expected sustained economic growth throughout the region will increasingly give city-dwellers the means to satisfy their rising requirement for recreation in open and clean spaces.

In 1998 the Egyptian and Italian Governments, respectively through the Environmental Affairs Agency (EEAA) and the General Directorate for Development Cooperation, have initiated a conservation and development project to support the Wadi el Rayan Protected Area. The World Conservation Union (IUCN) participates in an advisory capacity by providing technical support in accordance with internationally recognised guidelines and strategies related to the sustainable management of protected areas.

The WRPA has been defined as a Managed Resource Protected Area or Type VI area according to current IUCN/WCPA categories, although its closeness to Cairo and its unusually high potential as a recreational and educational area are more in line with Type II or V areas. The approach adopted by the project has therefore conformed to the management objectives of Type VI areas by focusing on the conservation of biodiversity and sustainable economic production, but has also taken into account the specificity of the WRPA by contributing to its development as a prime recreational and educational area.

a. Ownership

All desert land in Egypt is Government property. Hence declaring a Nature Reserve in a desert area does not need depossessing its owners. However, Bedouin tribes have traditional rights in land use that the Government acknowledges but does legally recognize. The Government recognizes right of land to Bedouins in two cases only: a home built of stone, and/or land cultivated with tree crops. In Wadi Al-Hitan there are absolutely no Bedouin inhabitants and no agriculture. There were therefore no problems of land ownership here. The Wadi el-Rayan was declared a Protected Area

according to Law 102 of 1983, which provides the framework for Protected Areas in Egypt. The entire area proposed to UNESCO has been declared protected by Prime Ministerial Decree #943. According to Law 102 of 1983, which provides the framework for Protected Areas in Egypt, the Egyptian Environmental Affairs Agency (EEAA) is the legal owner of the area.

b. Legal status

As mentioned above, WRPA has been declared protected and falls under the direct jurisdiction of EEAA. Law 102 of 1983 provides the legal framework for this protection. As of 1991, the policy of EEAA towards protected areas are as follows: “to construct an efficient network of natural parks, protected areas, and the wisely thought of multiple use management areas, by developing the recently declared sites and selecting new locations; integration of protectorates programme with the social and economic development, to attain sustainable development, conservation of biological resources, its monitoring, surveying, survival and development, to maintain sound management, and administration of protected areas projects and enforcing Law No. 102/1983. As mentioned above, the site has been declared protected and is falling under the direct jurisdiction of EEAA.

c. Protective measures and means of implementing them

WRPA is directly managed by the Nature Conservation Sector (NCS) of the Egyptian Environmental Affairs Agency (EEAA). The NCS is directly responsible for the management of the areas.

Any visitor wishing to go to Wadi Al-Hitan has to obtain prior permission from WRPA Administration, and has to be accompanied by a Park Ranger travelling with the visitor(s) in a Park 4x4 vehicle. The track to the fossil site is marked and the fossils themselves are surrounded by a fence to prevent trampling (Figs. 21 and 22).

It is important to note that other authorities have a certain management authority with regards to their specific areas of competencies. The Supreme Council of Antiquities (SCA) would have to give prior permission if somebody would like to make archaeological excavations within the areas of any of the suggested sites. The permit given by the SCA in any case is to be followed by and conditioned by another permission that is necessary from the EEAA management authority if the archaeological site is within a Nature Reserve.

The Antiquities Law 117/1983

Law number 117/1983 for the Protection of Antiquities, Article 22, stipulates that no permit for buildings on an archaeological site can be given. Similarly, canals, graveyards, roads, or farming cannot be allowed, nor planting of trees, their uprooting, removal of debris, of soil, of fertilizers, or any change of features can be allowed. This rule applies also to a buffer zone of 3 km wide of land around the site, or any other distance decided by the Supreme Council of Antiquities, that would ensure the protection of archaeological remains in the site or nearby.

The Environment Law 4/1994

The rules and regulations of Law 102/1983 on Nature Protectorates (Nature Reserves) are applied to the entire area of the WRPA, White Desert, and Siwa Nature Protectorates.

According to *Article 2* of this Law:

“It is prohibited to carry on actions or take measures that would result in destruction or deterioration of the natural environment, or harm to terrestrial or marine life, or to the area’s natural beauty. It is also prohibited to raise buildings, build roads, move vehicles, or carry on any agricultural, industrial, or commercial activities within the area of the Protectorate, except by license from the competent administrative authority, according to conditions, rules, and measures that are to be issued by Decree from the Prime Minister”.

Article 3 of the same Law stipulates, for the buffer zone:

“It is not allowed to practice any activities or business in the areas surrounding the Protectorate, that are to be delineated by the competent Minister, at the proposal of the Environmental Affairs Agency, if these activities are to affect the environment of the Protectorate, or its natural phenomena, except by license from the competent administrative authority.”

These rules and regulations are realized through the vigilant care of the Egyptian Government (the Nature Conservation Sector of the State Ministry of the Environment for the Nature Protectorate the Ministry of Culture for Antiquities, wherever applicable), and their various policing bodies, principally the Security Corps and the Tourist Police, or the Water Surfaces and Environment Police, as the case may be. There are various security systems, starting with the Park Rangers and ending with the District Attorneys and Criminal Courts. The relatively great distances of the regions in question and the consequent difficulty in access have contributed to a large extent in this sense, at least up to now. If tourism is to increase to higher volumes, this is luckily more than compensated for by a correspondingly increased care and vigilance on the part of the Egyptian Government.

Prime Minister’s Decrees

Regulations set by the Prime Minister’s Decrees for the declaration of specific nature reserves in Egypt, are based on the stipulations spelt out in that Law, and reiterate them, with some modifications according to the nature and requirements of each newly declared Nature Reserve. We can give the regulations for WRPA as follows:

Prime Minister’s Decree number 943/1989 makes the specific following arrangement for the WRPA and Lake Qaroun Protected Area (both in Fayoum Governorate, except for a small portion of the latter, in Giza Governorate), as such:

Article 2: “A branch of the EEAA is to be established in Fayoum Governorate, to be administered by an Executive Council under the Chairmanship of the Governor of Fayoum, with membership representing the Ministries of Agriculture (Agency for Wildlife Protection and Zoos), Defence, Tourism, Housing, Interior, and Culture, and Cairo University, the EEAA at the Cabinet of Ministers, the Academy of Scientific Research and Technology (National Oceanography and Fisheries Institute), and the Desert Research Center This Branch is charged with executing the competences spelt out in Law 102/1983”.

Article 3: “Are prohibited any actions or activities or measures that would destroy or spoil or degrade the natural environment or harm wild animal or plant life, or affect its aesthetic standard, within the two Protectorates. The following is especially prohibited:

- Hunting, transporting, killing, or disturbing terrestrial or aquatic organisms, or doing activities that can destroy them, limit their growth, affect their hereditary characteristics, or destroy their habitats,
- Destroying or transporting plants within the two Protectorates,
- Destruction or spoiling of geological formations or geographical features or areas that are considered habitats for animal or plant species or for their reproduction,
- Introducing alien species to the areas of the Protectorates,
- Polluting soil, water, or air in the areas of the Protectorates,
- Discharge of harmful liquids, chemical substances, oils, or any garbage of any kind into areas of the Protectorates, or in adjacent areas, if they may flow into these areas,
- Throwing away food wrappings and food remains or other refuse.

Also prohibited is the erection of buildings, paving roads, moving vehicles, or any agricultural, industrial, or commercial activities in the areas of the Protectorates, without obtaining a permit from the EEAA Branch at the Governorate, according to the conditions, rules, and procedures that are promulgated by a decision from the Prime Minister.

Article 4: The Governor of Fayoum is to supervise suitable measures for the guarding of the areas of the two Protectorates.

Article 5: The Executive Council is to assume direct responsibility that aims at developing and upgrading the areas of the two Protectorates. It has especially to:

- Prepare studies and programmes necessary for the upgrading and development of the two Protectorates,
- Monitoring of environmental phenomena and organizing censuses of terrestrial and aquatic organisms within the areas of the two Protectorates, and keeping records for each species,
- Management and coordination of activities related to the two Protectorates,
- Informing and educating the public about the objectives and aims of establishing nature reserves.

WRPA Administration has already appointed “Community Guards” from among the neighbouring tribe members. They will be moving on camel back to better monitor the landscape.

It is important to note that other authorities have a certain management authority with regards to their specific areas of competencies. For example, the Governorate of Fayoum, being the administrative body in charge of management at Governorate level, would have to agree on building an outpost in the Valley of the Whales; equally, the Supreme Council of Antiquities would have to give permission if somebody would like to make archaeological excavations within the areas of any of the suggested sites. Their authority though in any case is subordinated to EEAA’s management authority and conditioned by it.

The area is directly managed by the Nature Conservation Sector of the Egyptian Environmental Affairs Agency (EEAA). Other agencies have a management authority with regards to their competencies. The Governorate of Fayoum, for example, is responsible for supervising the guarding the two Protectorates, according to Article 4

above. would have to agree on building for example an outpost in the Valley of Whales; the Supreme Council of Antiquities would have to give a permission if a team would like to make archaeological excavations etc.

A provisional and non-exhaustive set of key management guidelines aiming at the development and conservation of the Wadi Al-Hitan site are outlined here:

Infrastructure and logistics

Permanent outpost. In order to counter the extremely hot and windy conditions prevailing in Wadi Al-Hitan, while mitigating the visual impact of the outpost, a simple design based on the long-standing experience of the Wadi El Rayan Coptic monastery is adopted. Sighted in a strategic location overlooking the open-air display, the outpost could be formed by three caves dug in the rocky escarpment and a small office/utility building oriented to act as a windshield. A rough sketch-plan for such an outpost was given in IUCN (1999) and more detailed plans have since been developed by the PAMU. Several possible sites for such an outpost have been identified but prior to making a final selection, the logistical implications of potential sites should be field-tested through the establishment of a temporary tented camp (Figs. 29 and 30) in Wadi Al-Hitan.

Transport. (i) N.1 Double cabin Toyota Hilux for liaison between PAMU headquarters and the Wadi Al-Hitan outpost; (ii) N.2 off-road motorbikes (e.g. Honda 250cc, trial bikes) for patrolling of Wadi Al-Hitan site and surroundings; (iii) N.6 camels for transport and logistics between Wadi Al-Hitan and Uta.

Communication. (i) 1 VHF base unit with relay station; (ii) 1 VHF mobile unit for vehicle; (iii) 4 walkie-talkie units. (iv) 2 GSM mobile phones.

Current activities at WRPA

- Further strengthening of the Field Unit
 - Evaluation, selection and Recruitment of trained staff by EEAA.
 - Preliminary proposal for staffing structure
 - Logistics and equipment
 - Follow up of priority issues (e.g. rallies)
 - Start up of administrative procedures for operations
 - Introductory meetings with local authorities and stakeholders by the PA manager.
- Preparatory activities
 - Planning, evaluation of priority actions, initial survey of declared boundaries (with the support of IUCN Senior Advisor)
 - Visitor management: visitor survey.
 - Public awareness: continuation of the program of Public Awareness in schools.
 - Production of information brochure
- Constraints:
 - Prolonged unavailability of the vehicle assigned to the Unit
 - Occasional difficulties in obtaining permission from military offices for access to desert areas.

Recommended actions for the coming months:

- Mobilize resources (funds for recurrent expenditures, ensure availability of vehicle)
- Ensure support to the field unit at the end of the extension

e. Level at which management is exercised (e.g., on property, regionally) and name and address of responsible person for contact purposes

Management is exercised in WRPA, White Desert, and Siwa, through the Nature Conservation Sector of the EEAA. Coordination with local government authorities (City Council and Governorate), and the local population is always ensured. In Bahariya Oasis, Environment Law #4/1994 controlling the Egyptian environment in general terms, applies, with the direct supervision of the EEAA.

The Institutional Framework

The majority of Reserves in Egypt suffer from some institutional problems due to interference in competences between the EEAA, represented by the administration of the Reserve, and other governmental or non-governmental administrations or organizations, such as the Governorates or Ministries, that have something to do inside the Reserve, such as the Ministry of Agriculture, or tribal organizations, that use the land or the resources of the Reserve or exploit it. Such interferences are a hindrance to the proper administration of the Reserve. They result in a serious loss of time and energy spent to solve them.

In order to avoid these conflicts, these organizations must, from the very beginning, not be separated from decision making. They must participate in solving the problems faced by its administration, and in political and social support (and probably financial) of these solutions. They can help in finding suitable alternatives for the economic activities that may be affected by these decisions. It is therefore suggested that a Governing Board for the Reserve should be established, comprising delegates of these stakeholder organizations. This Board should meet periodically and regularly under the joint supervision of the Ministry of the Environment and the Governorate.

Wadi Rayan is a protected area managed in cooperation with the Italian Government experts with experience in the management of the Protectorate for the last three years, Name of the Manager: Eng. Hossam Kamel:Tel:084- 830535

f. Agreed plans related to property (e.g., regional, local plan, conservation plan, tourism development plan)

In 1998 the Egyptian and Italian Governments, respectively through the Environmental Affairs Agency (EEAA) and the General Directorate for Development Cooperation (DGCD), have initiated a conservation and development project to support the Wadi el Rayan Protected Area. The World Conservation Union (IUCN) participates in an advisory capacity by providing technical support in accordance with internationally recognised guidelines and strategies related to the sustainable management of protected areas (Figs. 23-25).

The Wadi El-Rayan Protected Area is currently planning to construct an outpost in the Valley of Whales to ensure a permanent presence of park staff in the site.

The second phase of the Italian-Egyptian Environment Program for Wadi Rayan is also planning to provide technical management support and financial support for the

outpost construction and management. The support will be delivered directly by the program and by IUCN, the World Conservation Union

The WRPA Management Plan (attached) has been prepared in accordance with the management planning system for the protected areas of Egypt. Using the 1994 IUCN protected area management categories; WRPA has now been classified in a two-category system. A first category II part, managed mainly for ecosystem protection and integrity, environmental education, and ecotourism, and a second category IV part, managed mainly for the sustainable use of natural ecosystems, environmental education, and recreation.

The main management issues of WRPA are the variety of agencies and authorities that operate inside WRPA, including the Ministry of Agriculture and Land Reclamation, the Ministry of Petroleum, the Ministry of Water Resources and Irrigation, the Ministry of Tourism, the Ministry of Defence, and the Ministry of the Interior. It is also a major site of economic development and a popular site of recreational attraction for local and foreign visitors. The current rate of water extraction and evaporation from the lakes (created in the 1970's), exceeds the inflow, and this places the future of the lakes system in jeopardy.

The main external management constraints are the weak collaboration among Egyptian authorities involved in WRPA, the continuous expansion in both volume and variety of human activities inside WRPA, and the overuse of some resources of the protected area (e.g., the water of the lakes). Inadequate funding for running expenses, training, communication tools, etc., and the lack of permanent operating staff inside the protected area, are the main internal constraints.

Zoning into homogeneous use areas is an essential tool for the management of a protected area, allowing differential management, considering the different characteristics of each zone. WRPA has zones permitting zero impact, low impact, moderate impact, and high impact.

The natural resources of WRPA are under threat from the economic and human activities within it, but sound management practices, law enforcement (in collaboration with stakeholders), and monitoring, can ensure the sustainable use of its natural resources.

This management plan covers the period 2002-2006. It includes collaborative management, improving control over water use in the lakes, adaptive management, and focussing at the level of management zones.

The Governor of Fayoum described the management plan of WRPA as an essential tool for achieving the required level of coordination among the various public agencies active in the Protected Area.

All key stakeholders are being continuously informed and involved from the start of this management plan. The management plan has been forwarded to the appropriate collaborating authorities for endorsement. The development of public awareness programmes in WRPA is a main and important component of its management plan.

The management strategy is being achieved through using the following management tools: environmental regulations and law enforcement, communication,

documentation, monitoring and research, GIS and remote sensing, and EIA (environmental impact assessment).

The critical resources needed for the management of WRPA are infrastructure and equipment, financing, and staffing.

The WRPA project was funded by the Egyptian-Italian Environment Programme in the First Phase (March 1998-February 2001) and implemented by EEAA with international technical assistance from the World Conservation Union (IUCN). The transition phase started in June 2001 and stopped in December 2003, again with technical assistance from IUCN. The Second Phase is expected to begin early 2004, as one of the components of a broader support programme to the EEAA, the Nature Conservation Sector (NCS). It is funded by the Directorate-General for Co-operation Development (DGCD) of the Italian Foreign Ministry.

g. Sources and levels of finance

Sources of finance:

EEAA except for Wadi Rayan protected area for the last three years was cooperation with Italian Government. The White Desert PA is fully financed by the Egyptian Government, while the Siwa PA is co-financed by the Government of Egypt and the Italian Government. The Egyptian Government finances, among other things, the establishment of the infrastructure and the salaries and wages of employees.

Level of finance:

The outpost plans of the Protected Area are sponsored by EEAA. The Egyptian-Italian Environment Program is sponsored by the Italian Government.

Business plan. A business plan for the Wadi Al-Hitan site covering a period of 3-5 years, will be developed and implemented. Detailed budgetary requirements will be defined in terms of investments and operating costs and potential sources of revenue quantified based on a system of fees and other income generating and fund raising activities based on the leveraging of funds from government agencies, donor-sponsored projects and the private sector.

Marketing. A finely-targeted outreach programme will be designed to build the image of Wadi Al-Hitan as a unique conservation area and highlighting its significance as a palaeontological site. Effective tools based on the press, electronic and web-based media will be designed to disseminate information to a wide national and international constituency.

Conservation Fund. A permanent fund will be established and endowed in order to support the long-term and sustainable management of the Wadi Al-Hitan site. A stable institutional mechanism such as a Wadi Al-Hitan Management Board will provide an umbrella for all key stakeholders and ensure the necessary conditions of pluralism, credibility and transparency, which are crucial prerequisites for the effective management of such a Conservation Fund.

Schedule of the Implementation for WRPA

ACTIVITIES	2002		2003				2004				2005	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Human resources												
Deployment of Range Manager	■	■										
Recruitment of Community Guards	■	■										
Training of staff		■	■	■								
Infrastructure & logistics												
Site-selection and design of outpost	■	■										
Construction of outpost			■	■								
Procurement of equipment	■	■	■	■								
Visitor facilities and services												
Rehabilitation of Main Gate outpost			■	■								
Demarcation of new access track			■	■								
New ticketing system							■	■				
Establishment of open-air museum			■	■	■	■						
Camping sites			■	■								
Guided trekking tours							■	■				
Camel-tours									■	■		
Bedouin-style ecolodge							■	■	■	■		
Financial sustainability												
Design of business and marketing plans	■	■	■	■								
Outreach and promotion activities	■	■	■	■	■	■	■	■	■	■	■	■
Design of Conservation Fund							■	■				
Endowment of Conservation Fund									■	■	■	■

Budget for the Implementation Plan of WRPA

Code	Budget Items	Units	Qty	Unit cost	Total (Note 1)	
					L.E.	US \$
1.	TECHNICAL ASSISTANCE					
1.1	Design of infrastructure	m/m	3	5.000	15.000	3.529
1.2	Ecotourism facilities and services	m/m	3	5.000	15.000	3.529
1.3	Business and marketing plans	m/m	4	5.000	20.000	4.706
1.4	Outreach and promotion	m/m	5	5.000	25.000	5.882
1.5	Unallocated	m/m	4	5.000	20.000	4.706
	TOTAL TA				95.000	22.353
2.	OPERATIONS & MAINTENANCE					
2.1	Expenditure					
2.1.1	Outposts Operating Expenses	m	36	1.000	36.000	8.471
2.1.2	Museum Operating Expenses	m	36	500	18.000	4.235
2.1.3	Vehicle operating expenses	lump	1	90.000	90.000	21.176
2.2	Personnel					
2.2.1	Allowances existing PAMU staff	lump	1	20.000	20.000	4.706
2.2.2	Community Guards	m/m	216	600	129.600	30.494
2.2.3	Local travel	lump	1	10.000	10.000	2.353
	TOT. OPER. & MAINT.				293.600	69.082
3.	EQUIPMENT & SUPPLIES					
3.1	Rehabilitation Main Gate Outpost	lump	1	150.000	150.000	35.294
3.3	Fossil Area Outpost	lump	1	400.000	400.000	94.118
3.4	Tracks and signposts	lump	1	200.000	200.000	47.059
3.5	Open-air museum	lump	1	1.000.000	1.000.000	235.294
3.6	Ecotourism facilities	lump	1	150.000	150.000	35.294
3.7	N.1 Vehicle	lump	1	100.000	100.000	23.529
3.8	Communication equipment	lump	1	100.000	100.000	23.529
3.9	Field equipment	lump	1	50.000	50.000	11.765
	TOT. EQUIP. & SUPPLIES				2.150.000	505.882
4.	ACTIVITIES					
4.1	Training of staff	lump	1	75.000	75.000	17.647
4.2	Pilot ecotourism services	lump	1	100.000	100.000	23.529
4.3	Outreach and promotion	lump	1	300.000	300.000	70.588
4.4	Establishment of Conservation Fund	lump	1	100.000	100.000	23.529
	TOTAL ACTIVITIES				575.000	135.294
TOTAL PROJECT					3.113.600	732.612
INITIAL ENDOWMENT OF CONSERVATION FUND					1.500.000	352.941
GRAND TOTAL					4.613.600	1.085.553

h. Sources of expertise and training in conservation and management techniques

In general, for the last fifteen years the Government of Egypt in cooperation with the European Union work together to establish and develop the Gulf of Aqaba Nature Reserves and the St. Catherine Protectorate, the US/AID cooperates to establish the Red Sea Protectorates, the Italian Government cooperates to establish the Wadi El-Rayan Protectorate and some others. International expertise supports the training programmes, and the work and management plans for these areas. Expertise is transferred to the senior staff. EEAA supports the training of staff locally and abroad. Non-governmental organizations cooperate to train the EEAA staff and to assist them in various environmental matters.

The European Union established the NCS training center at Sharm El-Sheikh where nowadays the basic training of the newly recruited staff takes place.

Park Rangers have received a fair amount of conservation management training. Priority was given to technical biodiversity subjects. One Ranger, a trained palaeontologist, has received on-the-job training in conservation by a number of national and international palaeontologists. No training has yet been provided with regards to site management and visitor management.

WRPA is directly managed by one authority; each protected area having a local headquarter, headed by an Area Management (Manager) that reports directly to the Director of the Nature Conservation Sector of EEAA.

The responsible person for contact purposes is:

Dr. Mostafa Foda

Director, Nature Conservation Sector (NCS)

Egyptian Environmental Affairs Agency

Tel: + 20 (2) 5248 792 / 527 1391

Email: foudamos@link.net

Rangers of the Protected Areas received a fair amount of conservation management training. Priority was given to technical biodiversity subjects. Some Rangers acquired additional qualifications (3-month training periods in Kruger National Park in South Africa, or, for example, a Masters Degree from the UK). In general, the Rangers and Managers of the Protected Area do have a good technical background.

Lacking is management training for mid-management staff (Protected Area Manager) and general training in visitor management and tourism planning – in particular in view of the high visitor pressure existing in the sites.

i. Visitor facilities and statistics

Visitor facilities

A Visitor center at the water falls of Wadi Rayan lakes (Fig. 26) with an external exhibit of one of whale backbones. Brochures and information about the history of W. Hitan is available as well the track to the area being marked for about 44 km from the asphalt road. Notification to local authorities and the Protectorate prior to the visit of the area of W. Hitan is obligatory, just to follow up the safety of visitors, due to the rough road. Community Guard recruitment is in process.

A Visitor Center (Fig. 26) has been opened a few months ago. It has a fossil museum, large wall charts, a lecture hall for groups, and a fossil whale skeleton at its doorstep, brought from Wadi Al-Hitan. It is expected that even if some visitors are unable to visit Wadi Al-Hitan itself, they can get a glimpse of what it is about at the Visitor Center.

Statistics

Visitor statistics are obtained from the sale of tickets at the official entrance gate. It is estimated that 150,000 visitors come to WRPA annually, but only not more than perhaps one thousand people visit Wadi Al-Hitan, as it needs 4x4 vehicles and the road is not paved, passing through a treacherous sandy area between the lakes and Gebel Gahannam. Visitor facilities exist in the sites. There is still to be established a

monitoring system in place and protected area staff is not permanently present in the sites.

Access. The official access to the Wadi Al-Hitan site is through the Main Gate outpost of the WRPA, which will be rehabilitated and enlarged in order to accommodate ticket collectors as well as other PAMU staff. The existing track, which has been demarcated from the main road to Wadi Al-Hitan, will be modified so as to start from the Main Gate outpost. A guiding/security service is offered to legal visitors.

Ticketing. A new ticketing system will be established which differentiates between nationals and foreigners and with a specific additional fee levied for visiting the open-air museum in Wadi Al-Hitan.

Open-air museum. The open-air museum is established over a 1-2 km radius core area of the Wadi Al-Hitan fossil site. It will feature state of the art interpretation facilities and displays on the unique geology and palaeontology of the site and several professionally prepared skeletons. Vehicular access will be strictly reduced.

Camping. Two camping sites with basic facilities will be established and maintained. Camping may be allowed away from allocated areas but a special permit will need to be arranged with the PAMU.

Ecotourism services. Services will be provided by licensing private sector initiatives in the following areas: (i) guided trekking tours; (ii) camel rides either in Wadi Al-Hitan or along the ancient caravan trails approaching the Fayoum depression through Uta and Kasr Qaroun (iv) a Bedouin-style eco-lodge offering the “deep desert experience” (a preliminary proposal for such a facility has already been developed by the PAMU as part of an overall study for the development of ecotourism in the WRPA).

j. Site management and statement of objectives (copy to be annexed)

The conservation and development of the Wadi Al-Hitan site requires special and urgent attention. Against a backdrop of rapidly increasing visitor numbers, the key management issue is to strike the right balance between facilitating access for visitors, the need for extra surveillance and the logistical implications of maintaining a significant presence in this highly sensitive and remote section of the protected area.

Based on the proposed overall objectives and future activities of the WRPA project, the specific management objectives for the Wadi Al-Hitan site may be summarised as follows:

- ❑ Firmly establish a permanent presence of the WRPA Protected Area Management Unit (PAMU) in the Wadi Al-Hitan site.
- ❑ Ensure the participation of local stakeholders in the sound and collaborative management of the site.
- ❑ Promote Wadi Al-Hitan as a leading site for non-intrusive eco-tourism and environmental education.
- ❑ Ensure that the conservation and development of the Wadi Al-Hitan site is financially sustainable.

The management plan is annexed to this Nomination File. Its Executive Summary runs as follows:

“Wadi El-Rayan Protected Area has been declared by prime-ministerial decree No. 943 in 1989 according to law No. 102/1983 of the protected areas in Egypt, and is directed by the Nature Conservation Sector (NCS) of the Egyptian Environmental Affairs Agency (EEAA). The overall management goal of the protected area is the protection of the natural resources in accordance with the declaration decree of the protected area.

Using the 1994 IUCN protected area management categories, WRPA has now been classified in a two-category system. A category II part managed mainly for ecosystem protection and integrity, environmental education and ecotourism, and a category VI part managed mainly for the sustainable use of natural ecosystems, environmental education and recreation.

WRPA is a desert area situated in the Fayoum Governorate of the Western Desert of Egypt. In the nineteen seventies two lakes were created in the lower portion of Wadi El-Rayan sub-depression to channel out excess agricultural drainage water. The creation of a large body of water in this hyper-arid area had a striking ecological impact and new species of plants, mammals, birds and invertebrates moved to Wadi El-Rayan area.

The main management issues of WRPA are the variety of agencies and authorities that operate inside WRPA, including the Ministry of Agriculture and Land Reclamation, Ministry of Petroleum, Ministry of Irrigation, Ministry of Tourism, Ministry of Defence and Ministry of Interior. It is also a major site of economic development and a popular site of attraction for local and foreign visitors. The current rate of water extraction and evaporation from the Wadi El-Rayan lake system, exceeds the inflow, and this places the future of the lake system in jeopardy.

The main external management constraints are the weak collaboration among the Egyptian authorities involved with WRPA, the continuous expansion in both volume and variety of the human activities inside WRPA, and the overuse of some resources of the protected area (e.g. the water of the lakes). Inadequate funding for running expenses, training, communication tools, etc., and the lack of permanent operating staff inside the protected area are the main internal constraints.

Zoning is the division of the protected area into zones of homogenous use and is an essential tool for the management of a protected area, which allows differential management considering the different zones characteristics. WRPA has zones permitting zero impact, low impact, moderate impact and high impact.

Development of clear strategies for the management of WRPA is one of the desired outputs of this management plan covering the period 2002-2006 and the strategies include collaborative management, improving control over water use in the lake system, adaptive management, and focusing at the management zone level.

The Governor of El-Fayoum expressed his appreciation to WRPA for initiating the management planning process at WRPA and described the Management Plan as an essential tool to achieve the required level of coordination between the various public agencies active in the Protected Area.

All key stakeholders are being informed and involved from the start of this management plan continuously. The management plan will be forwarded to the appropriate collaborating authorities for endorsement.

The natural resources of the protected area are under threat from the economic and human activities within WRPA but sound management practices, law enforcement (in collaboration with stakeholders) and monitoring can ensure the sustainable use of the natural resources.

The public use inside the area has been identified to include eco-tourism activities, human economic activities and human settlement.

The development of the public awareness program in WRPA is a main and important component of the management plan of the protected area.

The management strategy is being achieved through using the following management tools; environmental regulations and law enforcement, communication, documenting, monitoring and research, GIS and remote sensing, and EIA.

The critical resources needed for the management of WRPA are infrastructure and equipment, financing and staffing and are described in the plan.

The WRPA project was funded by the Italian-Egyptian Environmental Program in the first phase (March 1998 - February 2001) and implemented by EEAA with international technical assistance from the World Conservation Union (IUCN). The transition phase of the WRPA project started in June 2001 and ceased in December 2002. As one of the components of a broader support programme to the Egyptian Environmental Affairs Agency (EEAA), Nature Conservation Sector (NCS), funded by the Directorate General Co-operation Development (DGCD) of the Italian Foreign Ministry, the total proposed budget of the second phase of WRPA project is 6,024,000 L.E. until December 2005 shared with the NCS/EEAA.”

An attempt at signage by a dedicated group was made in 2002 to put in signs of the Wadi Al-Hitan area fossil whale area (Fig. 27).

Advice to Visitors

To help preserve the beauty of the Wadi Rayan Protected Area, as in all other Egyptian protected areas, visitors are advised to follow these rules:

- Not to disturb or damage animals and plants.
- When driving, follow the marked tracks.
- To avoiding driving on vegetated areas.
- Not to collect, move or damage fossils, rocks or geological features.
- Not to leave any garbage.
- To avoid loud noise and the use of sound systems.
- Not to damage or pollute water sources.
- To respect the customs and sensitivity of the local community.

And for their safety, they are reminded that:

- A permit from military authorities is required for access to many areas, so they must make sure you have it before starting off.
- In order to visit the Protected Area, 4WD vehicles are necessary; travelling in convoys of at least 2 vehicles is recommended.
- If they are not experienced, some areas may be dangerous; the services of a guide are recommended for visiting the desert.
- Travelling time in the desert may be deceivingly long; they should make sure they are properly equipped and take with them enough food and water.
- Before leaving they should let someone know where they are going and when they are expected back.

Useful Contacts

Nature Conservation Sector, EEAA, Cairo. Tel. +20 (2) 5248792 / 5271391.

k. Staffing Levels (professional, technical, maintenance)

	Professional	Technical	Maintenance	Total
Number	15	10	14	39

5. Factors affecting the property

a. Development pressures (e.g. encroachment, adaptation, agriculture, mining)

So far no kind of development pressure on the nominated site herein, but for safety purposes, the Egyptian National UNESCO Committee recommend to the Governor of Fayoum to keep urban and agricultural development away enough from the fossil locations, while the Egyptian Urban Planning Authority requests from EEAA all conditions and limits proposed for urban planning and development of Protectorates. Local authorities consider a protectorate within their limits a treasure, as new income generation for the local people that should be kept from any kind of encroachment.

b. Environmental pressures (e.g. Climate change)

Climate in Egypt

The bioclimatic provinces in Egypt are defined with some modification according to the system applied in UNESCO map of the world distribution of arid regions (UNESCO, 1979) . This system is based on the aridity index P/ETP where ETP (potential evapotranspiration) is calculated according to Penman's formula. Two classes are recognized: hyper arid ($P/ETP < 0.03$), and arid ($P/ETP = 0.03-0.20$). These classes are, in turn, subdivided according to the mean temperature of the coldest month and that of the hottest month of the year. Consideration is also given to the time of the rainy period relative to the temperature region.

Accordingly, four climatic provinces are distinguished in Egypt:

- (1) The hyper arid provinces include all the area between Lat. 22 and 30 N, except the coastal mountains along the Gulf of Suez.
 - a) Hyper arid with a mild winter and a hot summer (mean temperature of the hottest month 20 – 30 C 0, this include Jebel Uweinat.
 - b) Hyper arid with a cool winter (mean temperature of the coldest month 0 – 10 C), and a hot summer, represented around the high land of the southern Sinai.

The rain in these provinces is less than 30 mm/yr and is occasional and unpredictable. (2) The arid province includes the northern section with winter rainfall, it extends along the Mediterranean coast and the Gulf of Suez. This section is distinguished into two provinces by the UNESCO/FAO map of 1963: the coastal belt province under the maritime influence of the Mediterranean, with a shorter dry period (attenuated), and the more inland with a longer dry period (accentuated), and an annual rainfall from 20 – 100 mm. Both provinces are characterized by a mild winter and a hot summer.

Temperature

The temperature regime in the desert of Egypt is governed mainly by the latitude location and maritime effect of the Mediterranean and the Red sea. The latitude effect is limited to the highlands: the Sinai Mountains, the Red Sea coastal chain and Jebel Uweinat at the western corner of the Sudan-Egypt border. Summer is generally hot (mean of the hottest month between 20°–30° C), or very hot (mean of the hottest month more than 30° C). Winter is either warm (mean of coldest month 20°-30°C) or mild (mean minimum of coldest month 10°-20°C) except on the highlands where the winter is cool with a mean minimum of the coldest month between 0°–10°C. The temperature along the Red Sea coast varies between a mean minimum of the coldest month of about 10°C towards the north and about 20°C towards the south and a mean

max of the hottest month of about 33°C towards the north and about 40°C towards the south. The range of variation becomes greater further inland (from about 4° to 38°C in the oasis of the Western Desert).

In continental locations temperature extremes of less than -4° C in the coldest month (e.g. Oases of the Western Desert of Egypt) have been recorded. The coldest month is between December and February, and the hottest month is between June and August in the hyper-arid provinces.

Relative Humidity

The relative humidity is affected mainly by the relative proximity of the Mediterranean and the Red Seas. The lowest records are those of inland locations of the arid and hyper arid provinces and the highest are those of locations closer to the Mediterranean coast and in the Nile Delta within the arid province (e.g. mean min 60% and mean max of 72 % in Damanhur City). The Lowest records of the relative humidity are generally those of the late spring whereas the highest records are those of the late Autumn and early winter.

Rainfall

In general three rainfall belts may be characterized in the desert of Egypt:

(1) The Mediterranean coastal belt; (2) Middle Egypt, with Latitude 29N as its southern boundary; and (3) Upper Egypt. The first and second belts have a winter rainfall (Mediterranean regime), the rainy season extends from November to April, though mainly concentrated in December and January. These belts correspond roughly to the attenuated and accentuated arid provinces of northern Egypt, where the average annual rainfall ranges from 100-150 mm in the attenuated arid province, and from 20-100 mm in the accentuated arid province. It extends rather south along the Gulf of Suez to Lat. 26N due to the orographic influence of the Red Sea coastal mountains. The third belt is almost rainless; it corresponds roughly to the hyper arid province. Rain at the center of this belt is not an annual recurring incident; 10 mm may occur once every ten years. The rainfall increases gradually to the north until reaches about 20 mm at the borders with the arid province (at Giza).

One of the major features of rainfall in arid and semiarid regions, other than being scanty, is its great temporal variability. Percentage variability (average deviation of annual precipitation from the mean, expressed as percentage of the mean) is greatest in the hyper arid province (e.g. Siwa oasis 83%) In the arid province the percentage variability is 65% at Giza, which is close to the hyper arid province.

Wind

Three high-pressure belts control wind circulation over Egypt: the Azores, the Indian subtropical, and the south Atlantic subtropical. Besides these, a permanent low-pressure belt, the doldrums, crosses the African continent in the vicinity of the equator. Seasonal high and low pressure systems also alternate over the continental mass, the red Sea, the Mediterranean, and the Arabian Peninsula.

Accordingly, two main flows may be distinguished: one originating in the north (the northerlies) and the other in the south (the southerlies) the tropical highs over the Indian and Atlantic oceans are the original sources of the southerlies.

In winter, the Sahara high pressure system dominates the circulation and the northerlies bring cool dry air from the North African continental source region, though occasionally the Arabian high brings warmer air to the eastern parts of the Sudan. Both of these types are occasionally interrupted by east west depressions along the Mediterranean and replaced by cold dry air from the Eurasian landmass. In spring and autumn, the Arabian high is more dominant in the east, and the effect of Mediterranean depression is relatively felt, as air from both the north African and the Arabian source is considerably warmer than in winter. In summer, the Sahara high is again dominant bringing hot dry air.

Occasionally, very hot dust-laden winds blow (Khamsin) which have numerous environmental consequences including a possible effect on climate, soil formation, ground-water quality and crop growth. They may create problems including substantial degrees of deflation and erosion, the spread of diseases through pathogen transport, the suffocation of cattle, disruption of transport and damage to property. Visibility during these storms is reduced substantially (below 1000 m). Dust deposition rate due to these storms in Egypt has been estimated as 371 t/km² in individual falls. In the early seventies a normal rate of 131 t/km² /yr was estimated in Cairo, which increased to 2236 t/km² /yr (17-fold) in areas near quarries. The grains were of calcite, quartz, amorphous silica and very little montmorillonite.

The Wadi Al-Hitan site is exposed to both erosion and deposition. The whale skeletons found by Beadnell in the early 20th century are no longer there. They have been eroded. The skeletons discovered in the late 1980s are now either partially or, alternatively, buried under thick sand sheets.

Moisture regime

The evaporative power of the air in the hyper arid provinces of Egypt as measured by the Piche evaporimeter, varies in January from 3.6 mm/ day in Aswan to 7.9 mm/day in Dakhla oases. In the arid province, the mean min. evaporation rate during winter is, in general, within the same range as in the hyper arid provinces.

The annual potential evapotranspiration is, in general, lower in the arid province than in hyper arid provinces. The lowest is that of Giza (592 mm according to Penman's equation, and 1582 mm according to Turc's equation).

In general, common threats are: wind deflation, sand accumulation, weathering, morning dew condensation, and vehicle traffic (especially rallies).

c. Natural disasters and preparedness (earthquakes, floods, fires, etc)

Some rare flash floods do occur in the Western Desert of Egypt, at an average rate of perhaps once every decade. They usually follow wadi beds chiselled on the desert floor by earlier streams. As for earthquakes, the adjacent Gebel Qatrani north of Lake Qaroun was the epicenter of the well remembered 1992 earthquake which caused great havoc in Cairo, but had almost no effect on the desert landscape. Fire is not a problem in the desert with its sparse vegetation.

d. Visitor/tourism pressures

With the active PAMU in W. Rayan we state that there good controls on the visitors pressures as the driving the four wheels drive the visitors can enter the place of W. Hitan from different directions, within the recruitment of the community guards the control will be excellent, and as the other protectorate (Siwa, white desert just started

and because of there remote area and no that much visitors, NCs can state that very soon the visitors controls for these places will be excellent, But for the Bahariya Oasis the situation is critical because so far the area is uncontrolled, and the visitors can go any where with no limits, NCS will work with UNESCO to add the area to the White Desert protectorate but this issue will take some time.

e. Number of inhabitants within property

None in the Wadi Hitan site, but a few thousand in the Lakes area, especially on its eastern side, working as temporary or settled farmers and fishermen. About 150,000 visitors come to WRPA annually.

f. Other.

WRPA Administration has a well-equipped headquarters at the Lake area (Fig. 28). Park Rangers make their daily sorties to patrol and for monitoring purposes in all directions, and especially in the Wadi Al-Hitan area, to catch any illegal visitors and/or poachers (Figs. 29-30).

6. Monitoring

Understandably, the monitoring programme is not for Wadi Al-Hitan, but for the whole of WRPA. We present here a brief summary of the first monitoring report (El-Hennawy 2002, attached), kindly provided by the NCS, EEAA.

a. Key indicators for measuring state of conservation

The key indicators selected in the monitoring programme for WRPA as a whole, as given in the first monitoring report (El-Hennawy 2002), are:

- Climate, a meteorological station regularly records the usual climate data, and there is special attention to phenomena such as sandstorms, frost, high humidity, etc.
- Land use, to monitor encroachment for irrigation or habitation, as well as erosion, sand movement, etc.
- Human population (resident about 13,000 and temporary about 150,000), to monitor human resident population and visitor pressure
- Plant and animal biodiversity, to monitor status of biota, through number of species, plant cover, etc.
- Degree of pollution, to monitor possible effect on water quality, possible weathering of fossils, etc.
- Observance of WRPA regulations, to monitor visitor behaviour, waste production and removal, tracks, poaching, etc.

b. Administrative arrangements for monitoring property

The Director of WRPA and his staff are responsible for the monitoring activity in the field. They may be aided by external experts from the EEAA or from universities. Their job is:

1. Surveying and preparatory activities: patrolling and revision of proposed borders and areas to be included in the Protected Area (PA), biodiversity inventories.
2. Regular field visits to focal areas
3. Baseline activities on assessment and monitoring of resources
4. Preparatory studies: Traditional and current natural resource use. A Preliminary study for Collaborative Management in the PA
5. Overview of traditional land tenure and natural resource use within the PA
6. Identification of natural resource uses within the Protected Area (livestock herding, tourism, hunting, agriculture)
7. Evaluation of their economic value and threat assessment
8. Overview of traditional land tenure claims.
9. Preparatory studies: Traditional and current natural resource use. A Preliminary study for Collaborative Management in the PA.
10. Definition of an outline strategy to facilitate the successful establishment of Collaborative Management between the local stakeholders:
11. Preparatory process and establishment of start up team;
12. Technical studies (impact of herding practices, livestock carrying capacity, impact of safari tourism)
13. Implementation of Pilot Collaborative Management Agreements
14. Surveying and preparatory activities: Public Awareness and Tourism.
15. Public Awareness : program of schools visits
16. Ecotourism: survey of safari guides (questionnaire for people organizing desert tours).

c. Results of previous reporting exercise

Monitoring in the Wadi El Rayan Protected Area (WRPA) was carried for more than three years now (El-Hennawy 2002, attached). More advanced and organized presentations of monitoring activities were introduced by WRPA personnel, each in his field. The third year of the monitoring activities inside WRPA was organized and practiced mainly by WRPA staff after the ending over of the First Phase of the Egyptian-Italian Project, with less presence of the Italian side at the intermediate period (the time of the monitoring work). The report of the monitoring work includes the following: Introduction: The Basic Information, Specific Aims and Total Achievements.

Mapping:

Topographic, infrastructure and habitat and land-use maps were produced and their continuous update is presented. Three maps at the scale of 1:100,000 were produced, for topography, infrastructure, and habitat/land use.

Biodiversity monitoring:

Includes the different practices and methodologies applied and the interpretation of the results obtained in the third year of scientific monitoring programmes of WRPA. These programmes included the available aspects of the main elements of biodiversity, such as vegetation, birds, and mammals. With only 10 mm/year rainfall, the area is hyper-arid. Temperatures vary from mean 13° in winter to mean 29° in summer. The plant cover is made up of 3 categories: cultivated crops covering about 4000 acres, naturalized date palms, and the spontaneous vegetation. In the fossil area the main plant species are: *Cornulaca monacantha*, *Salsola imbricata* subsp. *gaetula*, *Tamarix nilotica*, and *Zygophyllum coccineum*, indicating high soil salinity. The distribution of the main plant species in the different habitats was mapped. Birds were monitored only in the Lakes area. On the other hand, mammals were monitored all over WRPA. The species were: *Canis aureus lupaster*, *Vulpes v. aegyptiaca*, *V. r. rueppeli*, *Fennecus zerda*, *Herpestes ichneumon*, *Felis sylvestris lybica*, and *Gazella d. dorcas*. All six species are rare or unobserved in the fossil area, except the fennec. *Gazella leptoceros* (reem), which was very rarely seen in the 1980s was not seen these days.

Resources and environmental monitoring:

This includes the methodologies, results, and assessment of the natural resources within WRPA. Monitoring of geology and palaeontology, aquatic resources (water quality of the two Lakes, the Upper and the Lower), economic activities inside the Area, and their impacts on the environment of the Protected Area, and visitor monitoring. Photographs were made of 35 fossils every month. No damage was observed. A total of 25 fossil sites were examined for repair and 3 of them repaired. One fossil skeleton was transferred in front of the Visitor Center at the Lake shore, but this proved to be an experiment not to be repeated. As for the impact of economic activities, attention was especially paid to the oil well at the NE side of WRPA. Garbage is regularly collected and transferred to a garbage disposal site outside WRPA. Almost all activities are provided with septic tanks for sewage disposal. Regular visitor surveys are carried out. They show that Egyptian visitors constitute 99% of these. The age category with highest percentage is 21-25 years old.

The report on the third year of monitoring was carried out by the WRPA Rangers who became reliable sources of information and in collecting and presenting data, and are

able to evaluate and understand the proper way to keep the protected area well organized and managed.

7. Documentation

a. Photographs, Slides and, where available, film/video

See Atlas

b. Copies of property management plan and extracts of other plans relevant to the property.

See Attachments:

1. Atlas
2. Copy of the management plan for WRPA
3. Copy of the first monitoring report for WRPA

c. Bibliography

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d. Address where inventory, records, and archives are held.

1 - Main Depository:

Egyptian National Commission for UNESCO,
17 Kuwait Street (ex Ismail Aboul-Fotouh),
Dokki,
Cairo,
Egypt

2 - With copies at:

Nature Conservation Sector (NCS),
Egyptian Environmental Affairs Agency (EEAA),
State Ministry for Environmental Affairs (MSEA),
30 Misr-Helwan Agricultural Road,
Maadi,
Cairo,
Egypt

8. Signature on Behalf of the State Party

Name: Mrs. Mervat Omar

**Position: Secretary-General,
Egyptian National Commission for UNESCO**

Signature:

Date:

ACKNOWLEDGEMENTS

Meeting with HE the State Minister for Environmental Affairs

HE Dr. Mamdouh Riad, State Minister for Environmental Affairs, kindly asked for a meeting with the Steering Committee charged with the preparation of the Nomination File for inscribing Egypt's Northern Oases on the Natural World Heritage List, in his office, on 8 September 2003 and encouraged us to go on with the work. He observed that the Whale Valley in Wadi El-Rayan Nature Reserve was under great threat of being very easily damaged due to frequent visitation by large numbers of tourists, reaching as much as 600 on one day. He gave us instructions and urged us to finalize the Nomination File as quickly as possible. We are glad to implement the first phase of this nomination by finalizing herewith the nomination file for the Wadi Al-Hitan (Whale Valley).

Thanks are due to H.E. Dr. Mamdouh Riad, Minister of State for Environmental Affairs, and H.E. Dr. Saad Nassar, Governor of Fayoum, for their valuable support and the facilities offered during the excursions made by the Working Team to the Whale Valley in December 2002.

Thanks are also due to the personnel of the Nature Conservation Sector (NCS) of the Egyptian Environmental Affairs Agency (EEAA), Ministry of State for Environmental Affairs (MSEA): Dr. Mostafa Fouda, Under-Secretary of State of the NCS, Mr. Mohammad Ibrahim, then Director of Nature Reserves, Eng. Atef Darwish, then Director of Nature Reserves and now Consultant at the NCS, Eng. Hossam Kamel, Director of Wadi El-Rayan Protected Area, and his collaborators, for kind help and facilities offered during our excursions, for providing the necessary maps and documents, and for actively participating in our meetings.

It is our pleasure to extend our deepest gratitude to the personnel of the Egyptian National UNESCO Commission: Mrs. Mervat Omar, Secretary-General, Mrs. Intisar Mashaly, Assistant-Secretary-General, Mrs. Mona Allam, Director of Science, Mrs. Gazebia Abdel-Rahman, Environmental Science Specialist, Mrs. Azza Abdel-Aziz, Hydrology Specialist, Mr. Samir Nagy, Logistics Specialist, Mr. Shahhat Abdel-Hady, Financier, and many others in the Commission who offered help without sparing any effort, to make this endeavour a success.

We are pleased and honoured to extend our deepest thanks and sincerest gratitude to our Cooperating Guests who gave us a most valuable helping hand in many aspects and phases of the work: Mr. John Dolson, Dr. Philip Gingerich, Dr. Marco Marchetti, Ms. Nina Prochazka, Mr. Richard Hoath (who kindly gave us a list of the birds), Mr. Rafik Ghabbour, and Miss Samiha Ghabbour.

A most crucial last minute help came from an anonymous world calibre expert in cartography, to whom we extend our deepest gratitude.

THE SCIENTIFIC WORK GROUP

The Work Plan consisted of a meeting of the National MAB Committee in July 2002 to nominate the Steering Committee from within its own members. It was constituted of Prof. Samir Ghabbour (Cairo University), Chairman of the Committee, Prof. (Mrs.) Ferial El-Bedewy, geologist at the University of Mansoura, and Dr. (Mrs.) Boshra Salem, botanist at the University of Alexandria. The Steering Committee met in August 2002 and recruited the following experts as a Task Force to carry on the work needed for the preparation of the Nomination File

*1 – Prof. S. Ghabbour, Chairman of Egyptian National MAB Committee, Conservationist, Coordinator and Editor of the Nomination File.

*2 – Prof. Ferial El-Bedewy, geologist

*3 – Dr. Boshra Salem, botanist

*#4 – Dr. Mostafa Fouda, Under-Secretary of State for the Nature Conservation Sector (NCS), Egyptian Environmental Affairs Agency (EEAA), Ministry of State for Environmental Affairs

#5 – Mr. Mohammad Ibrahim, Director-General for Nature Reserves, EEAA, MSE

6 – Prof. Mohammad Abed, geologist, Univ. of Mansoura (invertebrate palaeontologist)

#7 – Eng. Atef Darwish, Consultant, Central Directorate for Nature Reserves, EEAA,

8 – Dr. Zenhom El-Alfy, Vice-Chairman, Geological Survey

9 – Mr. Yousry Attia, Director of Fossils Section, Geological Museum (vertebrate palaeontologist)

#10 – Eng. Tarek El-Qanawaty, Director of the White Desert (Farafra Oasis) Nature Reserve

#11 – Eng. Hossam Kamel, Director of Fayoum Nature Reserves

#12 – Mr. Ali Metrash, Director of the Siwa Nature Reserve

13 – Mr. Hesham El-Hennawy, Arachnid Specialist

14 – Prof. Wagieh El-Saadawy, Biodiversity Consultant (mosses and fossil plants), Univ. of Ain Shams

15 – Prof. Loutfy Boulos, Biodiversity Consultant (higher plants)

16 – Dr. Mohammad Abdel-Maksoud, Archaeologist, Supreme Council of Antiquities

17 – Prof. Wafai Z. A. Mikhail, zoologist, Cairo University (soil invertebrates)

18 – Dr. Mohammad Ismail, Palaeo-botanist, Univ. of Alexandria

19 – Eng. Mohammad Meheina, GIS specialist

20 – Mr. Joseph N. Soliman, Archaeologist, Supreme Council of Antiquities

* = MAB Committee members:

= from the NCS, EEAA

The Task Force also includes from the Egyptian National UNESCO Commission: Mrs. Intisar Mashaly, Assistant Secretary-General, Mrs. Mona Allam, Director of Science, Mrs. Gazebia Abdel-Rahman (who participated in the May 2002 Amman Workshop on the Harmonization of Tentative Lists of Arab Natural World Heritage Sites), Mrs. Azza Abdel-Aziz, Mrs. Amal Abdin, Mr. Samir Nagy, and Mr. Shahhat Abdel-Hady, who provided all the needed help in the preparation of the meetings, and notably, correspondence, travel and financial arrangements. We are grateful to them. It is a fact that without their support our work could never have been done.

Wadi al-Hitan Task Force Teams

1 – Geology Team:

- Prof. (Mrs.) Ferial El-Bedewy (U. of Mansoura)
- Prof. Mohammad Abed (U. of Mansoura)
- Mr. Yousry Attia (Geological Museum)
- Dr. M. Ibrahim Ismail (U. of Alexandria)

2 – Plant Life Team:

- Prof. Loutfy Boulos (Intern'l Consultant)
- Prof. Wagih El-Saadawy (U. of Ain Shams)

3 – Animal Life Team:

- Prof. Samir Ghabbour (Cairo U.)
- Prof. Wafai Mikhail (Cairo U.)
- Mr. Hisham El-Hennawy (Intern'l Consultant)

4 – Protectorates Administration and Informatics Team:

- Prof. Mostafa Fouda (NCS, EEAA)
- Mr. Mohammad Ibrahim (NCS, EEAA)
- Eng. Atef Darwish (NCS, EEAA)
- Eng. Hossam Kamel (WRPA)
- Eng. Tarek El-Qanawaty (White Desert PA)
- Mr. Aly Metrash (Siwa PA)

5 - Mapping Team:

- Dr. Z. El-Alfy (Deputy-Director, EGSMA)
- Dr. (Mrs.) Boshra B. Salem (U. of Alexandria)
- Mr. Mohammad Meheina (U. of Alexandria)

6 – Archaeology Team:

- Dr. Mohammad Abdel-Maksoud (SCA)
- Mr. Joseph N. Soliman (SCA)

7 – Assistants:

- Mr. Rafik Ghabbour (Cairo U.)
- Miss Samiha Ghabbour (EQI)

TESTIMONIES AND ENDORSEMENTS



0924/ur
Cairo, 29 OCT 2003

L' Ambasciatore d' Italia

Dear Mrs. Omar,

As a continuation of the Egyptian-Italian Environmental Cooperation Program initiative in Wadi El Rayan Protected Area (WRPA), I'm pleased to confirm that the Italian Government will support the development of Wadi El Rayan project during its Phase II, which is due to start early 2004 and lasting for three years.

As per the Overall Work Plan, the project will focus its support to the Ministry of State for Environmental Affairs, and its Nature Conservation Sector, on the consolidation of the results achieved during the first phase, and on the promotion of the environmental education and communication (for which a Visitor Center is already in operation), with integration of cultural resources (like the ancient city of Medinet Madi) for the broader development of sustainable tourism in Fayoum governorate.

Particular attention will be given on strengthening the capacity of the Protected Area officials to manage and conserve the ecosystem, in accordance with internationally recognized guidelines and strategies related to the protection and sustainable management of natural resources, and the Management Plan already adopted in the Protected Area.

Extraordinary efforts will be devoted to Fossil Area of Wadi Hitan (Whale Valley), which is part of the Protected Area. Within the Zoning System of the WRPA Management Plan, differentiated by the different degrees of protection level, this zone is treated as Special Protection Zone. At present the zone is fully under investigation, and a special team will further study the area and prepare a visitor use and education plan leading to a Site Management Plan and to its realization, as soon as the Phase II will be launched providing the required support from international technical assistance and financial resources.

Mrs. Mervat M. Omar
Secretary General
Egyptian National Commission for UNESCO
17, Kuwait Street, Dokki, Cairo

Cc: Dr. Moustafa Fouda
Director Nature Conservation Sector
EEAA – Ministry of State for Environmental Affairs

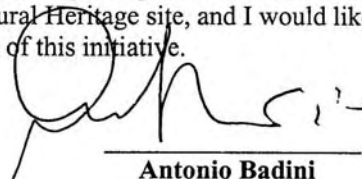
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Letter from HE Mr. Antonio Badini, the Ambassador of Italy, addressed to Mrs. Mervat Omar, Secretary-General of the Egyptian National Commission for UNESCO, explaining future Egyptian-Italian cooperation programmes for the Wadi Al-Hitan area, WRPA (page 1).

Consistent budget allocation is earmarked for the "Wadi Hitan initiative", which will cover technical assistance, training, recruitment of community guards from surrounding villages, the establishment of permanent outpost in a strategic location overlooking the zone, means of transport such as camels, motorbikes and vehicles, VHF base unit with walkie-talkie units, etc.

In addition, we also hope to involve in the near future in this joint endeavor other Italian partners, which have already shown keen interest and would bring the Italian parks experience, possibly facilitating the setting up of a system of exchange of acquisition for a better organization of the territorial management, and the creation of an integrated network of parks in the Mediterranean basin.

Believing in the world's significance of this unique Egyptian Site that is Wadi Hitan, the Italian Government is keen to participate to the efforts being exerted for its declaration as a World Natural Heritage site, and I would like to reaffirm our commitments for the success of this initiative.



Antonio Badini
Ambassador of Italy

Letter from HE Mr. Antonio Badini, the Ambassador of Italy, addressed to Mrs. Mervat Omar, Secretary-General of the Egyptian National Commission for UNESCO, explaining future Egyptian-Italian cooperation programmes for the Wadi Al-Hitan area, WRPA (page 2).

Endorsement by the Vertebrate Paleontological Society of America



SOCIETY OF VERTEBRATE PALEONTOLOGY

60 REVERE DRIVE, SUITE 500
NORTHBROOK, IL 60062 U.S.A.

August 11, 2001

John Dolson
Senior Geological Associate
BP-Egypt
14, Road 252 Digla
PO Box 2409
Cairo, EGYPT

Dear John,

We are delighted to hear that you have organized the support of so many companies in Cairo to help in the vital effort of preserving the prehistory of the Fayoum. For more than 100 years, this area has been famous both to the archeological and the paleontological communities as a world-class showcase of prehistory, a place where the geology is well exposed and the strata extraordinarily rich in important fossils, all overlain with the traces of ancient civilizations.

Your proposal, together with Dr. Aly Wally to coordinate a non-profit, multi-company organization to raise funds to preserve the site is most commendable, and the kind of initiative that we need to preserve these resources for future generations. As you know, there are sites in the United States where the natural setting of paleontological resources has been used to enhance the message, creating natural outdoor museums that are great tourist attractions. Dinosaur National Monument, the Big Badlands, and Dinosaur Ridge are several other examples that attract tens of thousands of visitors every year. Paleontological resources are unique and all too easily destroyed or removed. We strongly endorse the concept of creating local site-appropriate display facilities that not only teach the public about earth history, but which may become attractions, drawing and educating visitors who otherwise might pass by with little awareness of the marvels and significance of the land through which they travel.

The concept of 38 whales lying amidst the stony erg of the Sahara, surrounded by evidence of mangroves and ancient beaches is inspirational, and together with the other attractions of the Fayoum, clearly warrant every possible effort at interpretation and preservation. We heartily endorse your plans to this effect.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'R. Stucky', is written over a faint, larger version of the signature.

Richard K. Stucky, Ph.D.
President, Society of Vertebrate Paleontology
Director of Museum Programs, Denver Museum of Nature and Science

ENDORSEMENTS FROM INDIVIDUAL SCIENTISTS

“There are several reasons that the greater Whale Valley and northern part of Fayoum should be designated a World Heritage Site (or sites). First, Whale Valley itself has an absolutely unique richness of extraordinarily well-preserved early whale fossils. These were the first known to science to retain legs, feet, and toes, and there is much more material eroding at the surface in the site (and being carried away by tourists). Second, the northern part of Fayoum, north of Birket Qaroun, is the best known area in the world for fossils representing the beginning of ‘higher Primate’ evolution, the branch of the evolutionary tree to which we belong. In both cases these sites are part of our scientific heritage (and I use ‘our’ here representing all people of the earth). The region already generates a substantial tourist visitation, and thus needs the protection and respect that designation as a World Heritage Site would provide.”

Philip D. Gingerich, Professor of Palaeontology, University of Michigan, USA

“The site of Whale Valley (Wadi El-Hitan) is as important and perhaps even more significant than that of the Dinosaur National Monument in Colorado”.

J. Dolson, Exploration Advisor, BP.

“ repeated, persistent fossil collecting in the same productive areas will continue to unveil new fossil species and new information about paleoenvironments, biogeography and the evolution of all variety of plant and animal life.”

E. Simons and D. T. Rasmussen (1990)

Support from External Experts

We were surprised, and also very happy, to receive on the first of December 2002 from Ms. M. Ugo at the UNESCO World Heritage Center and from Ms. P. Matero, at the UNESCO Cairo Office, messages indicating that they were contacted by a team of Egyptian, American, and Polish geologists, who had been working since several years in the Valley of Whales and are specialists of the area, and who would like to give their contribution to this Nomination File, helping through their information and studies on the site. We were very glad for this unexpected help. A leading expert of that team, Mr. John Dolson, Team Leader, American Association of Petroleum Geologists, Egypt and NE Africa, and Exploration Advisor, BP (now located in Sunbury-on-Thames, United Kingdom) effectively paid a visit to the Egyptian National UNESCO Committee and talked to us about the importance of the Whale Valley (406 fossil skeletons in a stretch 10 kms long, from 45 million years ago), in an ancient lagoonal environment with fossil mangroves, indicating a tropical type of climate at that remote time.

Mr. Dolson who was on the Board of Directors for the Friends of Dinosaur Ridge, in Colorado, USA, which he had helped create, kindly gave us copies of a report detailing these researches. Moreover, he pointed out to another very important site, north of Lake Qaroun and within the boundaries of the Lake Qaroun Nature Reserve, in the north of Fayoum Governorate. The site is the area between Gebel Qatrani and the Lake Qaroun. The Gebel Qatrani, he pointed out, is the meeting point of the 2 great Afro-Arabian Shield faults, the Rift Valley and the Syrian Arc. The area in question contains the oldest basalt quarries, dating from the Neolithic, the most ancient paved road (about 10 km long) in the world leading from the quarries to the shores of Lake Moeris (the ancient Lake Qaroun), dating from the Predynastic and the early Dynasties of the Old Kingdom (Harrell and Bown 1995), a Graeco-Roman old city (Dima) and a temple (Qasr El-Sagha), and a Coptic monastery of the 8th-9th centuries B.C. (Deir Abu Lifa), all in acceptably good condition but exposed to threats (due to encroaching development schemes and uncontrolled tourism, besides vandalism), and all along a distance of 10-15 kms, relating a history of more than 5000 years. Dr. Dolson obtained several hundred endorsements from all over the world in favour of inscribing the Gebel Qatrani area on the World Heritage List.

Dr. Dolson also kindly came to our meeting with H.E. the Governor of Fayoum, in company of his colleague Dr. Ahmad El-Barkouky, Professor at the Geology Dept., Cairo University, and made a special presentation on both sites, namely the Valley of Whales and Gebel Qatrani. Geologist Yousry Attia, Curator of Vertebrate Fossils at the Cairo Geological Museum, confirmed to H.E. the Governor all the information given by Dr. Dolson. He added that the area contains the (Miocene) fossils of 12 Orders out of the 28 Orders of Eutherian (placental) Mammals, from Insectivora to Primates. Dr. Wagieh El-Saadawy, Professor at the Botany Dept., University of Ain Shams, Cairo, on his part, emphasized the importance of the fossil forests (petrified wood) in the area. Prof. (Mrs.) Ferial El-Bedewy and Prof. Mohammad Abed (both at the Geology Dept., University of Mansoura), also confirmed the geological uniqueness and interest of the Gebel Qatrani site, which they had been studying for the last 20 years.

Dr. Dolson further pointed out the threats to the Gebel Qatrani site from vehicles and uncontrolled tourism. He said that out of the 8 ancient basalt quarries, four are now

completely obliterated because of modern quarrying on the very same sites. *He strongly warned against the imminent loss of the remaining four.* Dr. Zenhom El-Alfy (Deputy Director, EGSMA), added that in some mysterious way the Ancient Egyptians apparently surmised that the black clay brought by the Nile with each flood originated from the erosion of basalt, and so they revered that kind of rock. They quarried it for making sacred objects. If the stone slabs or blocks they extracted from the mountain were fissured, they used them as floor slabs for temples. If they were in one piece, they carved the small ones for making vessels while the larger ones were carved into sarcophagi.

We sent Dr. Dolson's speech to H.E. the Governor at this meeting, by e-mail to Dr. Francesco Bandarin (Director, WH Center) and Dr. Giovanni Boccardi (responsible for Arab States at the WHC).

H.E. the Governor of Fayoum told us of plans to have a natural history museum for the Governorate. One highly placed investor offered the land and H.E. the Deputy-Prime Minister and Minister of Agriculture, Dr. Youssef Waly, offered a substantial private fund as seed money for its construction. The envisaged site is at the western end of the cultivated land of the Governorate, near to the entrance to the Wadi El-Rayan Protected Area. Another *in situ* open-air museum for the whales was also decided, with due protection of their fossil skeletons.

We later received an e-mail from Mr. Maged Toson, a not-for-profit safari organizer, on the remarkable beauty of the site, which we also forwarded to Drs. Bandarin and Boccardi.

**Decisions of the 25th Session of the World Heritage Committee,
Helsinki, Finland, December 2001
Concerning Desert Landscapes**

IX.16 Commenting on the Secretariat's report on the Desert Landscape Meeting, organized in Egypt (September 2001), the Committee recalled the importance of this category of properties. It recommended that resources be allocated to further the process of identification of potential desert landscapes for possible inclusion on the World Heritage List, starting with those located across two or more countries. Committee members from the Arab region stated that this should be the focus rather than dispersing resources on less urgent initiatives, such as the proposed Thematic Study on Modern Heritage in the Arab States. In this respect, and taking into account that deserts are a common feature across several regions of the world, the Committee stressed the desirability of a more intense inter-regional co-operation in this field, such as in the Mediterranean Action Plan. The Delegate of Egypt suggested that the year 2003 be declared an *International Year of the Desert*.

APPENDIX

EXTANT BIODIVERSITY
IN WRPA AND FAYOUM

1 Flora

1.1 Mosses

Mosses of Fayoum and Adjacent Areas

Taxa recorded	Oasis	Site of collection	Notes
CLASS: Bryopsida Order: Fissidentales Family: Fissidentaceae Schimp 1. <i>Fissidens bryoides</i> Hedw. var. <i>gymnandrus</i> (Büse) R. Ruthe.	Nile Fayoum	Zaw'yet El-Karadsa Bani Salem Ezbet Abou Shanab Ezbet El-Sheemi	Only sites in Egypt
<i>F. viridulus</i> (Sw.) Wahlenb.	Nile Fayoum	Ezbet Abou Shanab	
Order: Dicranales Family: Ditrichaceae Limpr. <i>Ceratodon purpureus</i> (Hedw.) Brid. var. <i>rotundifolius</i> Berggr.	Nile Fayoum	El-Zawia El-Khadhra Manshiy'yet Halpha Tobhar	Only sites in Egypt
Family: Dicranaceae Schimp. Subfamily: Anisothecioidea <i>Dicranella rufescens</i> (With.) Schimp.	Nile Fayoum	El-Qah'hafa	Only site in Egypt
ORDER: POTTIALES Family: Pottiaceae Schimp. Subfamily: Trichostomoideae Subfamily: Merceyoideae <i>Barbula bolleana</i> (Mull.Hal.) Broth	Nile Fayoum	Sersena Zaw'yet El-Karadsa Ezbet El-Sheemi El-Zawia El-Khadhra And others	
<i>B. unguiculata</i> Hedw.	Nile Fayoum	Sinnuris Tersa Abou Gensho El-Ghareeb near El-Ka'abi Fedimeen	
<i>B. unguiculata</i> Hedw. fo. <i>robusta</i> (Lindb.) Podp.	Nile Fayoum	Sersena Gabala	Only sites in Egypt
<i>Didymodon fallax</i> (Hedw.) R.H. Zander	Nile Fayoum	Sinnuris Ezbet El-shaikh Salem Tersa Manshiy'yet Halpha Kafr Mahfooze Ain Horrah	

	Farafra		
<i>D. tophaceus</i> (Brid.) Lisa	Nile Fayoum Farafra	Sinnuris Ezbet El-Shaikh Salem Sersena Zaw'yet El-Karadsa Between Ezbet El- Hadeer and El-Fayoum city Kafr Mahfooze Ain Beshowy	
<i>D. vinealis</i> (Brid.) R.H. Zander	Nile Fayoum Bahariya	Sinnuris Bani Salem El-Sele'yeen El-Agamain El-Ghareeb near El-Ka'abi	
<i>Gymnostomum aeruginosum</i> Sm.	Nile Fayoum	Between El-Gareeb and El-Fayoum city Between Ezbet El-Hadeer and El- Fayoum city	
ORDER: FUNARIALES Suborder: Funariineae Family: Funariaceae Schwägr. <i>Funaria hygrometrica</i> Hedw.	Nile Fayoum	El-Zawia El-Khadhra Manshiy'yet Halpha Tobhar Meniet El- Ga'afra Between El-Gareeb and El-Fayoum city and others	
Suborder : Splachineae Family: Splachnobryaceae A. Kop. <i>Splachnobryum obtusum</i> (Brid.) Müll. Hal.	Nile Fayoum	El-Qah'hafa Fedimeen	Only sites in Egypt
<i>Bryum alpinum</i> Huds. ex With.	Nile Fayoum	Between Ezbet El- Hadeer and El-Fayoume El-Mokhtalata	
<i>B. bicolor</i> Dicks.	Nile Fayoum	Manshiy'yet Halpha Siy'ala (on the way to Demmo)	
<i>B. caespiticium</i> Hedw.	Siwa	Qareat Zammour, 29° 11' N and 25° 32' E	
<i>B. elegans</i> Nees	Nile Fayoum	El-Qah'hafa Siy'ala (on the way to Demmo)	
<i>B. gemmiparum</i> De Not.	Nile Fayoum	Zaw'yet El-Karadsa Ezbet El-Sheemi Between Ezbet El- Hadeer and El-Fayoum city	

		+	
Family: Bartramiaceae Schwägr. <i>Philonotis evanidinervis</i> M. Fleisch.	Nile Fayoum	Sinnuris Ezbet El-shaikh Salem Sersena Gabala Zaw'yet El-Karadsa Ezbet Mekhaimer Yousef El-Sa-I-di-ya And others	
<i>P. hastata</i> (Duby) Wijk and Margad.	Nile Fayoum	Sinnuris Ezbet El-Shaikh Salem Sersena Gabala Kafr Mahfooze Ezbet Mekhaimer Yousef El-Sa-I-di-ya And others	
<i>P. marchica</i> (Hedw.) Brid.	Nile Fayoum	Gabala Teriet el-Gomhoriay Ezbet Bisheer Siy'ala Ezbet Et-Mahdi (Ebshowai) And others	
ORDER: ORTHOTRICHALES Family: Orthotrichaceae Arnold <i>Zygodon obtusifolius</i> Hook.	Nile Fayoum	Sinnuris Between Sersena and Gabala Manshiy'yet Halpha Etsa Qasr Kamel	Only sites in Egypt

1.2 Higher Plants

Psammophytic vegetation

The psammophytic vegetation occupies flat expanses of wind-drifted sand 'the sand plains' and 'sand dunes' at different stages of development. The vegetation on the plains is usually richer in plant cover. The dominant species is *Alhagi graecorum*, associated with *Stipagrostis scoparia*, *Calotropis procera*, *Aerva javanica*, *Tamarix nilotica*, *Hyoscyamus muticus*, *Suaeda vermiculata*, *Cressa cretica*, *Reaumuria hirtella* and *Zygophyllum album*. On the older stabilized sand dunes *Tamarix nilotica* and *Alhagi graecorum* grow in abundance and may cover the summits and slopes of the dunes. In Baris, a southern village of Kharga, *Balanites aegyptiaca* (heglig or desert dates) and *Hyphaene thebaica* (doum palm) trees are seen among the dunes.

Xerophytic vegetation

The xerophytic vegetation occupies the desert ecosystem mainly around the oases and is practically a part of the Western Desert Flora, with an extensive list of vascular desert plants which is outside the scope of this study.

2. Fauna

Note: Aquatic animals, especially fish, exist in the Rayan nearby lakes but only terrestrial animals are considered here.

2.1 Invertebrates

2.1.1 Soil Animals

Species listed here are those found in Fayoum.

Taxa	Fayoum
Carabidae	
<i>Siagona europaea</i>	+
<i>sesostris</i>	+
<i>eurytus</i>	+
<i>clypeatus</i>	+
<i>minutus</i>	+
<i>tensicollis</i>	+
<i>Apotomus velox</i>	+
<i>varium</i>	+
<i>mixtum</i>	+

Taxa	Fayoum
<i>Tachys fumigatus geminatus</i>	+
<i>scutellaris aegyptiacus</i>	+
<i>lucasi</i>	+
<i>metallicus</i>	+
<i>ornatus</i>	+
<i>Pogonus gilvipes</i>	+
<i>Grayi</i>	+
<i>Melaenus elegans</i>	+
<i>Graniger semeleleri</i>	+
<i>Abacetus stenoderus</i>	+
<i>Pterosticus barbarus</i>	+
<i>pharaoh</i>	+

<i>Orthotricus cymindioides</i>	+
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Taxa	Fayoum
<i>Agonum nigrum</i>	+
<i>Daptus vittatus</i>	+
<i>Anisodactylus virens winthemi</i>	+
<i>Amblystomus levantinus laevistriatus</i>	+
<i>Acupalpus elegans</i>	+
<i>Tetragonoderus arcuatus</i>	+
<i>Microlestes corticalis</i>	+
<i>Glycia ornate</i>	+
<i>rufolimbata</i>	+
<i>unicolor</i>	+
<i>suturalis</i>	+

Taxa	Fayoum
<i>Cymindoidea tessellata</i>	+
<i>Zuphium olens kochi</i>	+
<i>Varum sp.</i>	+
<i>Parallelus riffaudi</i>	+
<i>Brachynus latipennis</i>	+
Dytiscidae	
<i>Hydrovatus clypealis</i>	+

Taxa	Fayoum
Staphylinidae	
<i>galeatus</i>	+
<i>Vitulus</i>	+

Taxa	Fayoum
<i>spectabilis</i>	+
<i>aegyptius</i>	+
<i>wittmeri</i>	+
<i>Medon debilicornis</i>	+
<i>ochraceus</i>	
<i>Lathrobium torretassoi</i>	+
<i>Achenium cribriceps</i>	+

Taxa	Fayoum
<i>Tachyparus nitidulus</i>	+
<i>Aleochara bipustulata</i>	+
Malachiidae	
<i>Cephaloncus aegyptiacus</i>	+
Dasytidae	
<i>Microjulistus wegneri</i>	+

Taxa	Fayoum
Anobiidae	
<i>Xyletinus bucephalus</i>	+
<i>Lasioderma serricorne</i>	+
Elateridae	
<i>Cardiophorus humilis</i>	+
Buprestidae	
<i>Acmaeodera udsersula</i>	+
<i>kindermanni</i>	+
<i>viridis</i>	+
<i>Mimosa cyanea</i>	+

Taxa	Fayoum
<i>Sphenoptera dongolensis</i>	+
<i>trispinosa</i>	+
<i>Agrilus derasofasciatus</i>	+
<i>Aphanisticus aegyptiacus</i>	+
Hydrophilidae	
<i>Helochares melanophthalmus</i>	+
<i>maculiaper</i>	+

Taxa	Fayoum
Dermestidae	
<i>Phradonoma cercyonoides demaisonii</i>	+
<i>Anthrenus crustaceus</i>	+
<i>rotundatus</i>	+
Lathridiidae	
<i>Hyperaspis marmottani</i>	+
Anthicidae	
<i>Leptaleus unifasciatus</i>	+

Taxa	Fayoum
<i>Anthicus armatus</i>	
<i>bremei</i>	+
<i>phoxus</i>	+
<i>wegeneri</i>	+
<i>testaceipes</i>	+
<i>floralis</i>	+
Meloidae	
<i>Mylabris menthae</i>	+
<i>Meloe proscarabaeus</i>	+

Taxa	Fayoum
Mordellidae	
<i>Anaspis lutea</i>	+
Tenebrionidae	

<i>Oxycara pygmaeum</i>	+
<i>Pogonobasis ornate</i>	+
<i>Scaurus puncticollis puncticollis</i>	+
<i>Hispida</i>	
<i>major</i>	+
<i>latreillei</i>	+
<i>canescens canescens</i>	+
<i>angulata angulata</i>	+
<i>Blaps polychresta</i>	+

Taxa	Fayoum
<i>Opatrinus corvinus</i>	+
<i>Scleron orientale</i>	+
<i>Opatroides punctulatus</i>	+
<i>Cechenosternum rufulum nigrosuturale</i>	+
<i>Cossyphus moniliatus</i>	+

Taxa	Fayoum
Scarabaeidae	
<i>Oniticellus pallens</i>	+
<i>Onthophagus melanocephalus</i>	+
<i>lividus</i>	+

<i>Rhyssemus goudoti</i>	+
<i>Physemodes orientalis</i>	+
<i>Pleurophorus caesus</i>	+
<i>Hybosorus illigeri</i>	+
<i>Heteronychus licas</i>	+
<i>Tropinota squalida</i>	+

Taxa	Fayoum
Chrysomelidae	
<i>Cyaniris unipunctata</i>	+
<i>venusta</i>	+
<i>Stylosomus niloticus multinotatus</i>	+
<i>Cryptocephalus brunicollis innesi</i>	+
<i>maculicollis</i>	+
<i>punctatissimus*</i>	+
<i>Chloropterus pallidus</i>	+
<i>Diorhabda elongata sublineata</i>	+
<i>Chaetocnema tibialis</i>	+
Bruchidae	
<i>Bruchus angustifrons</i>	+
<i>baudoni</i>	+
<i>fulvus</i>	+
<i>incarnatus</i>	+
<i>poupillieri</i>	+
<i>sahlbergi</i>	+

* *signatithorax*

Taxa	Fayoum
<i>B. trifolii</i>	+
<i>quadrimaculatus</i>	+
<i>Pseudopachymerus lallemanti</i>	+
<i>Spermophagus sericeus</i>	+
Scolytidae	
<i>Phloeotribus scarabaeoides</i>	+
Curculionidae	
<i>Phacephorus nubeculosus</i>	+
<i>Tanymecus musculus</i>	+
<i>Ocellatus</i>	+
<i>Coniatus laetus</i>	+
<i>aegyptiacus aegyptiacus</i>	+
<i>Cleonus kahirinus</i>	+
<i>clathratus</i>	
<i>Vittiger</i>	+
<i>brevirostris</i>	+
<i>Lixus nubianus</i>	
<i>astrachanicus</i>	+

Taxa	Fayoum
<i>L. soricinus</i>	+
<i>Geranorrhinus suturalis</i>	+
<i>Smicornyx rufipennis</i>	+
<i>Arthrostenus alternans</i>	+
<i>Apion tamaricis</i>	+
<i>Corimalia latifrons</i>	+
<i>Letourneuxi</i>	+
<i>martini</i>	+
<i>Mutica</i>	+
<i>Setulosa</i>	+
<i>Lepidotychius morawitzi</i>	+
<i>Gymnetron melinum molle</i>	+

<i>spitzyi nesapia</i>	+
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2.1.2 Arachnida

Arachnida in Wadi El-Rayyan Arranged by Families

Spiders [11 families, 15 genera, 16 species]

Family	Genera	Species	Family	Genera	Species
Agelenidae	1	1	Oxyopidae	2	2
Araneidae	2	3	Philodromidae	2	2
Eresidae	1	1	Salticidae	1	1
Gnaphosidae	2	2	Tetragnathidae	1	1
Lycosidae	1	1	Thomisidae	1	1
Miturgidae	1	1			

Scorpions [1 family, 2 genera, 2 species] Buthidae

Sunspiders [1 family, 1 genus, 1 species] Galeodidae

Pseudoscorpions [1 family, 1 genus, 1 species] Olpiidae

2.2 Vertebrates

2.2.1 Amphibia and Reptiles

Taxa	Fayoum
Agamidae	
<i>Laudakia stellio stellio</i>	+
<i>Trapelus mutabilis</i>	+
Gekkonidae	
<i>Hemidactylus turcicus</i>	+
<i>Ptyodactylus guttatus</i>	+
<i>Stenodactylus sthenodactylus</i>	+
Lacertidae	
<i>longipes</i>	+
Scincidae	
<i>Chalcides ocellatus ocellatus</i>	+
<i>Sphenops sepsoides</i>	+

* *stenodactylus*

Taxa	Fayoum
Leptotyphlopidae	
<i>Leptotyphlops macrorhynchus</i>	+
Boidae	
<i>Eryx colubrinus colubrinus</i>	+
Colubridae	
<i>Coluber florulentus</i>	+
<i>nummifer</i>	+
<i>Dasypeltis scabra</i>	+
<i>Lycophidion capense capense</i>	+

<i>Malpolon moilensis</i>	+
<i>monspeulana insignita</i>	
<i>Psammophis schokari aegyptius</i>	
<i>sibilans sibilans</i>	+

Taxa	Fayoum
Elapidae	
<i>Naja haje haje</i>	+
Viperidae	
<i>Cerastes vipera</i>	+
<i>Cerastes cerastes</i>	+

2.2.2 Birds

The Western Desert of Egypt covers one of the most arid parts of the world supporting a relatively low biodiversity that is, nevertheless, of considerable biological interest. As regards the bird species, few breed, and these are catalogued in the attached lists. Only one of the areas covered in this summary, Farafra (White Desert), Siwa, Bahariya and the desert areas of Wadi Rayyan, is scheduled in Baha El Din (1999), as an "Important Bird Area", according to the criteria of "Birdlife International" and that is Wadi Rayyan, but based largely on the avifauna of the two lakes there. The breeding birds of these sites are summarized below.

The Breeding Birds of Wadi Rayyan*

(after Goodman and Meininger 1989)

Little Bittern *Ixobrychus minutus*
 Cattle Egret *Egretta ibis*
 Little Egret *Egretta garzetta*
 Black-shouldered Kite *Elanus caeruleus*
 Kestrel *Falco tinnunculus*
 Moorhen *Gallinula chloropus*
 Purple Gallinule *Porphyrio porphyrio*
 Senegal Thick-knee *Burhinus senegalensis*
 Cream-coloured Courser *Cursorius cursor*
 Kittlitz's Sandplover *Charadrius pecuarius*
 Kentish Plover *Charadrius alexandrinus*
 Spur-winged Plover *Hoplopterus spinosus*
 Rock Dove *Columba livia*
 Palm Dove *Strptopelia senegalensis*
 Senegal Coucal *Centropus senegalensis*
 Eagle Owl *Bubo bubo*
 Egyptian Nightjar *Caprimulgus aegyptius* **
 Little Green Bee-eater *Merops orientalis*
 Blue-cheeked Bee-eater *Merops superciliosus*
 Hoopoe *Upupa epops*
 Hoopoe Lark *Alaemon alaudipes* **
 Crested Lark *Galerida cristata*
 Sand Martin *Riparia riparia*
 Swallow *Hirundo rustica*
 Common Bulbul *Pycnonotus barbatus*
 Rufous Bush-chat *Cercotrichas galactotes*

Mourning Wheatear *Oenanthe lugens* **
 Fan-tailed Warbler *Cisticola juncidis*
 Graceful Warbler *Prinia gracilis*
 Clamorous Reed Warbler *Acrocephalus stentoreus*
 Olivaceous Warbler *Hippolais pallida*
 Great Grey Shrike *Lanius excubitor*
 Hooded Crow *Corvus corone*
 Brown-necked Raven *Corvus ruficollis*
 House Sparrow *Passer domesticus*
 Goldfinch *Carduelis carduelis*
 *Includes lake areas of Wadi Rayan
 ** Characteristic of the Saharo-Sindian biome

Significant Bird Species.

Wadi El-Rayan is included in Birdlife International’s inventory of IBAs in Egypt, and that largely due to the two large lakes, wetland areas.

2.2.3 Mammals

Taxa	Fayoum
Insectivore	
Erinaceidae	
<i>Hemiechinus auritus aegyptius</i>	+
Soricidae	
<i>Crocidura flavescens</i>	+
Chiroptera	
Rhinopomotitidae	
<i>Rhinopoma hardwickei arabium</i>	+
Emballonuridae	
<i>Taphozous perforatus</i>	+
Hipposideridae	
<i>Asellia tridens</i>	+
Rhinolophidae	
<i>Rhinolophus clivosus brachygnathus</i>	+
Vespertilionidae	
<i>Pipistrellus kuhli</i>	+
<i>Otonycteris hemprichi</i>	+
Lagomorpha	
Leporidae	
<i>Lepus capensis rothshildi</i>	+
Rodentia	
Muridae	
<i>Rattus rattus</i>	+
<i>Mus musculus</i>	+
<i>Nesokia indica</i>	+
<i>Arvicanthis niloticus</i>	+
Cricetidae	
<i>Gerbillus gerbillus</i>	+

<i>gerbillus</i>	
<i>andersoni andersoni</i>	+
<i>Dipodillus campestris</i>	+
<i>wassifi</i>	
<i>amoenus</i>	+
<i>Meriones shawi</i>	+
<i>Pachyuromys duprasi</i>	+
<i>Psammomys obesus</i>	+
<i>obesus</i>	
Spalacidae	
<i>Spalax ehrenbergi</i>	+
Muscardinidae	
<i>Eliomys quercinus</i>	+
<i>cyrenaicus</i>	
Dipodidae	
<i>Jaculus jaculus jaculus</i>	+
Hystricidae	
<i>Hystrix cristata</i>	+
Carnivore	
Canidae	
<i>Canis aureus</i>	+
<i>Vulpes rueppelli</i>	+
<i>rueppelli</i>	
<i>zerda</i>	+
Mustelidae	
<i>Poecilictis libyca</i>	+
Viverridae	
<i>Herpestes ichneumon</i>	+
Hyaenidae	
<i>Hyaena hyaena</i>	+
Felidae	
<i>Felis chaus</i>	+
<i>F. sylvestris tristrami</i>	+
Artiodactyla	
Bovidae	
<i>Gazella leptoceros</i>	+
<i>G. dorcas dorcas</i>	+
<i>Ammotragus lervia</i>	+

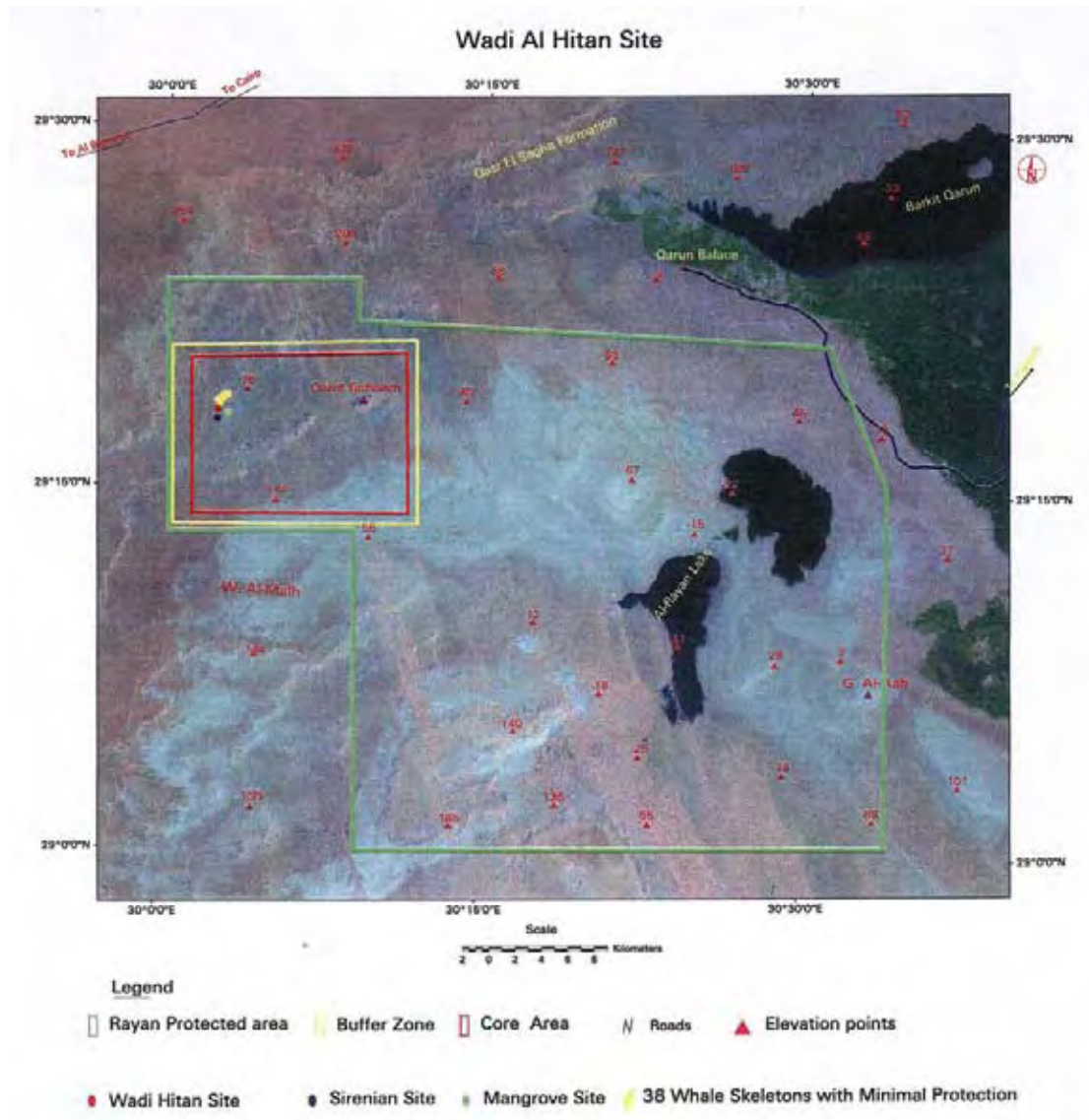


Fig. 1 – Map produced of satellite image of Wadi Al-Hitan (Whale Valley), Wadi El-Rayan Protected Area, Faiyum Governorate, proposed World Heritage Site showing approved boundaries of core area (red rectangle) and buffer zone (yellow rectangle). The boundaries of the Wadi Al-Rayan Protected Area (WRPA) are shown by a green line. Scale of A4 reduction: ~ 1:579,000. Map prepared by EGSMA (Egyptian Geological Survey and Minerals Authority).

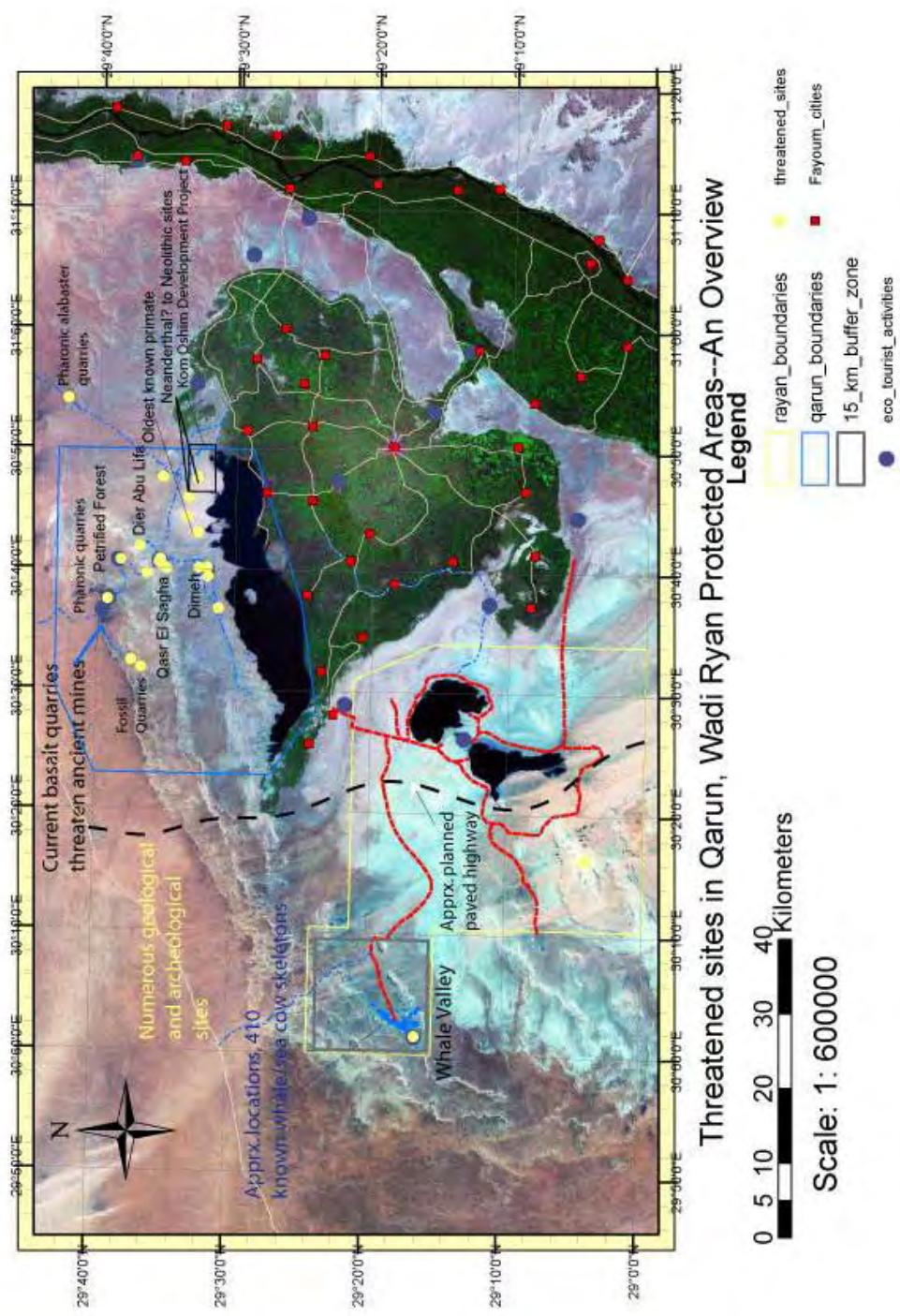


Fig. 3a –Satellite image of Wadi Al-Hitan (Whale Valley) within a 15x15 km area in WRPA. Scale; 1:600,000, showing some of the threatened sites and a 15x15 km area where whale fossils are concentrated (courtesy of Mr. J. Dolson). This area is not the proposed area for the World Heritage Site.

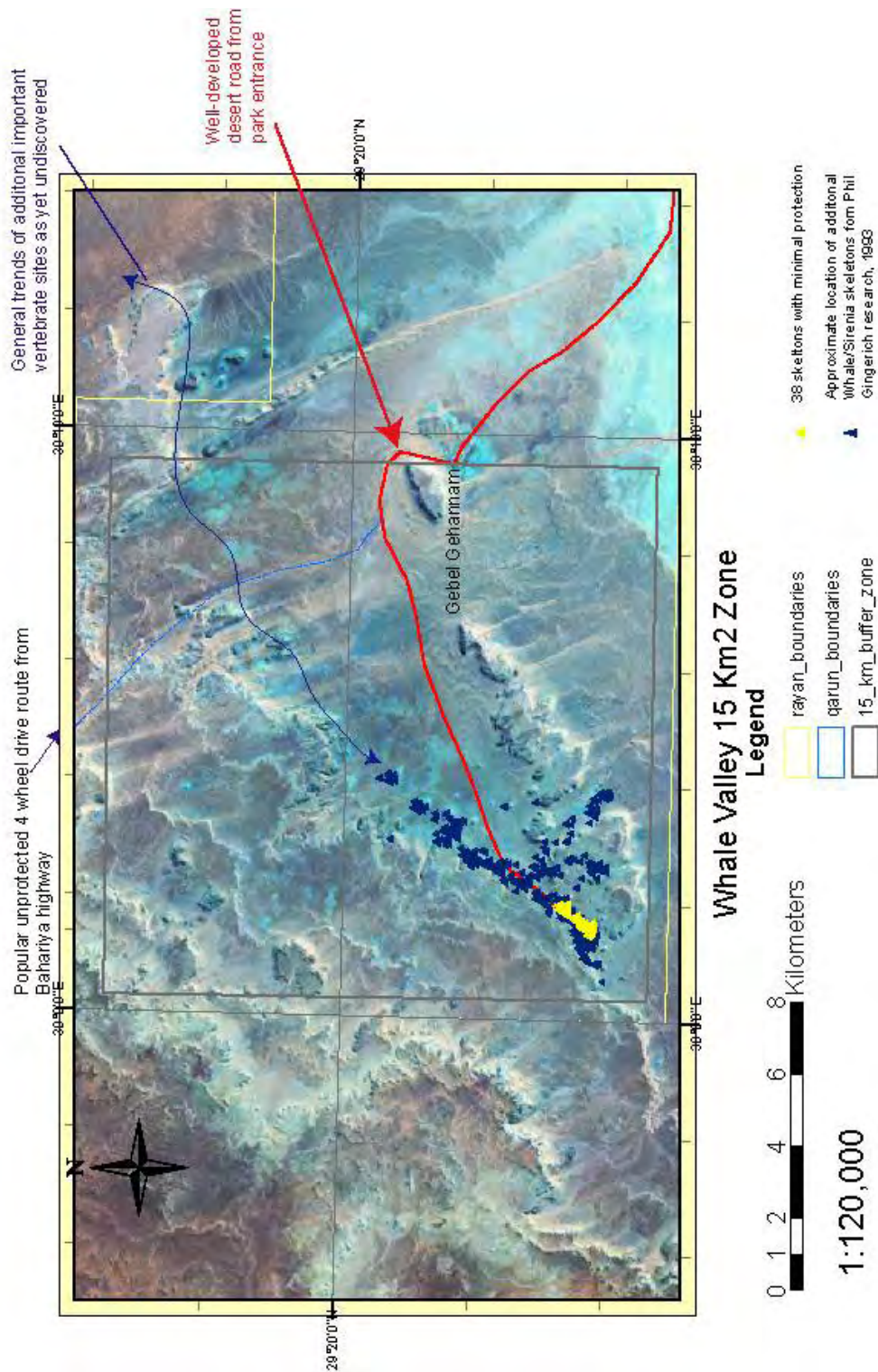


Fig. 3b – Enlarged part of previous map, scale 1:120,000, showing the well developed desert road from park entrance past Gebel Gahannam, position of some whale skeletons, and approximate location of whale and sirenian (sea cows) skeletons (courtesy Mr. J. Dolson).

Location: 1-3 hours from Cairo

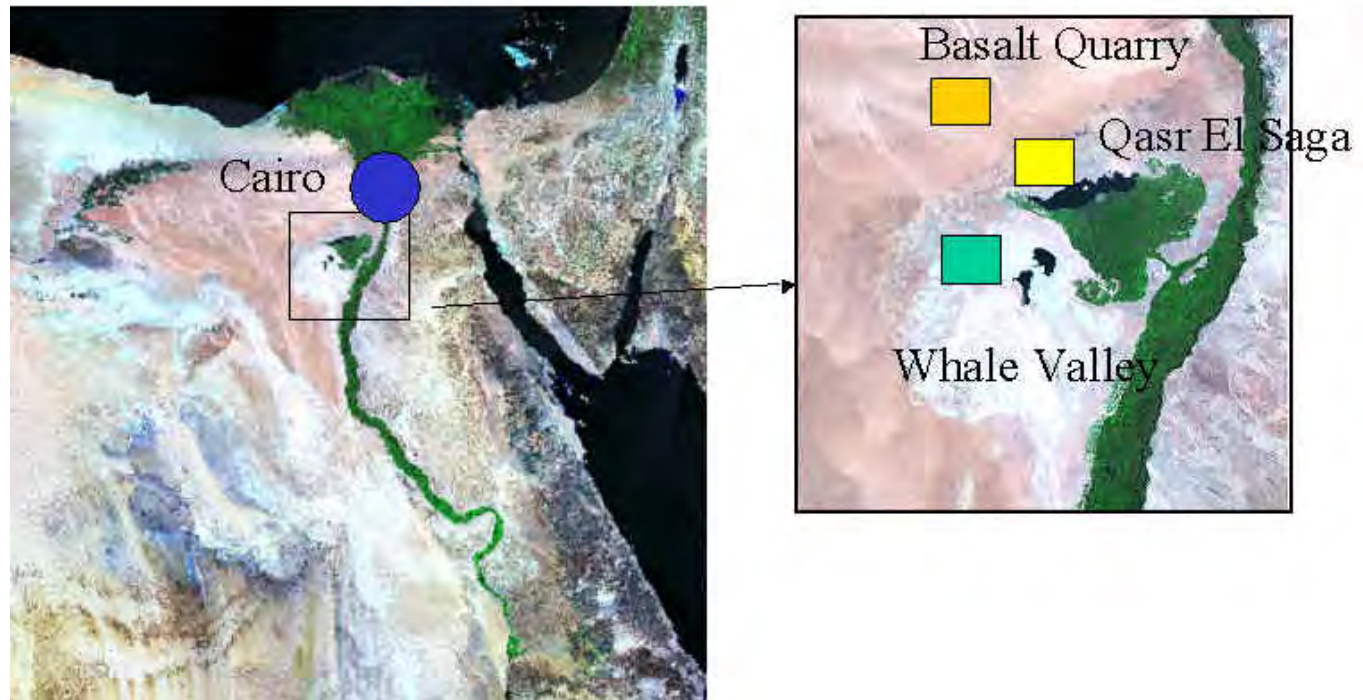
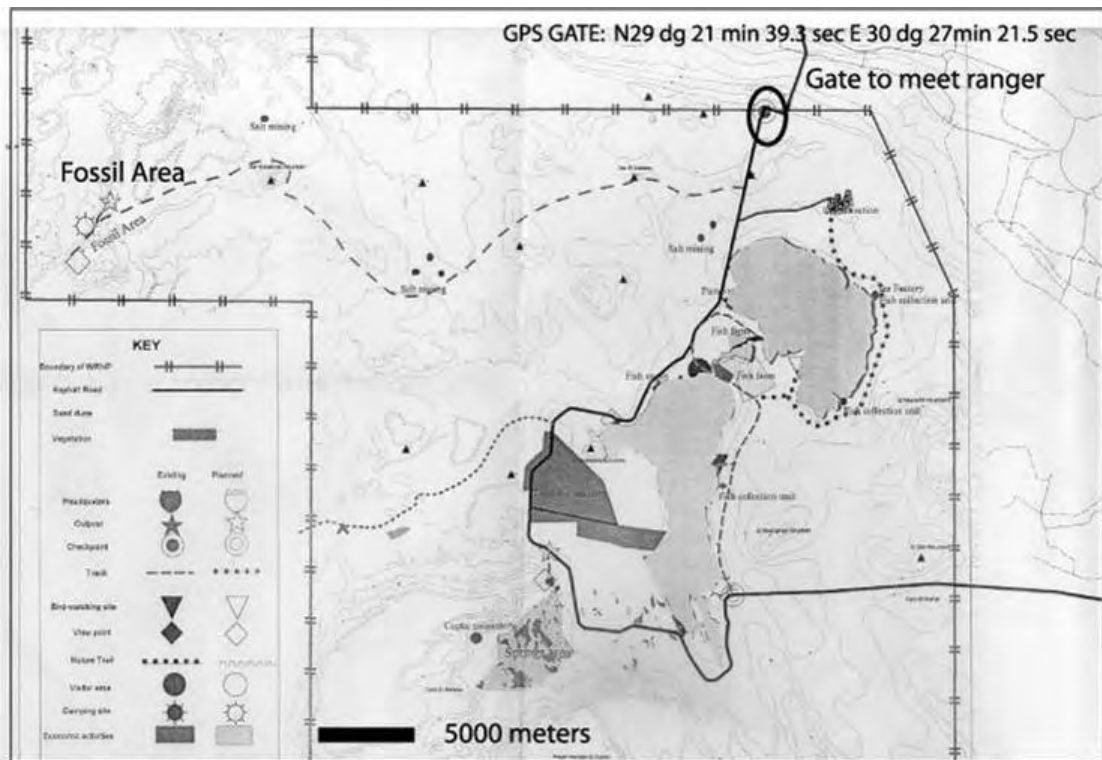


Fig. 4 – Location of Wadi Al-Hitan in relation to Cairo (courtesy Mr. J. Dolson).



Map 1999. Egyptian-Italian Environmental Programme: Support to Wadi El Rayan Natural Protectorate

Fig. 5 – Map of WRPA. The fossil whale area shown is apprixamately 35 km west of the entrance to the park, but the road winds for about 45 km (courtesy Egyptian-Italian Environmental Programme, EIEP).

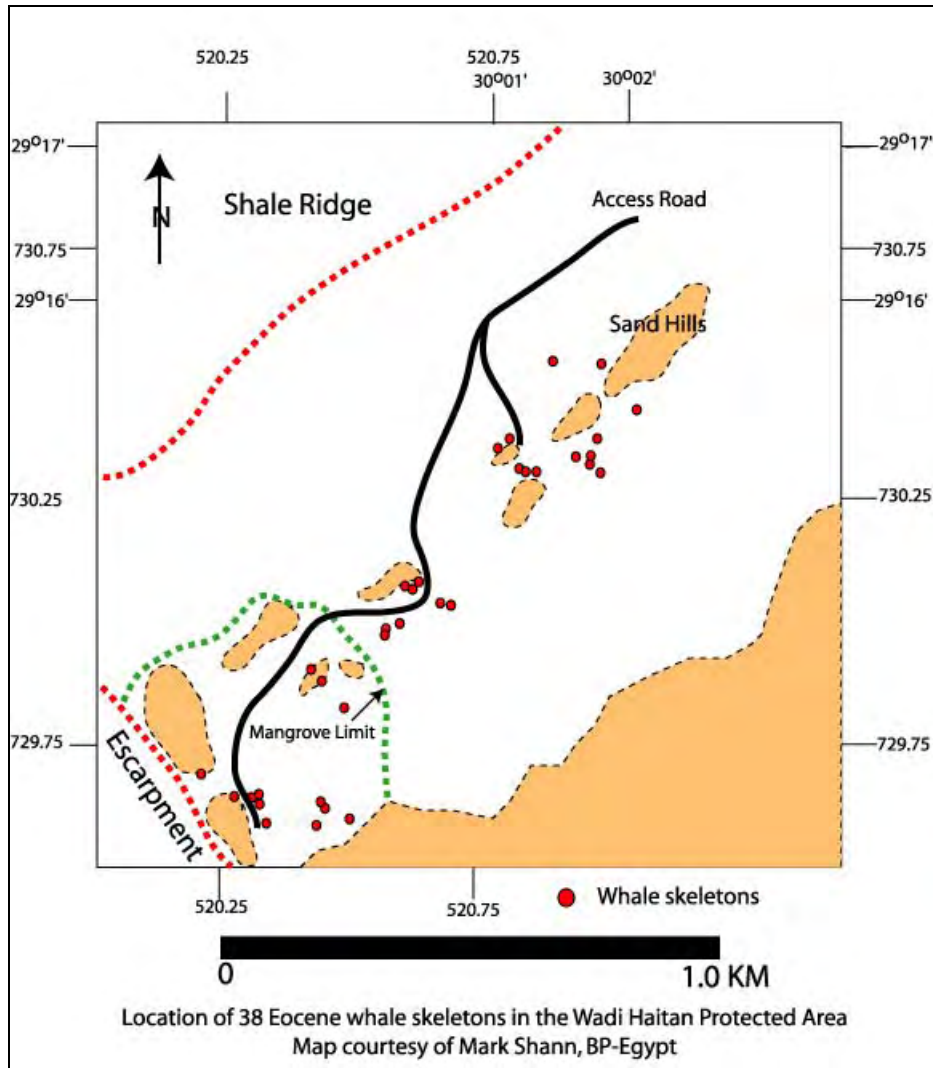


Fig. 6 – Map of 38 whale skeletons and location of heavily mangrove rooted ancient shoreline within the core area. Numbers for location are eastings and northings in meters (after Dolson *et al.* 2002).

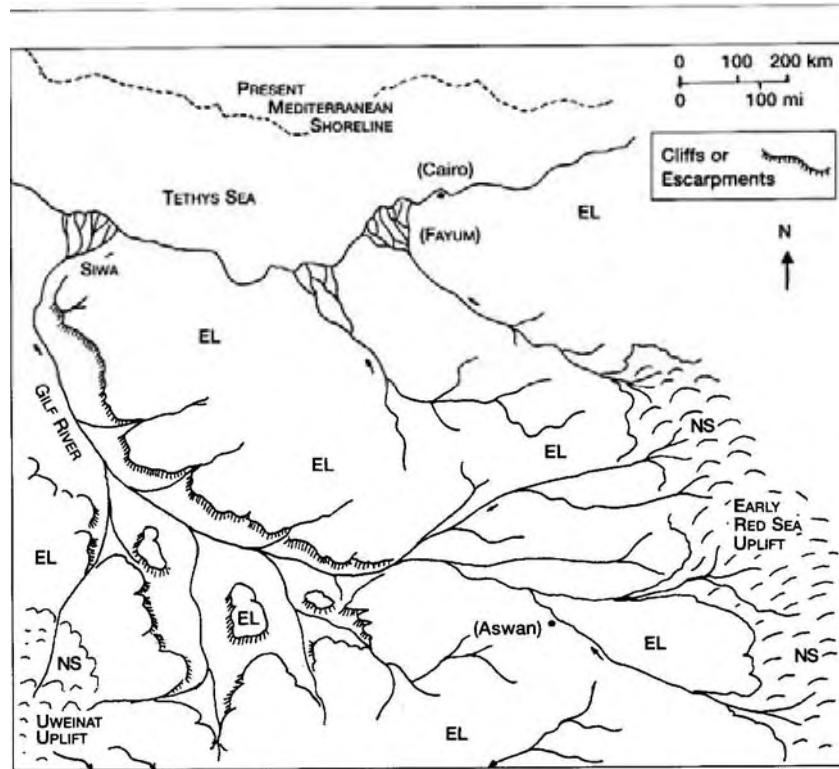


Fig. 7 – The proposed Gilf [Radar] River system of the Oligocene Epoch. Arrows indicate direction of flow in the channels. Rock layers at the surface: EL = Eocene limestone, NS = Nubia sandstone. Note the deltaic systems at present day Fayoum, Bahariya and Siwa (after Sampsell 2003, with kind permission of B. Issawi).

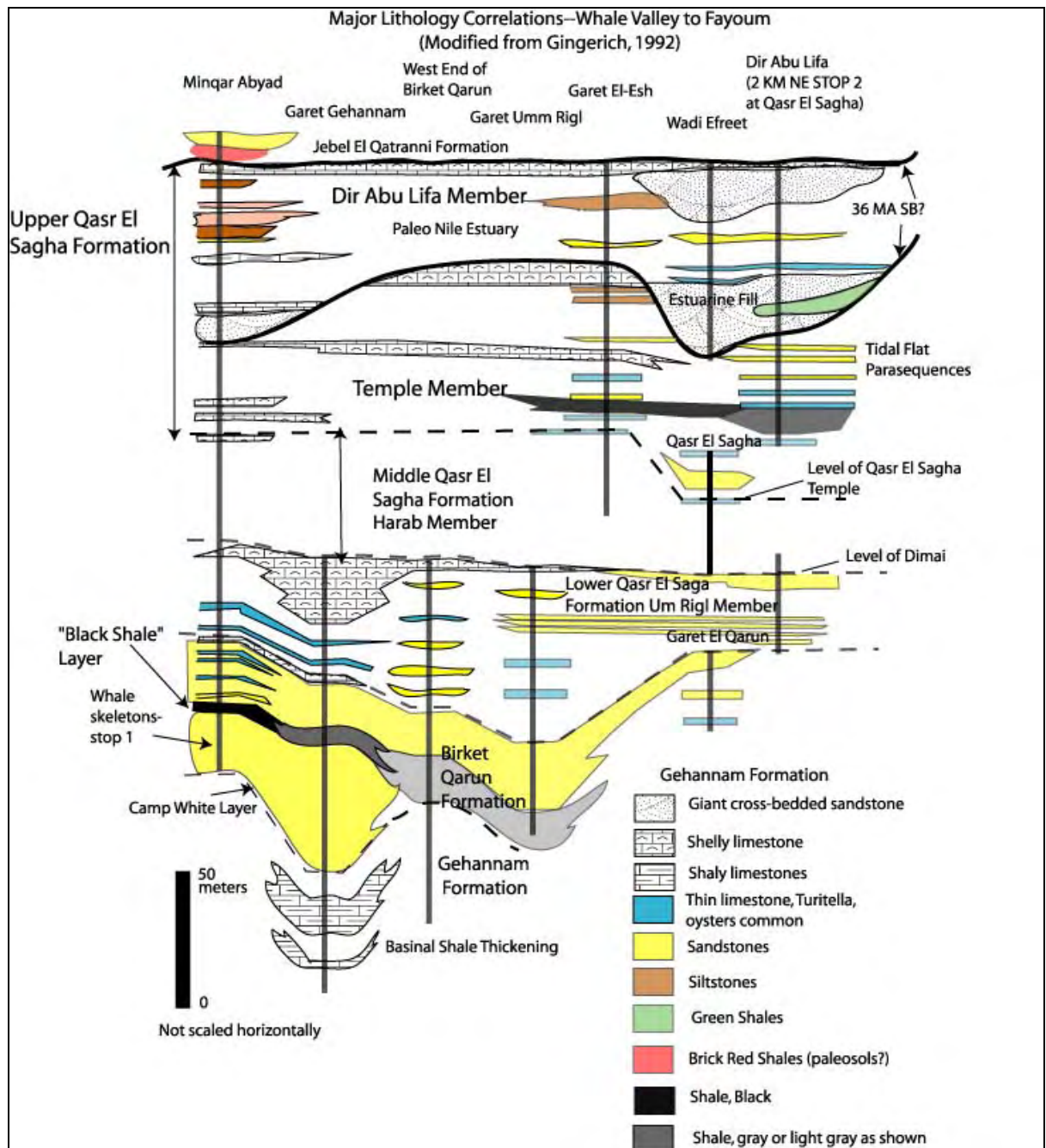
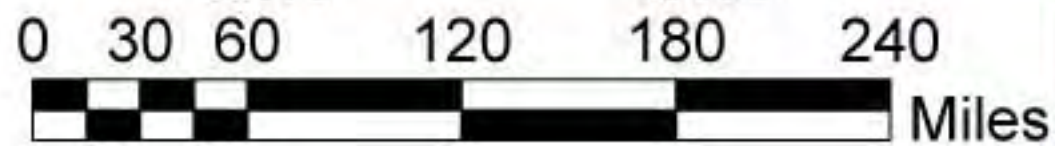
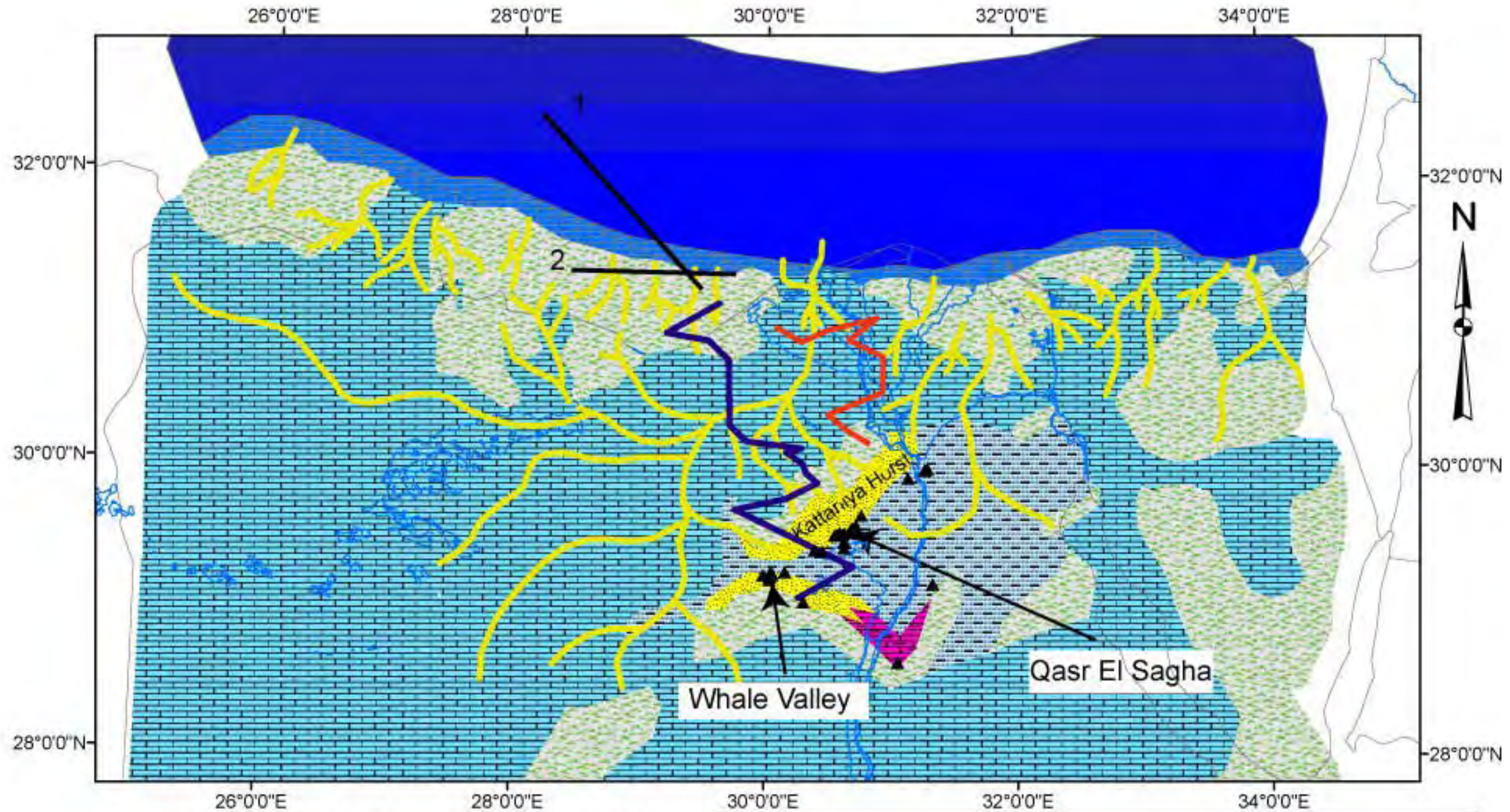


Fig. 8 - Semi-regional outcrop-based correlation of facies and environments, Whale Valley to Qasr El Sagha (after Dolson *et al.* 2002). The black shale layer shown on the left side extends to Wadi Al-Hitan.

Late Eocene Paleogeography



1, 2 — Seismic sections in text

Legend		Eocene environments	
	Regional section 2		land
	Regional section 1		restricted marine
	Eocene outcrops		shallow marine
	Oligocene drainages		shoreline
	Modern rivers		deep marine
	Country Boundaries		supratidal

COMPOSITE STRATIGRAPHIC SECTION IN WADI EL HITAN

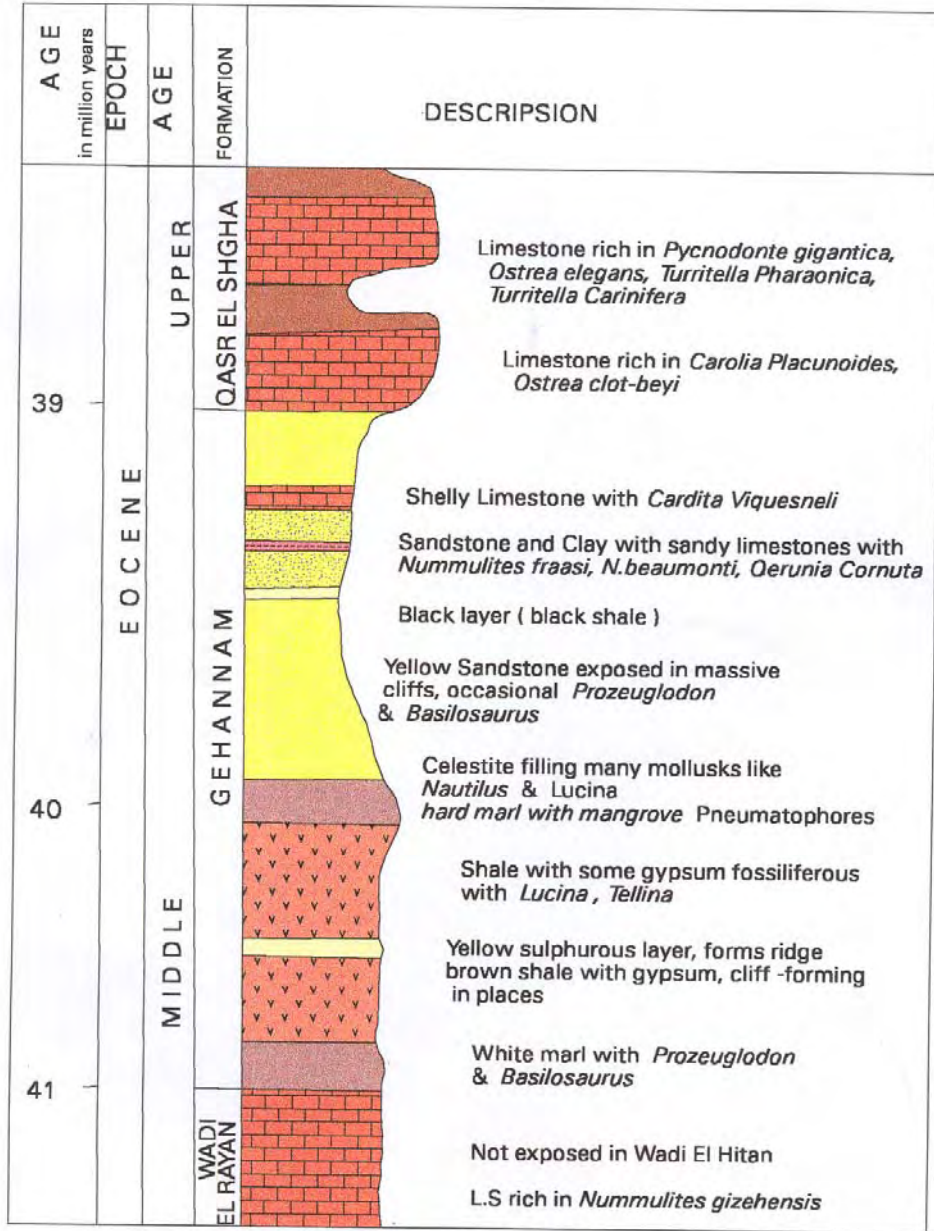


Fig.10 – Composite stratigraphic section in Wadi Al-Hitan (courtesy Prof. M. Abed and Prof. F. El-Bedewy).



Fig. 11 – General view of Whale Valley area.



Fig. 12 – WRPA Fossil Area, called Wadi Al-Battikh (= Water Melon Wadi).

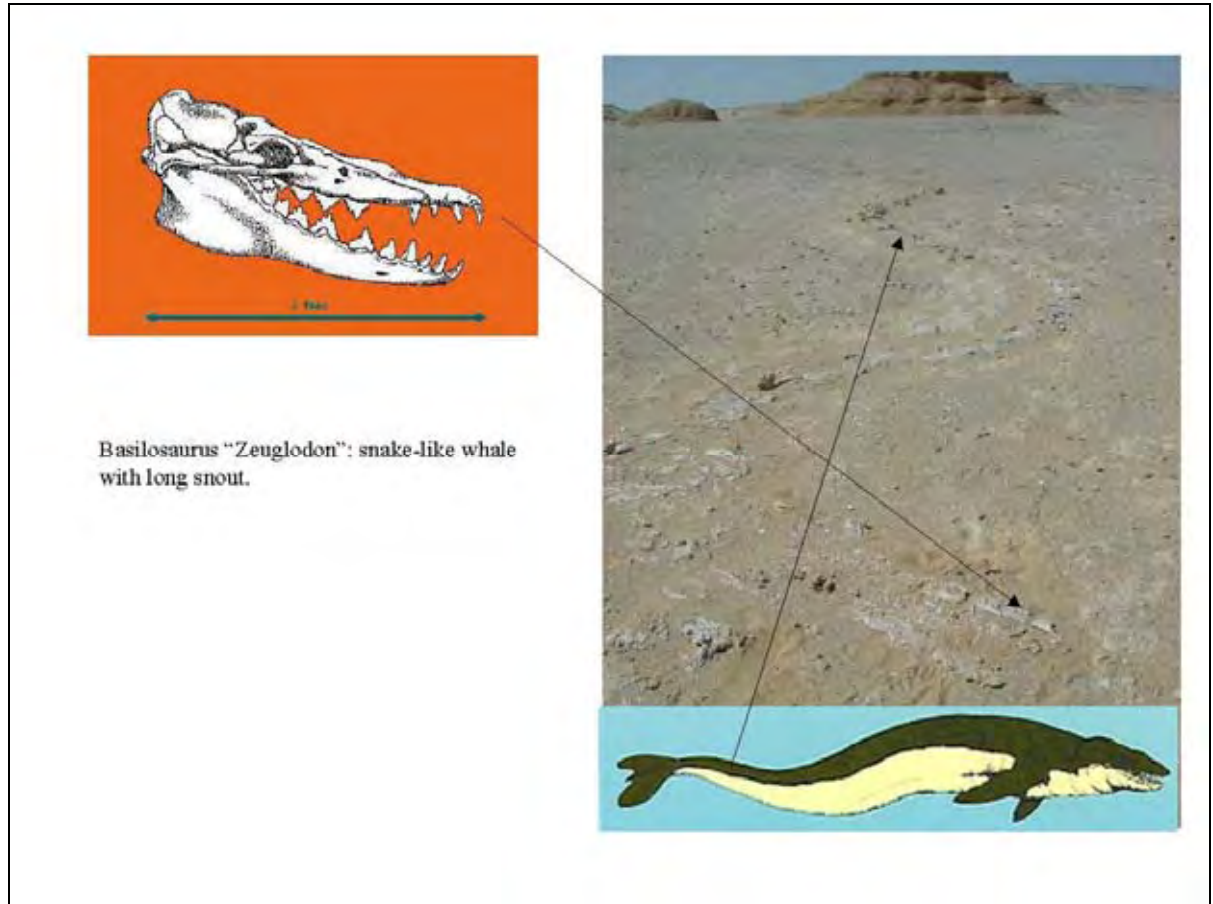


Fig. 13 - A complete whale skeleton (courtesy of Dr. A. El Barkooky). The reconstructed whale diagram is somewhat inaccurate, as the *Basilosaurus* whales were much more serpentine in shape. Note the curved spine typical of most skeletons. This is caused by muscle contraction after death that distorts the spine. The lower left hand figure shows how the whale may have looked like (after Dolson *et al.* 2002).



Fig. 14 – A fossil whale skeleton. Note the curved position at death.

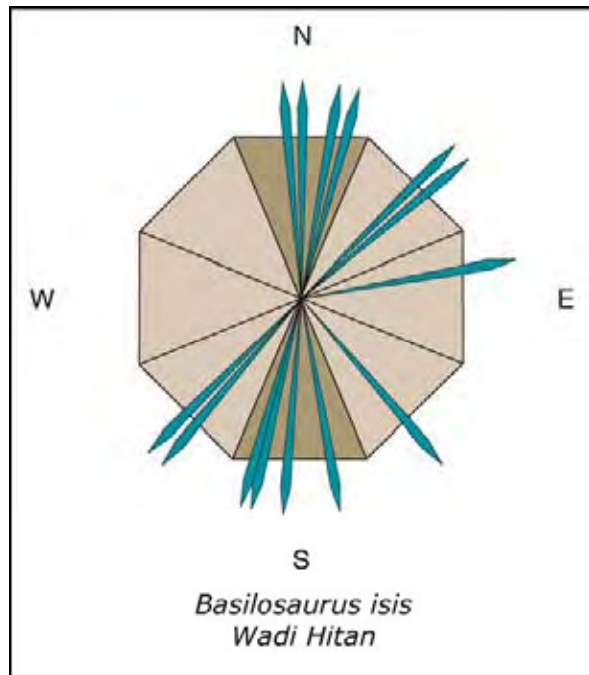


Fig. 15 - Rose diagram showing orientations of 14 *Basilosaurus isis* skeletons in Wadi Hitan. Tails are at the origin, and heads point away from the origin. Bearing of head relative to the trailing skeleton was recorded in the field, to the nearest five degrees, using a brunton compass. Eight of the 14 specimens are oriented pointing north (N) or south (S), which is unlikely to happen by chance alone, and those pointing north and south occur with equal frequency (after Dolson *et al.* 2002).



Fig. 16 - *Prozeuglodon* skull (now called *Dorudon*) at the Cairo Egyptian Geological Museum. Note large triangular teeth of an efficient predator (after Dolson *et al.* 2002).

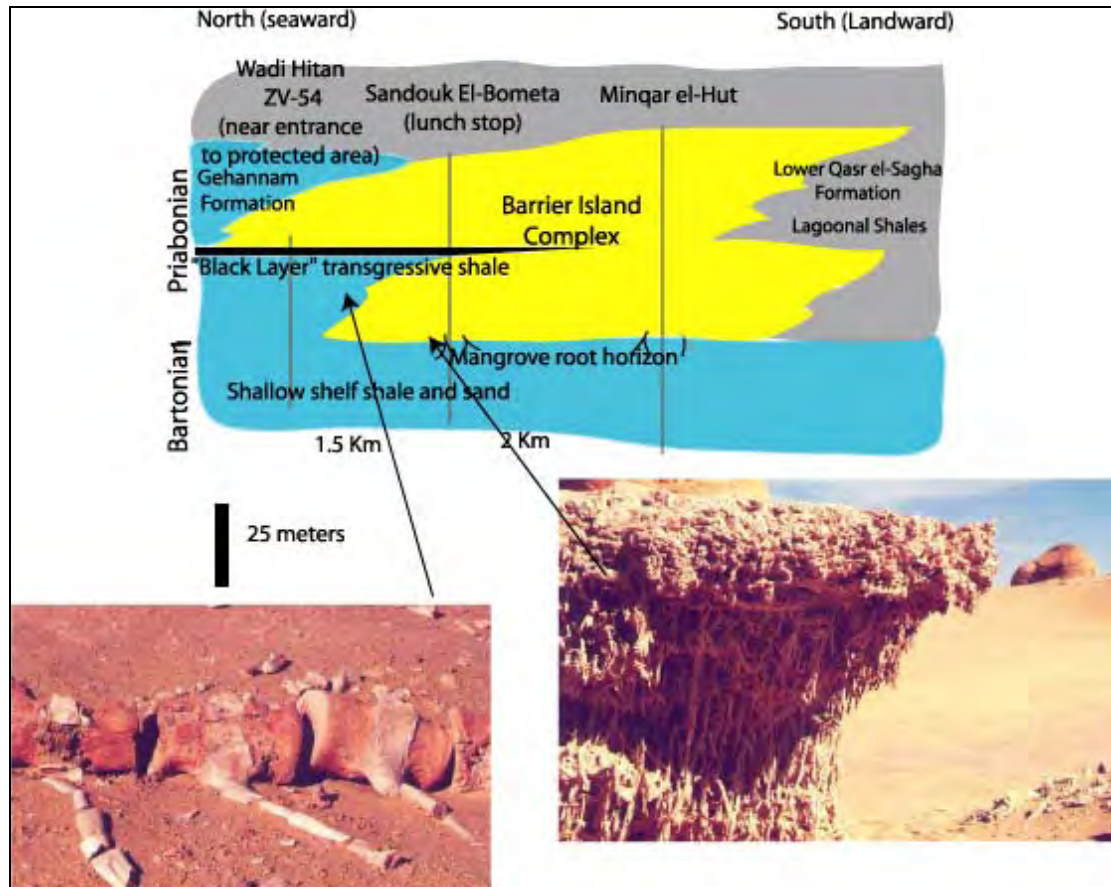


Fig. 17 – Top: summary stratigraphy of the fossil whale area (modified by Dolson *et al.* 2002, from Gingerich 1992). Fossil mangrove is clearly shown at the bottom right hand side. (The picture on the lower left hand side was for a moment's fantasy only.)



Fig. 18 – A block of fossil mangrove at Wadi Al-Hitan.

Worm-bored petrified tree located along a paleoshoreline at Whale Valley



Enlarged view of bored wood

Fig. 19 -. Along the northeast edge of the mangrove horizon (Camp White Layer) is a heavily worm-bored fossil tree. The extensive worm borings would have occurred in shallow water within the Wadi Hitan estuary (after Dolson et al. 2002).



Fig. 20 – Skeleton of *Basilosaurus isis* from Wadi Al-Hitan. Note vestigial hind limb.



Fig. 21 – Marked trail for cars at entrance to the whale fossil area.



Fig. 22 – One of the fenced fossil whale skeleton at Wadi Al-Hitan, to prevent trampling over.

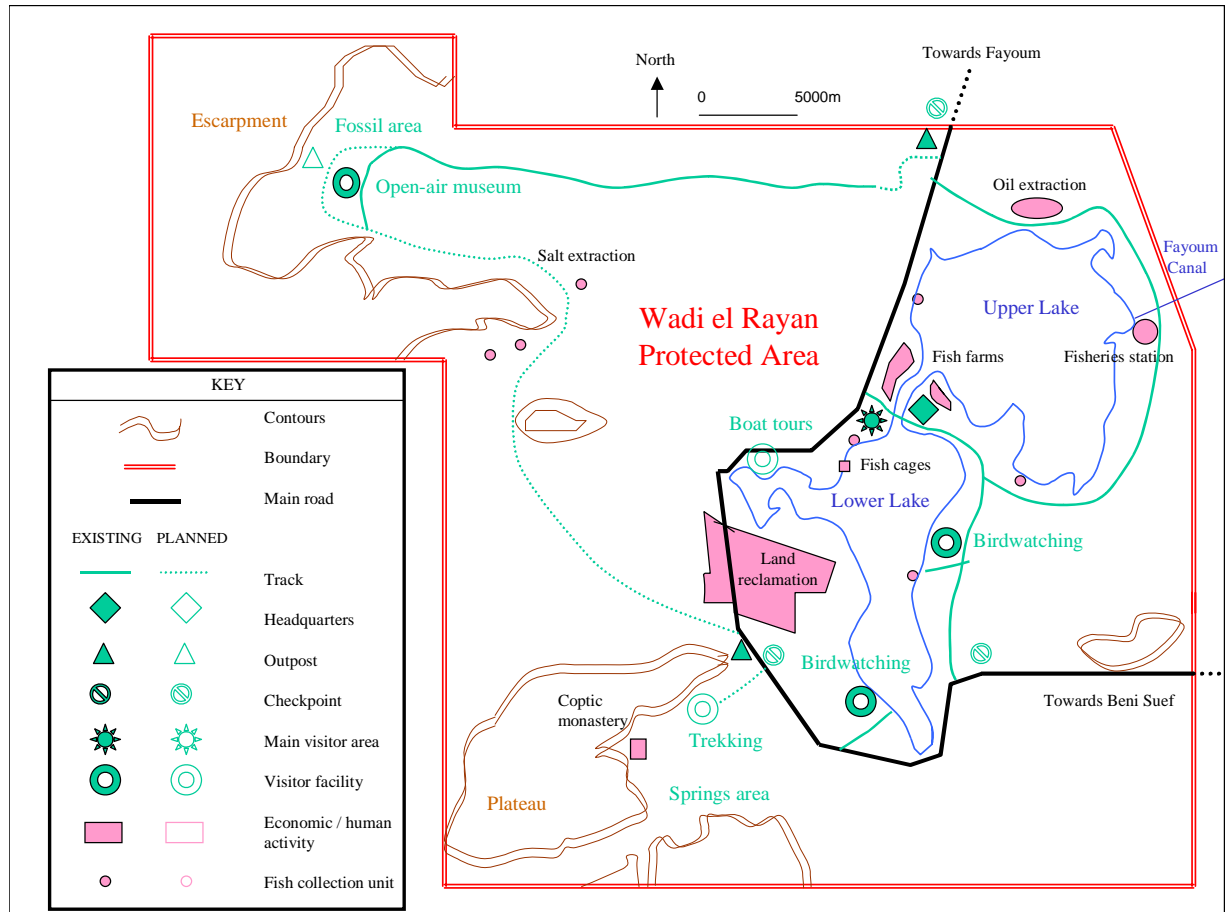


Fig. 23 - Schematic map of the Wadi Al-Rayan Protected Area – December 2001
(courtesy Dr. M. Marchetti)

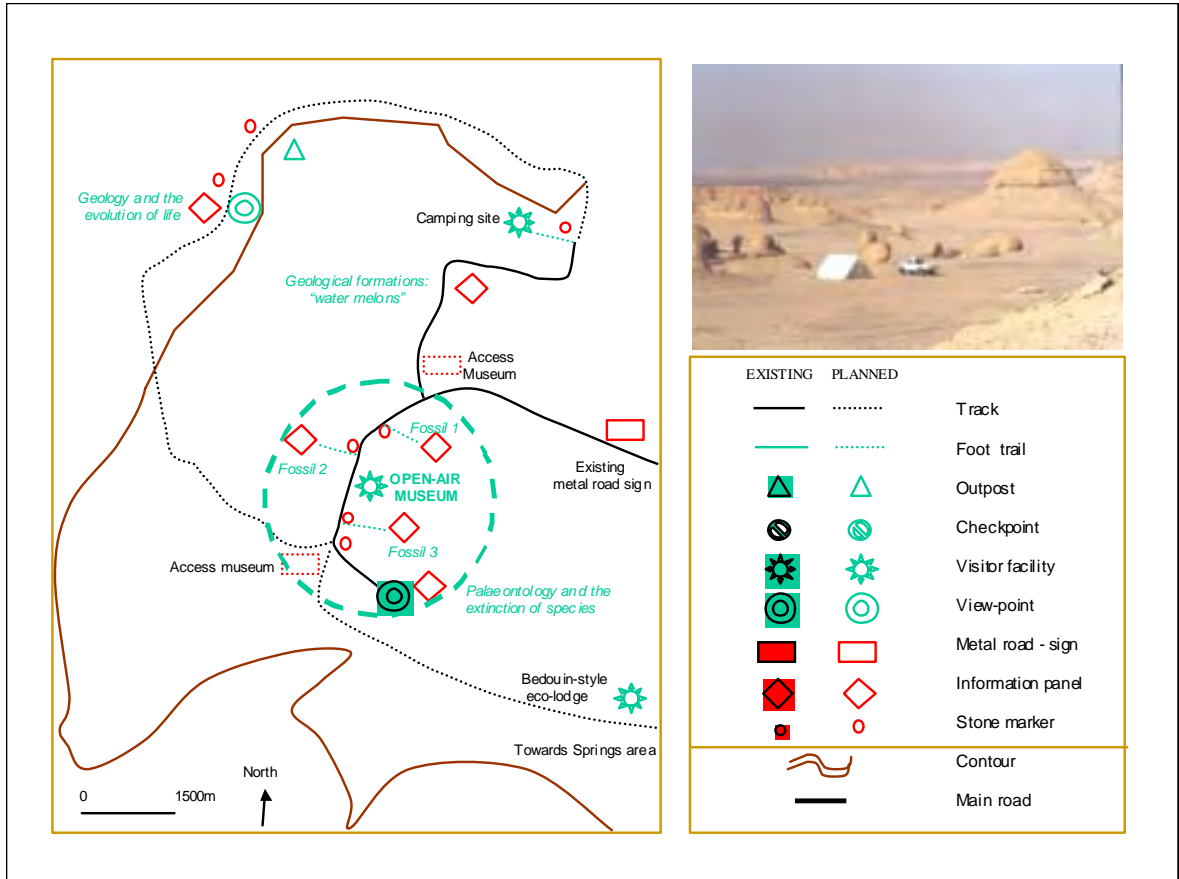


Fig. 24 - Schematic site plan for the Wadi Hitan area (courtesy Dr. M. Marchetti)

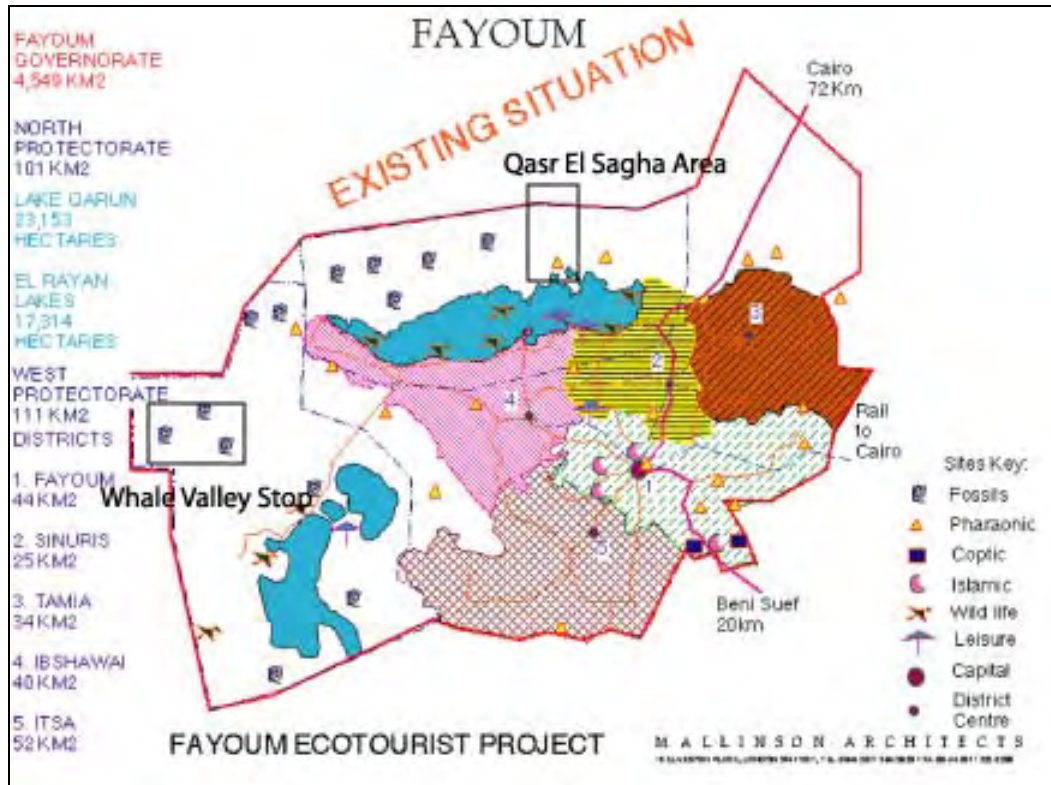


Fig. 25 - Current eco-tourism initiatives and major geological, cultural and archeological sites (courtesy Dr. M. Marchetti).



Fig. 26 – Visitor Center at WRPA, on the western shore of the Lake.

Fig. 27 – Signage operation at Wadi Al-Hitan (after Dolson *et al.* 2002).

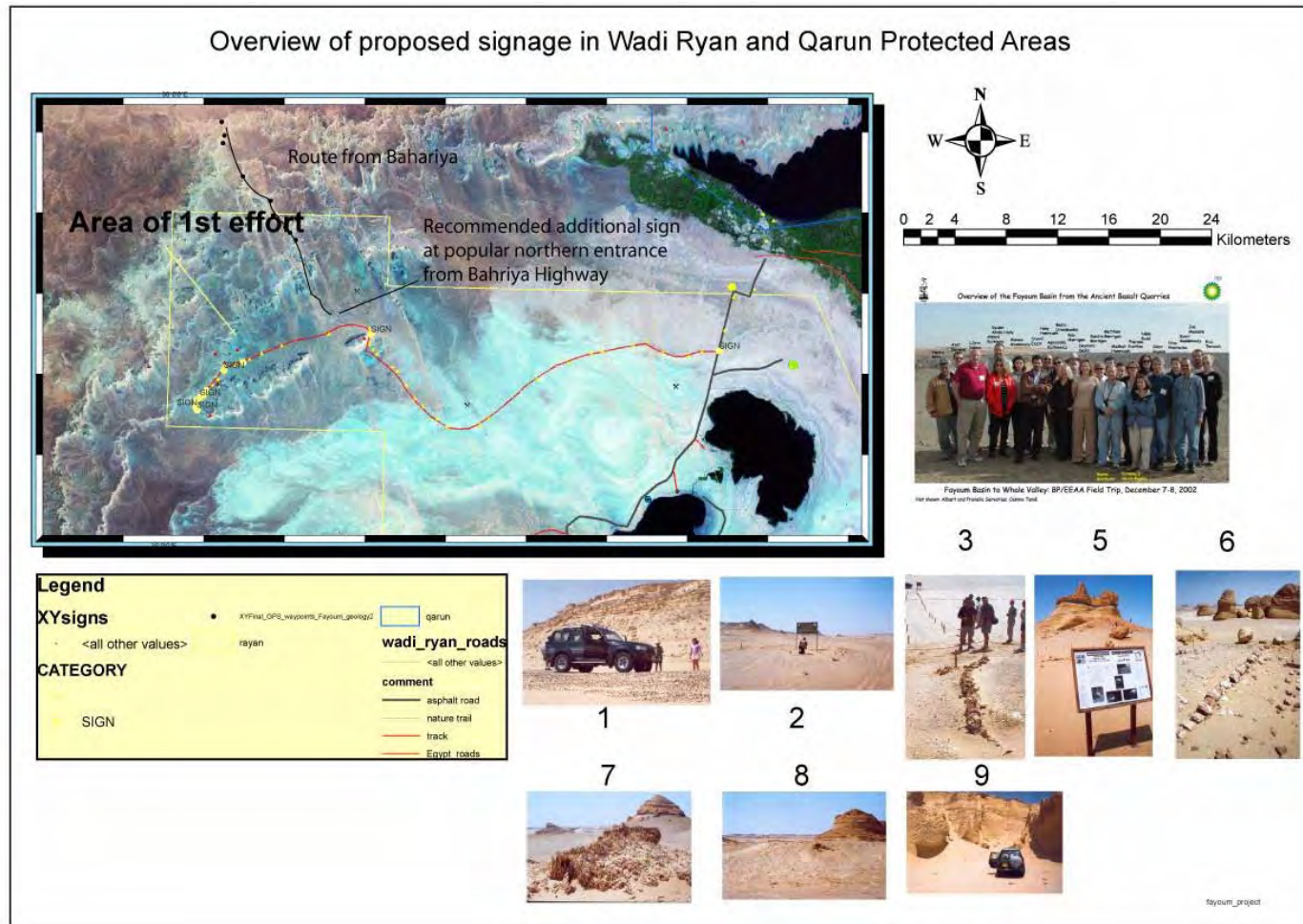




Fig. 28 - HQ of Wadi El-Rayyan Protected Area.



Fig. 29 - WRPA activities (monitoring).



Fig. 30 - WRPA activities (patrolling).

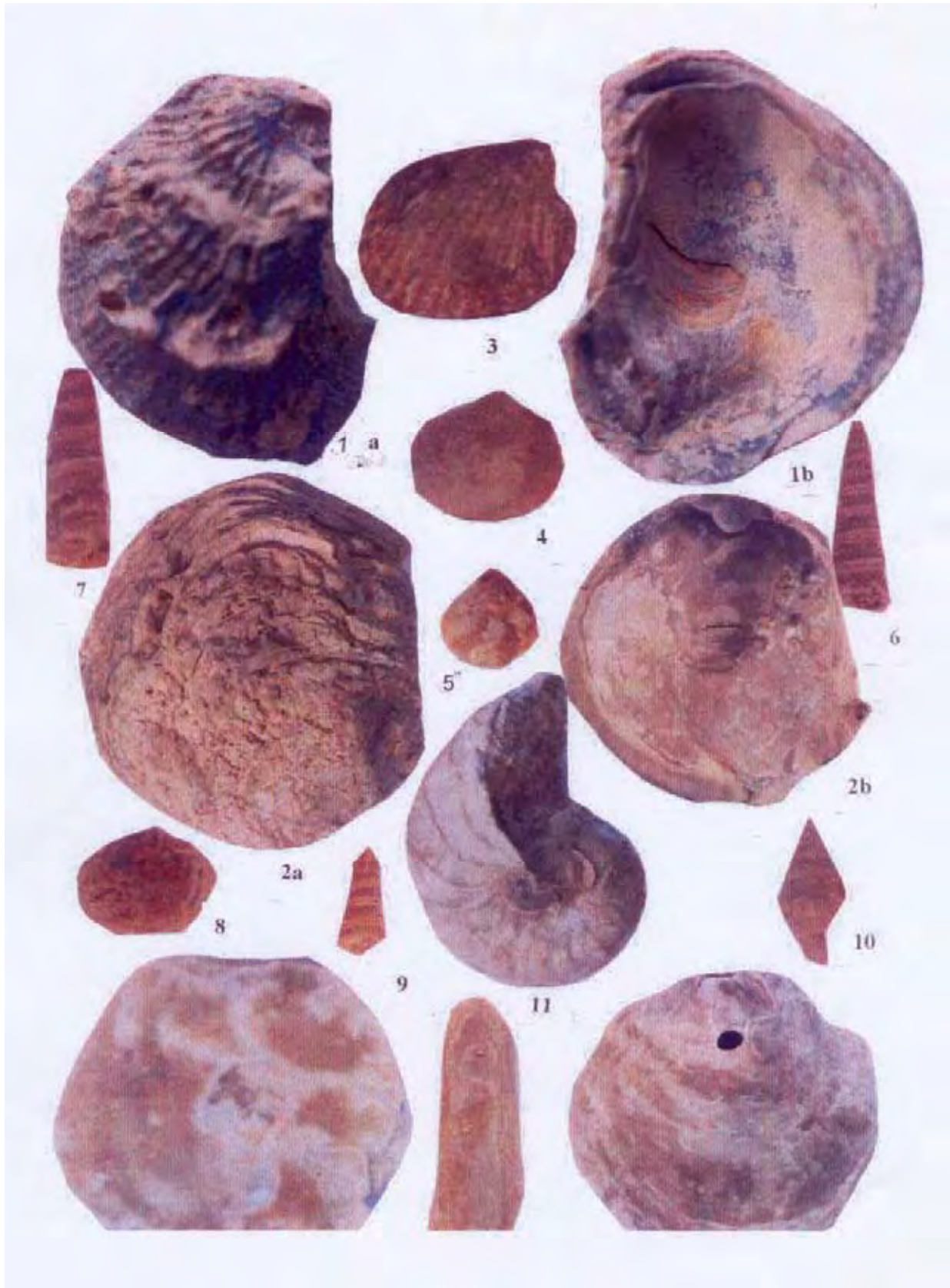
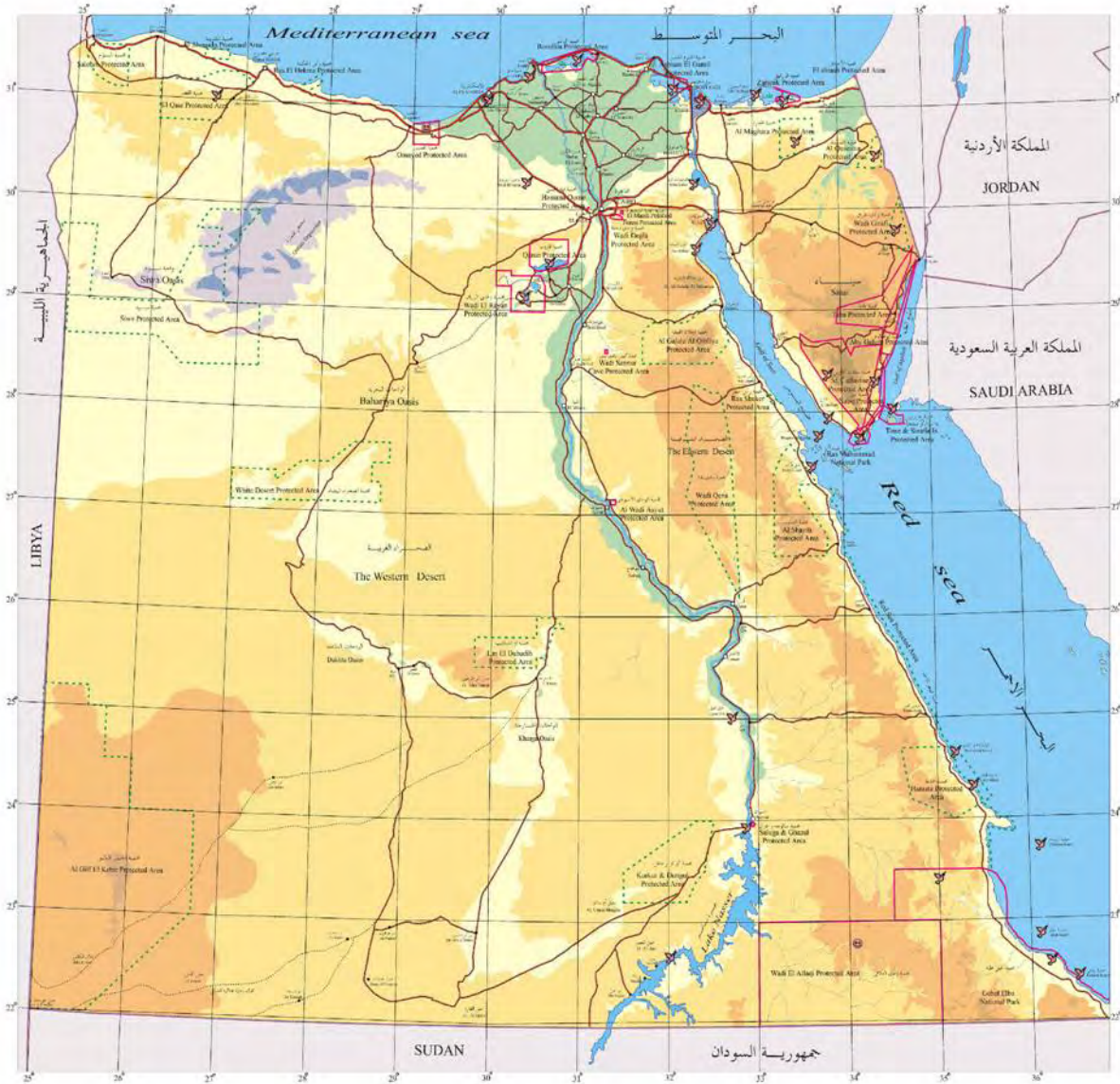
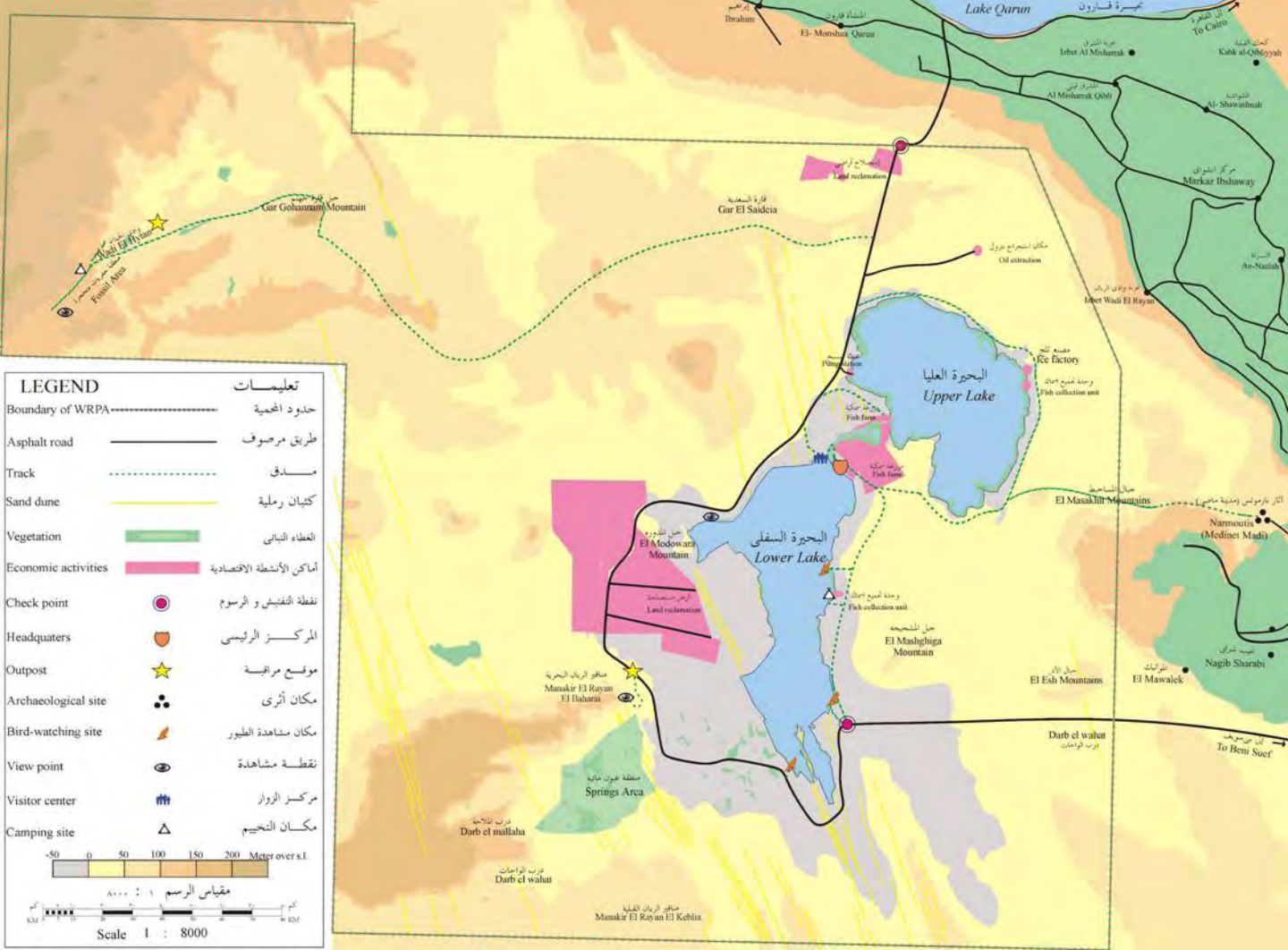


Plate I – Fossil invertebrates in Wadi Al-Hitan. The fossil in the middle bottom is number 12 while the two circular shapes on both sides are number 13 a and b.





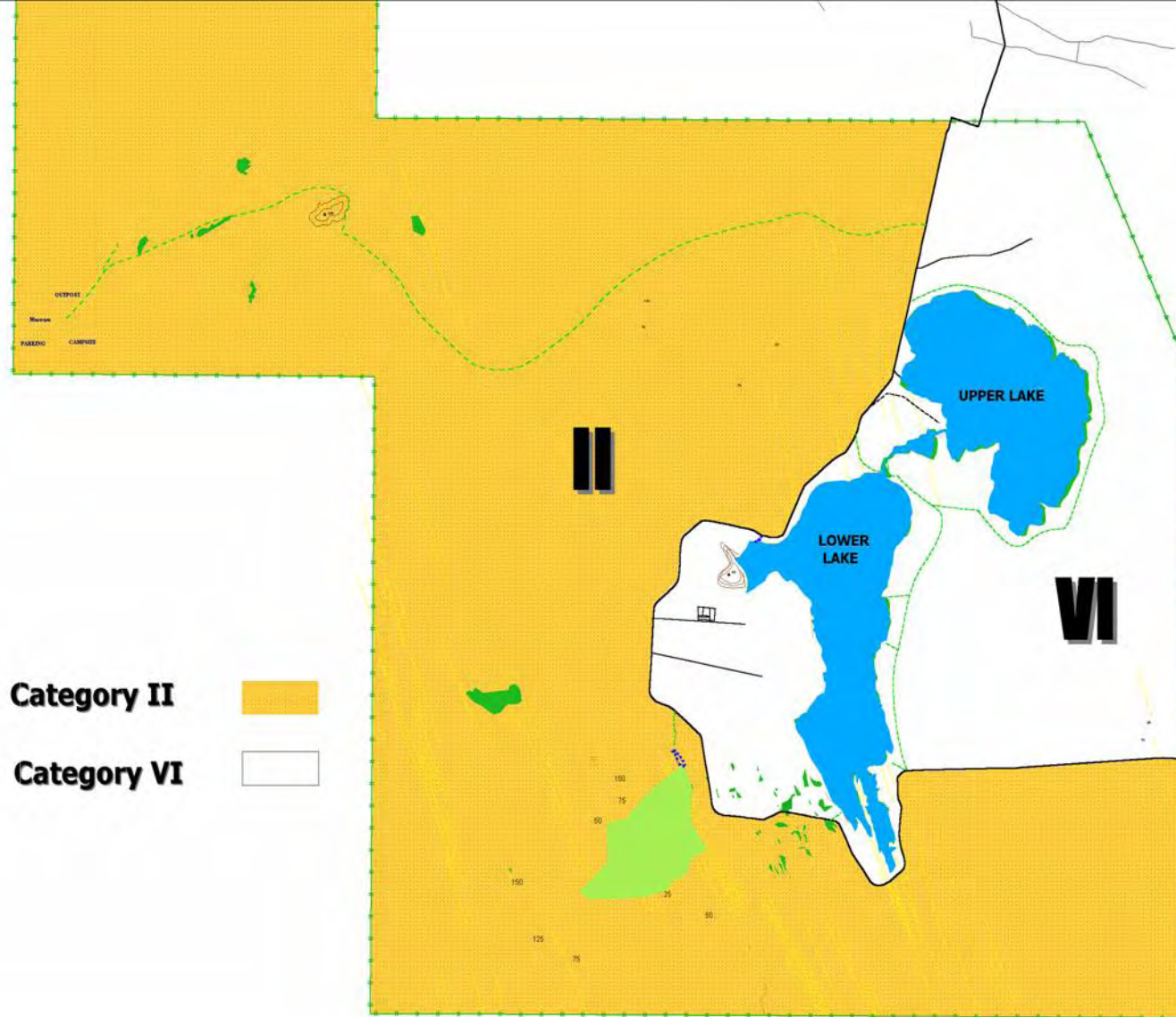


Figure 3. Map showing the 2-category system of WRPA

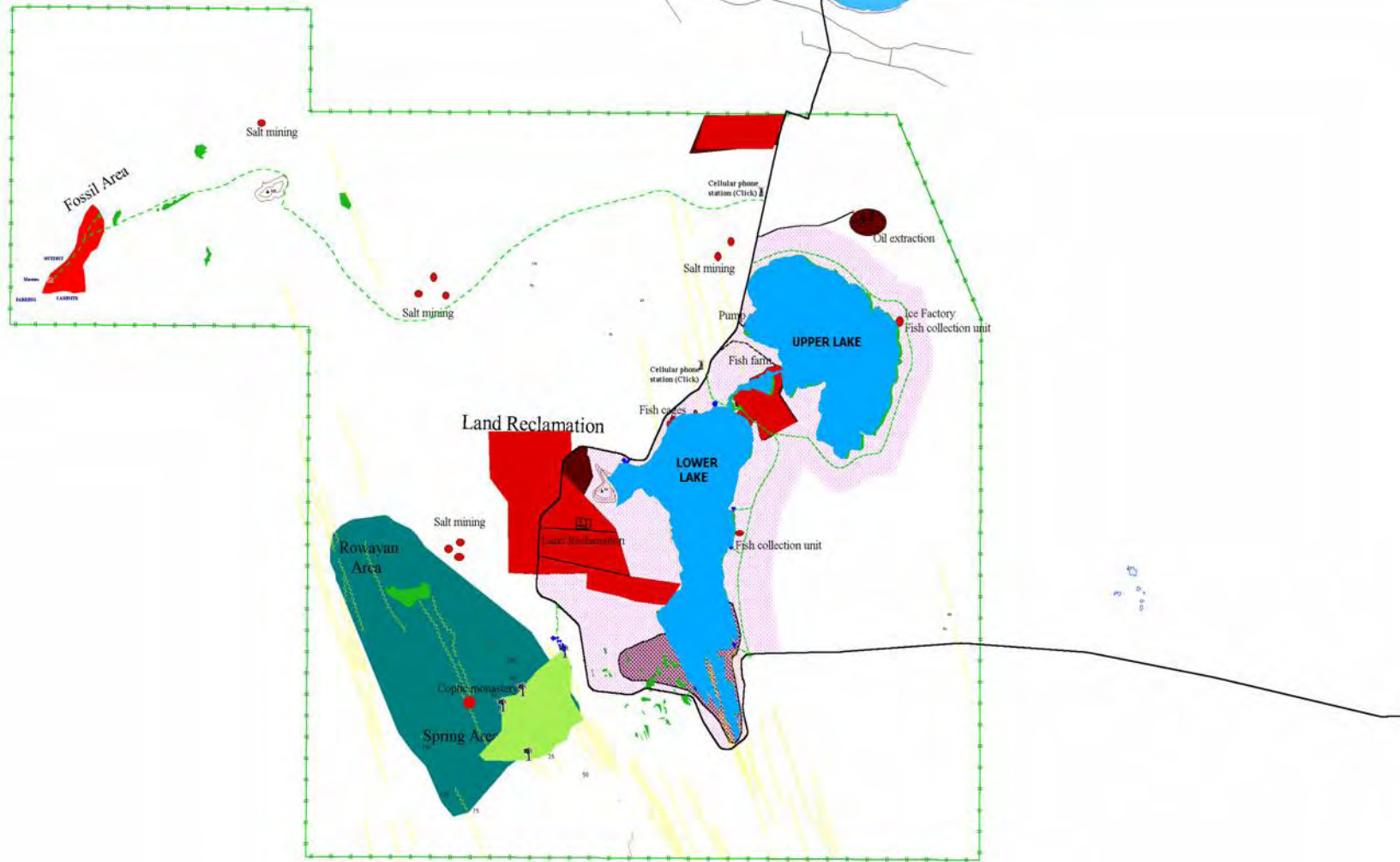


Figure 4. Map showing the Zonation of WRPA

- | | | |
|--------------------------------|--|--|
| Zone A Special Protection Zone |  | |
| Zone A Strict Natural Zone |  | Zone B Reserve Protection Zone  |
| Zone C Recreational Zone |  | General Use Zone  |

Philip Gingerich Home Page

www.redtailcanyon.com/items/10995.aspx

Page updated 7 January 2004

Research on the Origin and Early Evolution of Whales (Cetacea)

Introduction

The mammalian order Cetacea is divided into three suborders: (1) Oligocene to Recent **Odontoceti** or 'toothed whales'— living today; (2) Oligocene to Recent **Mysticeti** or 'baleen whales'— living today; and (3) older and more primitive Eocene **Archaeoceti** or 'archaic whales'— which evolved to give rise to odontocetes and mysticetes. My research on the origin and early evolution of whales is focused on archaeocetes. I have been fortunate to work with many colleagues on this in Pakistan, Egypt, and India (see co-authors in the publication list below). The stages of early whale evolution that we have documented are shown here in Figure 1. We have been fortunate to find virtually complete skeletons of middle-to-late Eocene Basilosauridae, exceptionally complete skeletons of middle Eocene Protocetidae, and a partial skull of earliest middle Eocene Pakicetidae. Recovery of diagnostic ankle bones in the skeletons of primitive protocetids during our field work in Pakistan in 2000 confirmed their derivation from Artiodactyla (the mammalian order including cows, deer, hippos, etc.), and showed convincingly that whales did not originate from mesonychid condylarths as Van Valen hypothesized (and we expected).

Field Work in Egypt (1983-1993)

In the 1980s field work on archaeocetes shifted to Egypt, to the classic but long-neglected site of Zeuglodon Valley or, today, Wadi Hitan. Our camp in the desert in Wadi Hitan is shown in Figure 2, and a *Basilosaurus* excavation in progress is shown in Figure 3. Our most interesting discovery came in 1989, when we found that both *Basilosaurus isis* and *Dorudon atrox* retained feet and toes (see Figures 4 and 5). This discovery then led to renewed investigation of middle Eocene whale strata in Pakistan, especially in the area where we earlier joked about 'walking whales'.

Additional whales described from Wadi Hitan and Fayum Province in Egypt include *Ancalocetus simonsi* (Gingerich and Uhen, 1996) and *Saghacetus osiris* (see Gingerich, 1992).



D. *Dorudon* (Basilosauridae) from the middle to late Eocene of Egypt



C. *Rodhocetus* (Protocetidae) from the early middle Eocene of Pakistan



B. *Pakicetus* (Pakicetidae) from the earliest middle Eocene of Pakistan



A. *Elomeryx* (Anthracotheriidae) from the Oligocene of Europe,
North America, Asia

Figure 1. Skeletons of the archaeocetes *Dorudon atrox* and *Rodhocetus balochistanensis* compared to that of *Elomeryx armatus*, which is here taken as a model for the extinct group of artiodactyls (Anthracotheriidae, *s.l.*) that we now think may have given rise to archaic whales. *Pakicetus* has a distinctive skull and lower jaw, but is not demonstrably different from early protocetids postcranially. **Note changes in body proportions and initial elongation of feet for foot-powered swimming in *Rodhocetus*, then later reduction of the hind limbs and feet as the tail-powered swimming of modern cetaceans evolved in *Dorudon*.**

A. *Elomeryx* drawing from W. B. Scott, first published in 1894. B. *Pakicetus* skull from Gingerich et al. (1983). C. *Rodhocetus* skeletal reconstruction from Gingerich et al. (2001). D. *Dorudon* skeletal reconstruction from Gingerich and Uhen (1996).



Figure 2. University of Michigan camp in Wadi Hitan, Egypt. This area, approximately 10 x 10 km, was studied in 1983, 1985, 1987, 1989, 1991, and 1993, during which time some 400 archaeocete and sirenian skeletons were found and mapped. These range in preservation from virtually complete specimens just being exposed by erosion to the last remnants of specimens destroyed by the wind. Photograph ©1991 Philip Gingerich.



Figure 3. Dr. B. Holly Smith working at the base of the tail at a *Basilosaurus isis* excavation in Wadi Hitan, Egypt. We are particularly interested in this part of the skeleton because this is where the reduced hind limbs, feet, and toes are found (see Fig. 4). Photograph ©1991 Philip Gingerich.



Figure 4. Ankle, foot, and toes of *Basilosaurus isis* excavated in Wadi Hitan, Egypt. This find was described in Gingerich et al. (1990). The foot as shown is approximately 12 cm long. Photograph ©1991 Philip Gingerich.



Figure 5. Hind limbs, feet, and toes of a virtually complete skeleton of *Dorudon atrox* excavated in Wadi Hitan, Egypt. Note the retention of hind limbs, feet, and toes like those found in *Basilosaurus*. This find is described in Uhen (1996, 2003). The skeleton is approximately 5 m long. Photograph ©1998 Philip Gingerich.

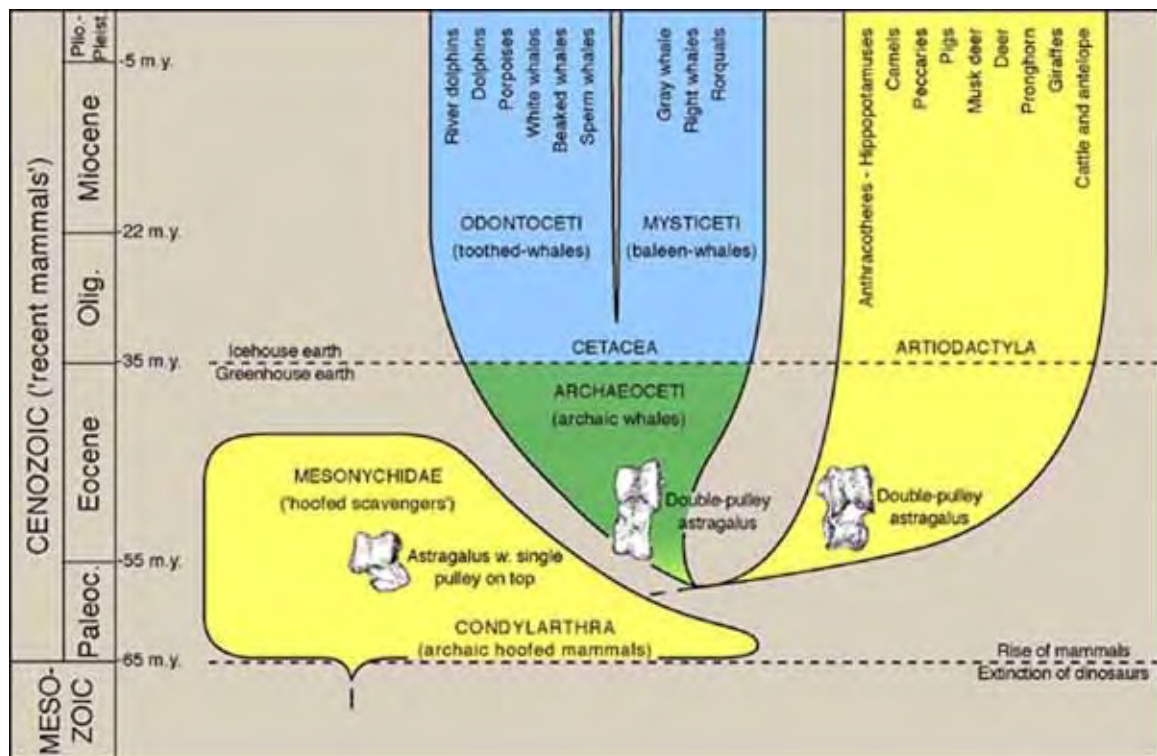


Figure 6. Phylogeny of Cetacea showing a common ancestry shared with Artiodactyla, and the hypothesized evolutionary origin of both from older Paleocene age Condylarthra. Horizontal axis is arbitrary, while the vertical axis is geological time. Our 2000 discovery of distinctively artiodactyl-like double-pulley astragalus bones in articulated skeletons of early archaeocetes is the principal evidence linking whales and artiodactyls as shown here (see Gingerich et al., 2001). The evolutionary origin of both whales and artiodactyls is closely tied to the Paleocene-Eocene boundary, and the transition from archaeocetes to modern whales is related to climatic and ocean circulation changes at the Eocene-Oligocene boundary. Source: University of Michigan Museum of Paleontology.

History of search for early whale fossils

A decade or so passed before paleontologists finally began unearthing fossils close enough to the evolutionary branching point of whales to address Van Valen's mesonychid hypothesis. Even then, the significance of these finds took a while to sink in. It started when University of Michigan paleontologist Philip Gingerich went to Pakistan in 1977 in search of Eocene land mammals, visiting an area previously reported to shelter such remains. The expedition proved disappointing because the spot turned out to contain only marine fossils. Finding traces of ancient ocean life in Pakistan, far from the country's modern coast, is not surprising: during the Eocene, the vast Tethys Sea periodically covered great swaths of what is now the Indian subcontinent. Intriguingly, though, the team discovered among those ancient fish and snail remnants two pelvis fragments that appeared to have come from relatively large, walking beasts. "We joked about walking whales," Gingerich recalls with a chuckle. "It was unthinkable." Curious as the pelvis pieces were, the only fossil collected during that field season that seemed important at the time was a primitive artiodactyl jaw that had turned up in another part of the country.

By 1983 Gingerich decided to cast his net in Egypt instead, journeying some 95 miles southwest of Cairo to the Western Desert's Zeuglodon Valley, so named for early 20th-century reports of fossils of archaic whales—or zeuglodon, as they were then known—in the area. Like Pakistan, much of Egypt once lay submerged under Tethys. Today the skeletons of creatures that swam in that ancient sea lie entombed in sandstone. After several field seasons, Gingerich and his crew hit pay dirt: tiny hind limbs belonging to a 60-foot-long sea snake of a whale known as *Basilosaurus* and the first evidence of cetacean feet. Here in the middle of the Sahara Desert hundreds of whale skeletons lie buried in sandstone. Gingerich's excitement turned to disappointment when he found that most of the skeletons were *Basilosaurus*, an already known aquatic whale ancestor. But Gingerich kept on digging. A few days later he made a new discovery—*Basilosaurus* had legs. Even though *Basilosaurus* was fully aquatic, it still had vestiges of its terrestrial past. Ten million years of whale evolution had passed between *Pakicetus* and *Basilosaurus*, and yet whales still had hind legs and feet. Now the challenge for Gingerich and his colleagues was to fill in the fossil gaps of whale history.

Earlier finds of *Basilosaurus*, a fully aquatic monster that slithered through the seas between some 40 million and 37 million years ago, preserved only a partial femur, which its discoverers interpreted as vestigial. But the well-formed legs and feet revealed by this discovery hinted at functionality. Although at less than half a meter in length the diminutive limbs probably would not have assisted *Basilosaurus* in swimming and certainly would not have enabled it to walk on land, they may well have helped guide the beast's serpentine body during the difficult activity of aquatic mating. Whatever their purpose, if any, the little legs had big implications. "I immediately thought, we're 10 million years after *Pakicetus*," Gingerich recounts excitedly. "If these things still have feet and toes, we've got 10 million years of history to look at." Suddenly, the walking whales they had scoffed at in Pakistan seemed entirely plausible.

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<http://www-personal.umich.edu/~gingeric/PDGwhales/Whales.htm>

MANAGEMENT PLAN

WADI EL-RAYAN PROTECTED AREA

Introduced by
Wadi El-Rayan Protected Area staff
EEAA



2002-2006

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List of abbreviations

DGCD	Directorate General Cooperation Development (Italian Foreign Ministry)
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
GOE	Government Of Egypt
IUCN	World Conservation Union
NCS	Nature Conservation Sector
PA	Protected Area
PAMU	Protected Area Management Unit
PCU	Programme coordination unit
WRPA	Wadi El-Rayan Protected Area
WRPAMU	Wadi El-Rayan Protected Area Management unit

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EXECUTIVE SUMMARY

Wadi El-Rayan Protected Area has been declared by prime-ministerial decree No. 943 in 1989 according to law No. 102/1983 of the protected areas in Egypt, and is directed by the Nature Conservation Sector (NCS) of the Egyptian Environmental Affairs Agency (EEAA). The overall management goal of the protected area is the protection of the natural resources in accordance with the declaration decree of the protected area.

Using the 1994 IUCN protected area management categories, WRPA has now been classified in a two-category system. A category II part managed mainly for ecosystem protection and integrity, environmental education and ecotourism, and a category VI part managed mainly for the sustainable use of natural ecosystems, environmental education and recreation.

WRPA is a desert area situated in the Fayoum Governorate of the Western Desert of Egypt. In the nineteen seventies two lakes were created in the lower portion of Wadi El-Rayan sub-depression to channel out excess agricultural drainage water. The creation of a large body of water in this hyper-arid area had a striking ecological impact and new species of plants, mammals, birds and invertebrates moved to Wadi El-Rayan area.

The main management issues of WRPA are the variety of agencies and authorities that operate inside WRPA, including the Ministry of Agriculture and Land Reclamation, Ministry of Petroleum, Ministry of Irrigation, Ministry of Tourism, Ministry of Defence and Ministry of Interior. It is also a major site of economic development and a popular site of attraction for local and foreign visitors. The current rate of water extraction and evaporation from the Wadi El-Rayan lake system, exceeds the inflow, and this places the future of the lake system in jeopardy.

The main external management constraints are the weak collaboration among the Egyptian authorities involved with WRPA, the continuous expansion in both volume and variety of the human activities inside WRPA, and the overuse of some resources of the protected area (e.g. the water of the lakes). Inadequate funding for running expenses, training, communication tools, etc., and the lack of permanent operating staff inside the protected area are the main internal constraints.

Zoning is the division of the protected area into zones of homogenous use and is an essential tool for the management of a protected area, which allows differential management considering the different zones characteristics. WRPA has zones permitting zero impact, low impact, moderate impact and high impact.

Development of clear strategies for the management of WRPA is one of the desired outputs of this management plan covering the period 2002-2006 and the strategies include collaborative management, improving control over water use in the lake system, adaptive management, and focusing at the management zone level.

The Governor of El-Fayoum expressed his appreciation to WRPA for initiating the management planning process at WRPA and described the Management Plan as an essential tool to achieve the required level of coordination between the various public agencies active in the Protected Area.

All key stakeholders are being informed and involved from the start of this management plan continuously. The management plan will be forwarded to the appropriate collaborating authorities for endorsement.

The natural resources of the protected area are under threat from the economic and human activities within WRPA but sound management practices, law enforcement (in collaboration with stakeholders) and monitoring can ensure the sustainable use of the natural resources.

The public use inside the area has been identified to include eco-tourism activities, human economic activities and human settlement.

The development of the public awareness program in WRPA is a main and important component of the management plan of the protected area.

The management strategy is being achieved through using the following management tools; environmental regulations and law enforcement, communication, documenting, monitoring and research, GIS and remote sensing, and EIA.

The critical resources needed for the management of WRPA are infrastructure and equipment, financing and staffing and are described in the plan.

The WRPA project was funded by the Italian-Egyptian Environmental Program in the first phase (March 1998 - February 2001) and implemented by EEAA with international technical assistance from the World Conservation Union (IUCN). The transition phase of the WRPA project started in June 2001 and ceased in December 2002. As one of the components of a broader support programme to the Egyptian Environmental Affairs Agency (EEAA), Nature Conservation Sector (NCS), funded by the Directorate General Co-operation Development (DGCD) of the Italian Foreign Ministry, the total proposed budget of the second phase of WRPA project is 6,024,000 L.E. until December 2005 shared with the NCS/EEAA.

PART 1

1. INTRODUCTION

1.1. Background

Wadi El-Rayan Protected Area (WRPA) was declared by the Prime-Ministerial Decree No. 943 in 1989 according to Law No. 102/1983 of the protected areas in Egypt.

Wadi El-Rayan Protected Area (WRPA) is one of the protected areas of Egypt administered by the Nature Conservation Sector (NCS) of the Egyptian Environmental Affairs Agency (EEAA). (Figures 1 and 2: Appendix 1)

The WRPA project was funded by the Italian-Egyptian Environmental Program in the first phase (March 1998 - February 2001) and implemented by EEAA with international technical assistance from the World Conservation Union (IUCN). The transition phase of the WRPA project started in June 2001 and will cease in June 2002 with the possibility to continue until the start of the second phase in January 2003.

1.2. Conservation objectives

Using the 1994 IUCN categories, WRPA has now been classified in a two-category system as follows: (Figure 3: Appendix 1)

CATEGORY II area:

A protected area managed mainly for ecosystem protection and integrity, environmental education and eco-tourism

CATEGORY VI area:

Protected area managed mainly for the sustainable use of natural ecosystems, environmental education and recreation

The management objectives and goals are discussed in part 4 of this plan.

PART 2

2. SITE DESCRIPTION AND EVALUATION

2.1. General Information

Wadi El-Rayan occupies a depression in the northern part of the western desert of Egypt. It is situated between longitude 29°00' 00" and 29°24' 11" E and latitude 30°00' 00" and 30° 34' 00" N. Wadi El-Rayan protected area located 210 km right angle south to the Mediterranean coast at co-ordinates of 30°00' N and 30°18' E. The main supply of water is underground water, and 4 natural sulphured water springs. The total area of the protected area is 1759 km². (Figure 2: Appendix 1)

Wadi El-Rayan is a desert area situated in the Fayoum Governorate of the Western Desert of Egypt. The area has a special historical significance as a major crossroad that was used for many centuries by travellers between the Nile Valley and the oases of the Western Desert. Remains of human settlements from Egyptian and Roman-Greek eras are found in the area (Fakhry, 1957). (Figure 1: Appendix 1)

In the seventies two lakes were created in the lower portion of Wadi El Rayan sub-depression to channel out excess agricultural drainage water in order to slow-down the increase of the water-table in the Fayoum main depression and in the Qarun lake. The creation of a large body of water in this hyper-arid area had a striking ecological impact: new species of plants, mammals, birds and invertebrates moved to Wadi El Rayan area (IUCN, 2000a).

2.2. Physical Settings

Climate

The climate is typically Saharan, hot and dry with scanty winter rain and bright sunshine throughout the year. According to the bio-climatic provinces of Egypt defined by Ayyad and Ghabbour (1986), the area is hyper-arid with mild winters and hot summers. The annual average of the precipitation rate is 10.1 mm. The highest rainfall occurs in December (40 % of annual rain) and the lowest (0%) in August. The average ambient relative humidity is 51%. The direction of the wind is, for most of the year, from the North, varying North-West or North-East, after Saleh, (1988).

Table (1) Summary of the monthly means of 50 years of temperature records (Saleh, 1988)

TEMPERATURE VALUES	WINTER	SUMMER
Mean	13.7°C	28.5°C
Absolute minimum/maximum	-1.2°C	48.8°C
Mean amplitude of diurnal fluctuations	14.2°C	17°C

Geology and Geomorphology

Wadi El Rayan is one of the three sub-basins that compose the large circular depression of Fayoum. The Fayoum depression is a marine sedimentary basin that has undergone alternating periods of erosion and deposition since the late Cretaceous period 70 million years ago (El Bedewy et al., 1998). The present depression was formed at least 1.8 million years ago, probably by wind erosion in the desert.

The geology and geomorphology of Wadi El Rayan have been extensively investigated starting from the end of the XIX century (Schweinfurth, 1886; Blankchenhorn, 1901; Beadnell, 1905; Bagnold, 1935; El Baz, 1984). Wadi El Rayan formation is essentially made of Middle Eocene, Pliocene, Early and Late Pleistocene and Holocene times. Badnell (1905), showed that the middle Eocene rocks, clays, marls and limestone with *Nummulites cezehensis*, a foraminifer species, formed the oldest beds found in the area. The land exposure from late Eocene to late Oligocene (40 to 30 million years ago) allowed the ancient "Lybian river" to begin eroding the thick Eocene sediments and laid down some of Egypt's most valuable fossil deposits of early mammals, primates, reptile and fish species. Schweinfurth (1886) discovered the first fossil vertebrate (whale remains of the most common species *Zeuglodon isis*) in Fayoum depression. The following studies and explorations showed that in WRPA, especially in the areas of Wadi Hytan and Garet Gehannam, four Eocene formations are present, all of them marine. A paleontological and paleoenvironmental report that summarizes the existing data about the area of Wadi El Rayan has been finalized by the PAMU of WRPA with the consultancy of paleontologists and geologists (El Bedewy et al., 1998).

Regarding the different landform types of Wadi El Rayan depression, Abd El-Aal (1984) reports that they have different origins: alluvial, alluvial-colluvial and desert deposits. The Wadi El Rayan depression is an important site for the deposition of Eolian sand in the Western Desert. Extensive dune fields run the length of WRPA oriented NNW to SSE and, probably, they are formed within the Holocene period as a result of disintegration and transportation of friable stones. The dunes vary in length from a few hundred meters to thirty km and may reach the height of 30 m.

Table (2) is providing the vital statistics about the protected area as a whole.

Table (2): WRPA Summary Statistics Sheet

WADI EL-RAYAN PROTECTED AREA		
Location	Fayoum Governorate	
Climatic Zone	Hyper-Arid Saharan	
Area	175.900 ha (1759 km ²)	
Declaration	Prime-Ministerial Decree N. 943/1989	
Category	Type II and VI of IUCN categories	
Habitats	Area (ha)	Proportion (%)
Oasis	1935	1.1
Desert	160.949	91.5
Wetland	1583	0.9
Lakes	11.434	6.5
Taxa	Number of Species	Last Update
Plants	38	2002
Mammals	24	2002
Birds	164	2002
Reptiles	14	1999
Fish	29	2001
Terrestrial Invertebrates	113	1992
Aquatic Invertebrates	11 families	1999
Human Activities	Area (Feddans)	No of operators
Land Reclamation	4575	12 240 approx.
Fisheries	16236.28 (2 lakes and channel)	
Aquacultures	1300	35
Oil Extraction	71	23
Salt Mining	Negligible	50 approx.
Eco-Tourist Services	24.1	11 operators and approx. 150 000 tourists
Coptic Monastery	11.36	25

2.3. Ecological settings

Monitoring reports of Wadi El-Rayan have been introducing the detailed information about the area, (IUCN, 2000b; IUCN, 2001 and EEAA, 2002)

2.4. Cultural and Social Settings

The environmental profile of WRPA has been presenting the available information in this matter, (IUCN, 2000a).

2.5. Values of the resources and contribution to PA network

The environmental profile of WRPA has been presenting the available information in this matter, (IUCN, 2000a).

PART 3

3. MANAGEMENT ISSUES AND CONSTRAINTS

3.1. Management issues

The general management issues of Wadi El-Rayan Protected Area have been identified as follows:

The variety of other agencies and authorities that operate inside WRPA which are represented in the Ministry of Agriculture and Land Reclamation, Ministry of Petroleum, Ministry of Irrigation, Ministry of Defence and Ministry of Interior.

Wadi El-Rayan Protected Area as a main popular site of attraction for local and foreign visitors and as an important ecotourism site.

Wadi El-Rayan Protected Area as a major site of continuous economic development.

The current rate of water inflow into the Wadi El-Rayan lake system is less than the total rate of water use and evaporation and this places the future of the lake system in jeopardy.

3.2. Constraints

External

The weak collaboration among the Egyptian authorities especially those stakeholders involved with WRPA.

The continuous expansion in both volume and variety of the human activities inside WRPA.

The low conservation awareness of the local people, which constitute 95% of the visitors to WRPA.

Lack of representatives of some economic activities inside the protected area (e.g. traditional boat fishermen).

Internal

Inadequate annual funding of the protected area (running expenses, training, communication tools, etc....).

Lack of permanent operating staff inside the protected area except the protected area manager.

PART 4

4. MANAGEMENT GOALS AND OBJECTIVES

4.1. Overall goal and objectives

The overall management goal of the protected area is the protection of the natural resources in accordance with the declaration decree of the protected area (943/1989) and follows the general protection rules of the law 102/1983.

The protected area as a whole has been identified to follow two broad conservation management objectives using the category classification system of IUCN and these are category II and VI (see Figure 3: Appendix 1). Each category has its own management objectives.

Category II

Management objectives

To protect natural and scenic areas of national and international significance for scientific, educational, recreational and 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 educational, cultural and recreational purposes at a level which will maintain the area in a natural or near natural state;

To prevent a future exploitation or occupation inimical to the purposes of designation;

To maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designation; and

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.

Category VI

Management objectives

To protect and maintain the biological diversity and other natural values of the area in the long term;

To promote sound management practices for sustainable production purposes;

To protect the natural resource base from being alienated for other land-use purposes that would be detrimental the area's biological diversity; and

To contribute to regional and national development.

4.2. Specific objectives

The specific management objectives of WRPA are grouped under the following three headings and apply in both the category II and category VI areas.

1. Natural Resources Management

- Biodiversity
- Water resources
- Geological formations and fossil sites

2. Human and economic activities

3. Public awareness and environmental education programs

Each of the previous issues has specific goals to be achieved, which can be summarized below:

1. Natural Resources Management

Biodiversity (Conservation of biodiversity)

Preventing of illegal hunting of biodiversity elements inside WRPA (water birds, falcons and gazelles).

Preventing all other illegal actions against the elements of biodiversity inside WRPA (e.g. removal of plant species)

Limiting of all sorts of habitat destruction that can come through economic activities, unwise and uneducated visitors and different sorts of human settlements as land reclamation schemes and Coptic monastery.

Limiting of man made fires that threat the biodiversity inside the natural wetland systems of Rayan Lakes.

Water resources

Monitoring of water quality of the two Rayan lakes and their connecting canal.

Monitoring of inlet to outlet of the operating fish farming activities

Preventing of any illegal discharging of different pollution sources to the water of the lakes e.g. illegal fishing activities that use decayed remains, vehicle cleaning beside the body of the lake system....etc.

Limiting of man made fires that increase the enrichment of the water of the lakes with inorganic elements.

Avoiding the wastewater discharging from the land reclamation scheme.

Geological formation and fossil sites

Keeping the naturally stored fossil remains (of about 400 vertebrate whale skeletons under the soil surface and more than 38 fossil skeletons above the soil surface) of Wadi El-Hitan site.

Developing of a site plan that ensuring the control of the public use of the area for the scientific, educational and eco-tourism purposes.

Controlling the illegal access of the vehicle tours to the valley that can adversely affect the fossil remains.

2. Human and economic activities

Promoting wise exploitation of the natural resources present such as the water of the lakes, which can be greatly affected by the fish farming and land reclamation activities.

Conserving the natural resources of the protected area through the high level control of the licensed activities (license format and restricted eligibility for the EIA studies of the different activities).

Identifying and promoting the development of potential activities such as ecotourism in alignment of management goals.

3. Public awareness and environmental education programs

Promoting WRPA as a valuable recreational and educational area.

Influencing policy makers and other key players by highlighting the economic significance of the protected area and how judicious management can create sustainable and growing real income.

Improving the accountability of license holders operating inside the protected area.

Increasing the targets of environmental education and awareness program by WRPA staff (school children, lower-middle income Egyptian nationals and upper-middle class Egyptian nationals and foreigners).

PART 5

5. ZONE PLAN

Zoning is the division of the protected area into zones of homogenous use and legislation: each zone with different characteristics (biologic, geologic, etc.) will have a different use. Zoning is an essential tool for the management of a protected area, which allows differential management considering the different zone's characteristics.

Wadi El-Rayan Protected Area includes areas with various environmental characteristics, which determine different ecological, tourism, educational and economic vocations.

Each site of Wadi El-Rayan Protected Area has been allocated one of the management zone categories listed below in accordance with the NCS management planning system:

Table (3): Zoning system of WRPA

Protection Level	Name of Zone	Activities permitted
Zero impact A	Special Protection Zone Strict Natural Zone	Under investigation. <u>Visitor use and educational plan</u> is urgently needed Studies and research under specific authorization and control. Habitat exploitation is prohibited. Tourism and Economic activities are not allowed.
Low impact B	Reserve Protection Zone	Studies and research under specific authorization and control Eco-tourism only after authorization of WRPA.
Moderate impact C	Recreational Zone	Tourism and tourism facilities and recreation Bird watching Camping Pathway for the traditional fishing activities
High impact D	Development Zone	Controlled habitat exploitation Long-term high impact projects of the black and grey lists according to the Egyptian settings High-density tourism is allowed.

The following general rules apply to the whole protected area and all zones:

Prohibited activities:

- ❖ Hunting, capturing, damaging or disturbing wildlife
- ❖ Damaging or collecting vegetation (including firewood) and grazing
- ❖ Damaging or collecting fossils of geological formations
- ❖ Any activity modifying the natural landscape
- ❖ Liquid or solid waste discharging
- ❖ Driving out of the demarcated tracks or walking outside the demarcated area
- ❖ Introduction of pets, exotic animals or plants
- ❖ Camping outside the demarcated area
- ❖ Using sound systems or any other source of disturbance
- ❖ Lighting fires outside designated areas
- ❖ Mining or quarrying without EEAA authorisation
- ❖ Building permanent or semi-permanent structures or infrastructure including roads without EEAA authorization
- ❖ Using an engine powered boat on the lakes
- ❖ Building a structure closer than 200 m from the lake edge

Each zone has additional rules specific to the zone

5.1. Zoning system

Four zone types with different degrees of protection level will be described and explained (Figure 4: Appendix 1).

5.1.1. Zone A: Special Protection Zone _____

This zone is fully under investigation. A special team is recommended to study the area and prepare a visitor use and education plan for the area. This zone includes high paleontological values:

Zone description

The above and under soil surface part of Wadi El-Hitan which is located in the fossil area located northwest of the protected area. This part is limited with the GPS coordinates: N 29.29647, E 30.05411 and N 29.29228, E 30.03870 and N 29.26612, E 30.01765 and N 29.26968, E 30.04240. The total area of this part is 7.00 km². This part is containing an enormous number of vertebrate fossil skeletons of the old middle Eocene whale (40-43 million years ago).

Zone Rules

The rules for this zone will be drawn up by the special planning team

5.1.2. Zone A: Strict Natural Zone _____

The areas of unique ecosystem, which is used by the key wildlife species inside the protected area, have been classified as zone A. This zone is under strict control and total protection. The total area of this zone is 73.90 km², 4.2% of the total area of the protected area.

Zone description

(See also IUCN 2000a, The Environmental Profile of WRPA and EEAA 2001, report on the third year of the monitoring program)

Two zone A areas have been identified inside WRPA.

1. The first one is the **Spring Area** located south west of the protected area and limited with the GPS coordinates: N 29.10645, E 30.30554 and N 29.06877, E 30.33292 and N 29.02038, E 30.26481 and N 29.06744, E 30.22659. The total surface area is 53.33 km². The key-species *Gazella dorcas dorcas* and other wild life species such as fennec fox, sand fox and Egyptian golden jackal are also present. Those species are supported by the high plant diversity (with key-species *Nitraria retusa* and *Alhagi graecorum*) in the area and 3 natural springs. The fourth spring is zoned as Zone B where low impact ecotourism is permitted.

2. The second is the **Rowayan Area** located also in the southwest of the protected area just north to the first zone and is limited with the GPS coordinates: N 29.12808, E 30.24724 and N 29.12527, E 30.22013 and N 29.14209, E 30.18640 and N 29.162321, E 30.21640. The total surface area is 20.57 Km². The only small community of the key-species dorcas gazelle present in WRPA is found moving between this area and the first one. The habitat is quite similar to the first one with a mountain separating the two areas.

The two Zone A areas will be linked up in a way that excludes the Coptic Monastery but includes the gazelle movement routes.

Inside this zone, all the sorts of natural resources are completely protected and under strict control.

Zone Rules

- ❖ Public access is prohibited except for scientific activities with written authorization from NCS.
- ❖ No agriculture or livestock is permitted

5.1.3. Zone B: Reserve Protection Zone _____

The areas of a) special importance for resident and migratory birds, and b) characteristic landscapes have been classified as zone B. This zone is under high control and total protection for the natural resources. The total area of this zone is 24.92 km², 1.4% of the total area of the protected area.

Zone description

(See also IUCN 2000a, The Environmental Profile of WRPA and EEAA 2001, report on the third year of the monitoring program)

Two zone B areas have been identified inside WRPA.

The area south of the Lower Rayan Lake and limited with the GPS coordinates: N 29.12099, E 30.41873 and N 29.09338, E 30.42061 and N 29.05785, E 30.42468 and N 29.09196, E 30.35669. The total area of this part is 24.92 km². This area has a special importance as a resting-place for the migratory bird species passing WRPA. It also represents the most important site for nesting and

reproduction of birds inside WRPA. The area has characteristic landscape of sand dunes overlapping with the southern part of the Lower Rayan Lake.

Spring Area walking trails and view sites. This area extends from the visitor car park north of the spring area to the first spring. Visitors are encouraged to walk into a small section of the Spring Area to experience the natural beauty of the area. Low impact trails and view-sites have been made for visitors.

Inside zone B areas, all the sorts of natural resources are completely protected and under high-level control.

Zone Rules

- ❖ Public access is prohibited except for visitors viewing wildlife and landscapes.
- ❖ Scientific activities with written authorization from NCS
- ❖ Navigation with any kind of boats (with or without engine) is prohibited, except for scientific activities authorized by NCS
- ❖ All kinds of fishing activities are not allowed
- ❖ No floating structures are allowed.
- ❖ No agriculture or livestock is permitted

5.1.4. Zone C: Recreational Zone

The area of this zone is designated for a) eco-tourism and environmental education activities (visitor center tracks and bird watching sites), b) recreational uses (safari camp, cafeterias and camping site), c) high landscape values and d) less impact activities as traditional boat fishing. The total area of this zone is 49.5 km², 2.8 % of the total area of the protected area.

Zone description

(See also IUCN 2000a, The Environmental Profile of WRPA and EEAA 2001, report on the third year of the monitoring program)

One zone C area has been identified inside WRPA. The strip surrounds the Upper and Lower Rayan Lakes. The total area of this part is about 49.5 km². In the area of this zone only infrastructure for the protected area management or for educational and eco-tourism purposes are permitted. The only infrastructure related to the traditional fishing is the ice factory (solar panel system) and the small fish collection units, which are representing a negligible area as a whole.

Traditional fishery activities have been carried on in the Wadi El-Rayan lakes since 1980. First by a private company, and then since 1983 by the General Authority for Development of fish Resources. The General Authority for Development of fish Resources implemented a policy to develop the lakes which includes transplanting fish fry of different species into the lakes, controlling fishing gear, fishing seasons, the numbers of boats and fishermen. To more control and manage fisheries the lakes now have five fish-collecting units as following:

First Lake.

- 1- Main fish-collecting unit.
- 2- Abo Rokba fish-collecting unit.
- 3- Baccarat fish-collecting unit.

Second lake

- 1- Waterfall fish-collecting unit.
- 2- Horria fish-collecting unit.

The fish in Rayan Lakes are divided into two groups: resident species that arrived in the drainage water from Fayoum Governorate, and those that were introduced as a fry in order to increase fish production in the lakes. (See the species list)

Zone Rules

- ❖ Only infrastructure for educational and eco-tourism purposes after approval from EEAA
- ❖ Construction of new tracks, only or for educational and eco-tourism purposes, and after EEAA approval;
- ❖ No floating structures are allowed
- ❖ No commercial fishing closer than 150 m from the lake edge

5.1.5. Zone D: Development Zone

The areas of this zone are designated for different kinds of activities that are fully under official license: oil extraction, agriculture, fish farming, infrastructure for eco-tourism and recreation. All the activities must be licensed by EEAA after submission of an exhaustive Environmental Impact Assessment (EIA) following the "Guidelines for Egyptian EIA". EEAA has the right to monitor that existing establishments are conformed to the requirements of the law No. 4/1994 and law 102/1983.

Zone description

(See also IUCN 2000a, The Environmental Profile of WRPA and EEAA 2001, report on the third year of the monitoring program)

There are three types of zone D area in WRPA

1. The first area is the oil extraction field located on the north-eastern corner of WRPA. The area has low landscape, geological and paleontological and biodiversity values.
2. The second area is the land reclamation area, which is divided into two divisions:
 - a) The 1st division (2 parts) is located on the other side of the asphalt road from the petroleum field and near the main gate of the protected area. The total area of this division is 3.92 km² and limited with the GPS coordinates: part 1: N 29.34501 E 30.42448 and N 29.34029, E 30.42559 and N 29.33722, E 30.41406 and N 29.33649, E 30.40014 and N 29.34966, E 30.40524. Part 2: N 29.35221, E 30.45013 and N 29.34618, E 30.45404 and N 29.33984, E 30.45375 and N 29.34440, E 30.43657 and N 29.35312, E 30.44116. The area has low landscape, geological and paleontological and biodiversity values.
 - b) The 2nd division includes the reclamation area (Saiedna El-Khedr reclamation village) of an area of 48.134 km², and limited with GPS coordinates: N 29.20320, E 30.32731 and N 29.20295, E 30.27968 and N 29.13512, E 30.29092 and N 29.12995, E 30.39348 and N 29.12101, E 30.38212 and N 29.17719, E 30.34407.
3. The third area is that of fish farming activities along both sides of the junction canal between the two Rayan Lakes, limited with GPS coordinates: N 29.23184, E

30.45002 and N 29.20805, E 30.45855 and N 29.19965, E 30.43898 and N 29.21216, E 30.42371 and N 29.22276, E 30.42484, and with total area of 6.4 km².

Fish farming is a relatively new activity in Wadi El-Rayan Protected Area and comprises an intensive fish farming section situated immediately below the upper lake, and an extensive fish farming section above the lower lake.

Intensive fish farming has been in operation for four years and there are currently 90 ponds covering an area of 30 feddan in the section. Extensive fish farming has only been operating for a year. There are a total of 68 licensed fish farms in the extensive section of which only 12 are currently in operation.

Zone Rules

- ❖ The licensee must strictly follow the terms of the EEAA license;
- ❖ Infrastructure, including roads, should be compatible with the environmental needs.
- ❖ Solid wastes have to be regularly collected and conveyed to the nearest authorized waste disposal facility
- ❖ Sewage must be collected into septic tanks and the tanks must be cleaned regularly.

The Prime Minister's Decree No 264/1994 establishes that the total area for economic activities allowed must not exceed 10% of the total extension of the protected area. The total extension of the D zone is 119.744 km², 7 % of the total area of the protected area. Adding the 2.8% surface occupied by the eco-tourism activities, the 10% limit has almost been reached. Consequently, no more protected area land should be allowed for human activities.

PART 6

6. MANAGEMENT STRATEGIES AND ACTIONS

Development of clear strategies for the management of WRPA is one of the desired outputs of this management plan covering the period 2002-2006. The strategies as well as the future well-studied actions will contribute to the process of effective environmental management in the protected area.

The following specific management strategies and actions have been adopted:

6.1. Collaborative Management will be given a high priority.

The successful management of the protected area requires the support of stakeholders in the public and private sectors. All main key stakeholders at Governorate level, including the Governor, will be informed and involved from the start of the management planning process, and on an ongoing basis. A copy of the management plan in Arabic and English will be discussed with the appropriate collaborating authorities for endorsement.

At a special meeting with the Governor of El-Fayoum, Professor Dr. Saad Nasaar, held on 14 October 2002, the Governor expressed his appreciation to the WRPA Manager for initiating the management planning process for WRPA. He described the Management Plan as an essential tool to achieve the required level of coordination between the various public agencies active in the Protected Area and undertook to advise all the relevant departments in the Governorate that they should give the Management Plan their full support.

The following departments have already given their formal support of the Management Plan.

- The Irrigation and Water Resources Department
- The Tourism Department
- The General Authority for Development of Fish Resources.
- The Water and Environmental Police

A meeting was held with the Security Department on 15 October 2002 to discuss the Management Plan.

Meetings with other key stakeholders will be held and meeting schedules will be given in the 2002 – 2003 Operating Plan.

6.2. Special attention will be given to improving control over water use in the lake system

Inflow into the tunnel that feeds the upper lake is the surplus runoff water from the El-Fayoum irrigation system and the amount varies depending on the amount of water recycled for irrigation before it reaches the tunnel. According to the Water Resources Department the extraction and evaporation of water from the lake system is currently greater than the inflow, and the allocation to each user will have to be reduced.

It is also their recommendation that the Nature Conservation Sector should request a technical meeting on water supply to the Wadi El- Rayan lakes, held under the chairmanship of the Governor of Fayoum. The meeting will discuss the water allocations

to the different water users in the system. WRPA staff supports the recommendation and NCS will arrange the meeting.

6.3. Adaptive management will be applied to ensure that the plan objectives are achieved.

Results obtained from the monitoring programs will be continuously evaluated and the management actions will be adapted where necessary to ensure that the management objectives set out in the management plan are being achieved.

6.4. Management actions will cover the three core protected area functions of natural resources management, public use and public awareness and community outreach.

Each function is described below.

Natural Resources management

The management of natural resources is the priority among the other objectives of the protected area. The natural resources can be simply classified into:

A. Biotic elements

1. Biodiversity elements
 - a. Flora
 - b. Fauna
 - Mammals
 - Birds
 - Invertebrates
 - Amphibians
 - Reptiles
 - Fish

B. Abiotic elements

1. Water resources and wetlands
 - Lakes and natural springs
2. Geological formations
3. Paleontological sites
4. Cultural heritage elements.

Each of the above resource elements will be discussed under the identified zonation system of the protected area. The management strategy for the biotic elements can be principally represented in the spring and Rowayan areas of zone A (Strict Natural Zone). The strategy of the abiotic elements can be represented in a) the Fossil Area - Wadi El-Hitan - of zone A (Special Protection Zone) and b) the two Rayan Lakes which are in zones B, C and D.

Public Use

The public use inside the area has been identified to include one or all of the following a) eco-tourism activities b) human economic activities or c) human settlement.

Public Awareness and Community Outreach

The development of the public awareness program in WRPA is a main and important component of the management plan of the protected area. The role of public awareness program is clear on the light of the potential of WRPA as a main popular as well as economic development site. The different targets of the program have been identified for each zone inside the protected area. The components of the program for each of these targets inside each zone have been also identified. The overall targets as well as the different components of the program constitute the public awareness program for the protected area as a whole.

6.5. Management will be focused at the management zone level.

Each zone has its own unique management objective, and management actions will be focused mainly at the management zone level to ensure that the specific management objectives of each zone are achieved.

The management actions are described in each zone below.

6.5.1. Zone A: Special Protection Zone

Fossil Area (Wadi El-Hitan)

Natural Resources management

Geological formations as well as paleontological sites are the main resources in this special protection zone. Magnificent Saharan scenes as well as interesting vertebrate fossils constitute the main targets to apply the management strategy of the protected area in this zone. Those skeletons of whales are date back to about 40 million years ago, scattered in Wadi El-Hitan and embedded in a thin layer of sand and parts of them are exposed to the surface. The valley contains about 400 whale skeletons some of them are exposed and some others are not.

The strategy of this zone is the extreme protection of these natural and cultural resources. The protection strategy is coming parallel with the wise investment of the area from the eco-tourism point of view. The protection strategy has been identified to serve the following: a) safeguard structural landscape features and whale skeletons, b) ensure that future generations have the opportunity to experience understanding and enjoyment of the fossil area and its whales and c) maintain respect for the ecological and geomorphological values. A permanent staff outpost is planned to control visitors in this sensitive and remote area.

Application will be made for the site to be listed as a World Heritage Site.

Public Use

The public uses of this zone are limited clearly to the well-controlled eco-tourism forms. The following forms of eco-tourism are coming to be the acting ones in the area.

- a) An ecotourism site plan will be developed in the operational plan with the assistance of experts, following the guidelines developed in the first phase of the Italian project, (El-kamash, 2001).
- b) The open-air museum, which containing the most integral vertebrate fossil skeletons in a natural protected show among one of the most amazing and attractive senses.

Public Awareness and community outreach

The program is including targets mainly outside the protected area, which are represented in the local and foreigner visitors. (see zone C).

6.5.2 Zone A: Strict Natural Zone

Spring and Rowayan Areas

Natural Resources management

This zone encompasses spring and Rowayan areas. This zone has biological cultural and historical significance. This zone characterized by unique sand dune ecosystem in which small population of Dorcas Gazelle is living. The presence of a small group of monks in the Coptic monastery inside the spring area is the only exception of this zero impact zone. The use of natural resources is limited in the water of one spring mainly for the irrigation of the small half-feddan garden of the monks.

The strategy for the management in this zone is the conservation of wildlife, especially Gazelle population inhabiting this area to provide proper site and time for breeding to increase their number returning with this population back to their original natural status.

Public Use

The only sort of public use inside this zone is the human settlement of the Coptic monastery inside the spring area (the only exception inside the zone). The settlement of the Coptic monastery is limited to 9 monks (some times increased and some times decreased), 20 caves and some infrastructure represented in some exposed guest rooms and about half feddan garden for personal use of fresh vegetables. In order to avoid any further expansion of the existing infrastructure or agriculture activities, regular monitoring and extensive interaction has been carried out by WRPA staff and should be continued for the settlement inside the area. Their Father and protected area representatives have signed after these regulations.

Public Awareness and community outreach

The public awareness program in this zone has only one target and should be directed for the monks of Coptic monastery. The program must involve different communication channels between their side and that of the protected area, identifying what is new for both and what are the different means to support the collaboration of the different programs of the protected area as the monitoring program.

6.5.3. Zone B: Reserve Protection Zone

The Area South of the Lower Rayan Lake and the fourth spring

Natural Resources management

Conservation and total protection of natural resources constitute the management strategy for this zone. The areas are of special importance for wildlife, resident and migratory birds, and characteristic landscapes.

Public Use

No sorts of public use has been identified in this area except low impact wildlife viewing, the controlled car tours around the area through the designated tracks in the area around the lake with the roles mentioned in part 5. The existing bird watching sites and visitor footpaths will be maintained

Public Awareness and community outreach

The two primary targets of the program in this zone are the local communities of the main villages surrounding the protected area and the fishermen as a sub-target, and the visitors to the sites. The protected area roles have to be brought to the attention of the first target. The program must involve the concept of the protected area parallel with the collaborative management issues.

6.5.4. Zone C: Recreational Zone

The Area of Rayan Lakes and their Destinations

Natural Resources management

Conservation of the biotic elements as well as wise and controlled use of available natural resources represents the management strategy of this zone.

Both biotic and abiotic resources are moderately invested from the two side of economic as well as eco-tourist approaches. The vegetation has been identified as the acting biotic factor as well as the bird species inside for the eco-tourism purposes. The water of the lakes as well as the natural landscapes around the lakes is wisely invested.

Public Use

The area of this zone is designated for a) eco-tourism and environmental education activities b) recreational uses and d) moderate impact activities as traditional boat fishing.

One bird watching site, one campsite and the visitor center are existing eco-tourism facilities for the moment. Six cafeterias and one safari camp are existing as mild economic activities. Two proposed ecolodges are planned to construct in this zone according to the feasibility study for eco-tourism facilities inside WRPA depending on the mild availability of the natural resources inside this zone.

General Authority for Development of Fish Resources opened the Rayan lakes to fishing for nine months, during this time it collects fishes from fishermen every day according to this distributed fish-collect unit. The closed season supposed to allow the fry introduced into the lakes each year to grow, as well as the resident fish to spawn. Season is now closed about three months, from (1/7/2002) to (1/10/2002) in the upper lake and from (1/7/2002) to (20/10/2002) in the lower lake.

In 2001-2002 the lower lake was extended to one month more open, but with non-significant harvest. The problem of illegal fishing: Many fishermen [with or without license] are fishing by illegal ways without any control from collecting fish unit. This people can use illegal nets to capture any fish at any size, also they are fishing in closing season.

Public Awareness and community outreach

The primary targets of this program have been identified as local communities around the protected area and the local and international visitors (outside the PA). Fishermen and owners of economic activities (inside the PA) are representing sub-targets. Students. The main visitor area (waterfall area) is included in this zone.

The channels of communication must involve the media tools in addition to the normal pre-described ones.

The protected area program can introduce the following:

The communication through multi-media tools

- Radio is a powerful media-type reaching most parts of the country, through local language. "Radio is particularly instrumental in reaching the two largest pivotal audience groups". First, it can influence subsistence users of natural resources. Second, radio can reach to the majority of women -the repositories of values.
- Use of the TV has a strong influence in the urban areas and amongst the middle class especially the women who stay at home.
- Cinema is popular amongst certain groups in society.
- The use of newspapers in both English and local language is limited to the small percentage of the population who is literate. It is, however, a useful and powerful medium for communication with the senior decision-makers, which may not have time for other activities. The use of posters, pamphlets and the visitor center.
- Increasing the collaboration with the tourist companies.
- Publications e.g., visitors guides, maps etc.
- Website

6.5.5. Zone D: Development Zone

Spots of intensive economic activities around Rayan Lakes

6.5.5.1. Land Reclamation

Natural Resources management

Sustainable use of natural resources is the management strategy of this zone parallel with the conservation of biotic elements inside. Water of the lakes and soil are the main resources involved in this zone.

Public Use

Activities are fully under official license issued by EEAA after submission of an exhaustive Environmental Impact Assessment (EIA) following the "Guidelines for Egyptian EIA". EEAA has the right to monitor that existing establishments are conforming to the requirements of the law No. 4/1994 and law 102/1983.

No increase in the size of the land reclamation area should be permitted until the problem of the over use of the water resources in the lake system has been solved. This is discussed under paragraph 6.5.3.

Public Awareness and community outreach

The program is directed at the settlers inside the area. The program is dealing mainly with the creation of appropriate communication channel between WRPA management unit and the settlers. These channels are represented in a) establishment of a permanent office for the protected area inside the reclamation area to increase the collaboration as well as help WRPA staff in different management issues, b) introduction of important and vital studies for the area as the bio-agriculture program, increasing awareness in the administration as well as the settlers of the area with the advantages of this program for them and in the same time for the protected area and c) raising the level of public awareness for school children to create new generation able to assist and support the nature conservation concept.

6.5.5.2. Oil Company

Natural Resources management

Geological residues (crude oil) is the main resource involved in this zone.

Public Use

A high impact economic activity depending on the natural resources of this zone. Activities are fully under official license issued by EEAA after submission of an exhaustive Environmental Impact Assessment (EIA) following the "Guidelines for Egyptian EIA". EEAA has the right to monitor that existing establishments are conformed to the requirements of the law No. 4/1994 and law 102/1983.

Public Awareness and community outreach

The program should deal with introduction of the protected area objectives and giving the difference between working inside the protected area and outside

6.5.5.3. Fish Farms

Natural Resources management

Sustainable use of natural resources is the management strategy of this zone parallel with the conservation of biotic elements inside. Water of the lakes and soil are the main resources involved in this zone.

Water supply problems for the fish farms

In their report Joint Mission Report on Fresh water quality and ecosystem evaluations, and on feasibility assessment of constructed wetland technologies for fish farm wastewater treatments, Pucci and Masi (May, 1999) expressed concern about the water use and suggested that any future incrementation in water use for productive activities should be avoided.

During a field visit to the intensive fish farm section on 3 November 2002 the fish farm managers stated that the water supply to the farms used to be 1.00 cubic meters per second but had been reduced to 0.25 cubic meters per second after the “water crisis”.

According to the Water Resources Department the extraction and evaporation of water from the lake system exceeds inflow, and the allocation to each user including the fish farmers will have to be reduced. It is their recommendation that no further licences for fish farming should be issued until the critical problem of over use of the available water in the lake system has been resolved.

Public Use

High impact economic activity depending on the natural resources of this zone. Activities are fully under official license issued by EEAA after submission of an exhaustive Environmental Impact Assessment (EIA) following the "Guidelines for Egyptian EIA". EEAA has the right to monitor that existing establishments are conformed to the requirements of the law No. 4/1994 and law 102/1983.

Public Awareness and community outreach

The program should deal with introduction of the required base-information about environmental low-cost technologies (such as artificial wetland) to mitigate the pollution of the fish farm effluent and giving in the same time a satisfied investment result.

PART 7

7. MANAGEMENT TOOLS

The long-term application of the management strategy is being achieved through using the following management tools; environmental regulations and law enforcement, communication, documenting, monitoring and research, GIS and Remote Sensing, and EIA. The tools are the same for the protected area as a whole but each of the four allocated zones of WRPA is treated dealing with monitoring and research.

7.1 Environmental regulations and law enforcement

Regulations

Law No. 102/1983 provides the legal framework and Prime minister's decree No. 943 /1989 established the Protected Area of Wadi El-Rayan.

Law No. 4/1994 provides the rules governing the granting of licences and Prime minister's decree No. 264/1994 promulgates the regulations.

Law enforcement

Patrols are carried out by Rangers and Community Guards.

Any violations of the regulations observed during patrols are recorded in a police report and submitted by WRPAMU to the water police station. The police report is transmitted to the main police station in Abshaway, then to the prosecutor and finally to the court. The court decides the penalty.

Community Guards are stationed at outposts to improve patrolling of remote areas, but coverage of the PA is not yet adequate.

7.2 Communication

Communication uses multi-media tools such as

- talks, lectures, Radio, TV, Print media, (Arabic and English.)
- posters, pamphlets and the visitor center.
- publications e.g., visitors guides, maps etc.
- website

7.3 GIS and Remote Sensing

These two tools play an important part in supporting the other tools such as monitoring and are used throughout the protected area. Realization of topography, land-use, infrastructure, monitoring, categorization and zonation maps in the protected area.

Remote sensing facilities assess and record the accumulated changes of the natural habitats, land-use and infrastructure for the existing and developing economic activities.

7.4 Environmental Impact Assessment (EIA)

This tool is used whenever a development activity involving infrastructure is planned in the protected area. All the activities in the area are only licensed by EEAA after submission of accepted EIA study following the guidelines of Egyptian EIA.

7.5 Documentation

Monitoring of project activities has been carried out by WRPA staff as a continuous process to support an effective management of the area, modify the strategies and actions and ensure the wise-use of resources. Periodical internal reporting system for evaluation have been carried out and recommended to continue as biannual, annual and final reports including a statement of:

- Scientific and ecological monitoring
- Management effectiveness monitoring
- Budget and expenditure

Scientific and ecological monitoring

The reporting system of this item had been done annually. The report included two main monitoring categories:

Biodiversity monitoring that includes Flora and Fauna. Biodiversity is the main target resource of the protected area.

Resource monitoring that includes the followings:

- Water quality monitoring
- Geology and palaeontology monitoring
- Monitoring of resource-based economic activities
- Visitor monitoring

The current monitoring system is strongly recommended to be followed for the next period.

Management effectiveness monitoring

Twice annual reporting of the management activities is recommended to continue according to the guidelines done by the IUCN joint mission (IUCN, 1998).

Budget and expenditure

Periodical internal evaluations have been done through the previous part of management and effectiveness monitoring. The reporting is presented in the form of an annual report including a statement of expenditure. These will be presented together with annual work plans and budgets at the end of each year in the Operating Plan. A project final report and statement of expenditure will be presented at the end of the period of the plan.

7.6 Monitoring and Research

7.6.1. Zone A: Special Protection Zone _____

Two types of scientific regular monitoring program in this zone are found to deal mainly with the paleontological sites of the area in addition to a satisfactory program for visitor monitoring.

7.6.2. Zone A: Strict Natural Zone

Scientific regular monitoring program in this zone is dealing mainly with the elements of biodiversity. Two monitoring programs have been applied in the area. The first is the mammal-monitoring program, which deals mainly with the large mammals especially dorcas gazelle communities. Fennec fox, Sand Fox, Egyptian Jackal and Wildcat are also involved. The second is the vegetation-monitoring program, which deals with the abundance of plant species in the different microhabitats of the area. Another program for monitoring of the activities of Coptic monastery had been adopted. The existing monitoring programs (EEAA, 2002) have been recommended to continue for years of application of this management plan.

7.6.3. Zone B: Reserve Protection Zone

Scientific regular monitoring program in this zone is dealing mainly with the elements of biodiversity. The same monitoring programs for the large mammals and vegetation of the zone A has been applied also in zone B except that of gazelle monitoring part at the lake. The existing monitoring programs (EEAA, 2002) have been recommended to continue for year of application of this management plan.

7.6.4. Zone C: Recreational Zone and Zone D: Development zone

Scientific regular monitoring program in these two zones is dealing mainly with the elements of biodiversity as well as monitoring program of economic activities (EEAA, 2002).

PART 8

8. MANAGEMENT RESOURCES

The critical resources for the management of WRPA can be identified under three main categories, which are infrastructure and equipment, financing and staffing which have been described below:

8.1. Infrastructure and Equipment

The existing and proposed infrastructure was simply described below (Table 4). A complete housing for the staff is strongly recommended in Fayoum City. The minimum living needs, health care, communications, etc must be provided in the place of housing, so Fayoum City is strongly recommended as a proposed housing place. One house with a separate apartment for each of the staff could be satisfactory.

The current status of the existing equipment was introduced in the monitoring and evaluation report (IUCN, 2001).

Table (4) Existing and proposed Infrastructure

Infrastructure	Existing		Proposed	
	Location	Purpose	Location	Purpose
WRPA Headquarters	Main visitor area	Main management structure	-	-
Personnel accommodation	Headquarter	Accommodate staff	At an appropriate site	Senior staff accommodation
Outpost	Spring area	Satellite management structure	Fossil Area (Wadi El-Hitan). Special Protection Zone A	Satellite management structure (zone A control)
Visitor center	Main visitor area	Public Awareness	-	-
Environmental school	-	-	Inside the protected area	Environmental education facility
Main Gate	Main Entrance	Ticket collection	-	-
2 Ticket Check Points	- Entrance of the main visitor area (Temporary structure) - Southern entrance way from Beni-Suif road (Temporary structure)	- Ticket check - Ticket collection	- 2 Permanent at the same places	Same purposes
Control Check Point	-	-	Fossil Area (Wadi El-Hitan). Zone A	Entrance control to the special protection zone A
Cafeterias	6 at Main Visitor Area	Visitor facilities	Remove three of the cafeterias-	In accordance with the plan-
2 WCs	Main Visitor Area	Visitor facilities	-	-

Bird Watching Site	2 at Lower Rayan Lake	Eco-tourism Facilities	-Additional sites	Ecotourism facilities-
Camping Site	Lower Rayan Lake	Eco-tourism Facilities	-Proximity of fossil area	Ecotourism facilities-
Ecolodge	-	-	- Lower Rayan Lake - Upper Rayan Lake - Fossil Area	Ecotourism facilities
Tracks and footpaths	The 4 zones of the area	110 km tracks Covering the most uses of the 4 zones Footpath in the Springs area	- Foot path (Wadi El-Hitan) - Track West of the protected area (to Baharia) - Track East of the PA (To Madi cultural monument)	- Educational - Eco-tourism - Eco-tourism
Natural Fences	- Main Visitor Area - El-Modawara area - Wadi El-Hitan	Management structure	- Fossil Area (Wadi El-Hitan) Special protection zone A	- Open Air Museum
Signposts	The 4 zones of the area (25)	Covering the most uses of the zones	Supporting Coverage of the 4 zones	Management, Information and education
Information Panels	Main areas of the 4 zones	Educational and Eco-tourism facilities	Supporting Coverage of the 4 zones	Information and education

8.2. Financing

Financing is important for management, regarding to profit seeking or non-profit seeking, to manage the activities that depend on financing, and no goals can be achieved in case of having no money.

Protected areas management (non-profit seeking) devotes the majority of attention to nature conservation, and needs funds for reaching the aims.

In WRPA different sources of financing have been provided as follows:

- 1-Local fund (Egyptian Government, EEAA, NCS)
- 2-Donor Contribution (Italian Co-operation, DGDC)

The salaries of the staff are given by GOE. The returns of the tickets (coming from commercials and custom license) are going directly and totally to the administrative body of EEAA without any deduction for WRPA.

Usually, the local fund is not sufficient for the activities of the protected area. Self-financing can solve this problem and cover these needs.

General Financial analysis and planning steps:

- 1- financial analysis and planning is concerned with transforming activities and financial data into a form that can be used to monitor the PA financial condition.
- 2- evaluating the need for increasing management capacity.
- 3- determining the requirements for additional sources of financing.
- 4- making wise uses to cover the cash requirements.

Proposed sources of financing for WRPA

- 1) The annual fees (for the concession use) paid by the owners of economic activities inside WRPA, must be direct (totally or partially) to manage the activities of the PA.
- 2)- Raising the entrance ticket fees of WRPA. The returns of the tickets could be reduced at once, however, in the future will gradually increase, especially after the new facilities introduced by WRPA management unit.
- 3)- Merchandising shop can sell the posters, stickers and handcraft, which can be done by the local community.
- 4) Increasing paid-trips for the most attractive and famous place inside WRPA.

8.3. Staffing

The current status of WRPA staff is as the following:

JOB	NUMBER
Protected Area Manager.....(PAM)	1
Environmental Affairs Researcher (ranger)(EAR)	9
Legal Affairs Officer(LAO)	1
Accountant.....(Acc)	1
Financial Affairs Officer.....(FAO)	1
Ticket Collector.....(TC)	3
Guards.....(Gd)	7
Secretary.....(Sec)	1
Driver.....(Dvr)	2
Supporting Staff (House watching).....(SS)	2

The entire staff is lacking of the permanent recruitment by EEAA except the protected area manager and the two drivers. The general and specific duties of the PAMU staff are given in the Duty Handbook for the Wadi El-Rayan Protected Area Staff.

Recruitment of following human resources

Job Description	Number	Specialization
Environmental Affairs Researcher	4	At least Bachelor degree
Guard	8	Diploma is preferred
Ticket Collectors	3	At least diploma degree

PART 9

IMPLEMENTATION AND EVALUATION AND REVISION

Details on the implementation of the Management Plan are given in the annual Operating Plans for WRPA. The first Operating Plan is for the period July 2002 – June 2003.

Evaluation of the Management Plan will be carried out annually in June as part of the process of preparing the Operating Plan for the following year.

A full revision of the Management Plan will be done at the end of the five-year period of the Plan, which is in June 2006. A second five year Management Plan for the period 2007 –2011 will then be drawn up in accordance with experience gained in the first five year period.

APPENDICES

Appendix 1

Maps:

Figure 1. Map showing the protected areas of Egypt

Figure 2. Map showing Wadi El-Rayan Protected Area

Figure 3. Map showing the 2-category system of WRPA

Figure 4. Map showing the zonation of WRPA

Appendices (2 - 9): Check lists

Appendix 2

List of Bird species inside WRPA

No	LATIN NAME	ENGLISH NAME	ARABIC NAME	NOTES
1	<i>Accipiter brevipes</i>	Levant Sparrowhawk	باز/بيدق	Migrant
2	<i>Accipiter nisus</i>	Sparrowhawk	باشق	Migrant
3	<i>Acrocephalus arundinaceus</i>	Great Reed Warbler	هازجة القصب الكبيرة	Resident
4	<i>Acrocephalus dumetorum</i>	Blyth's Reed Warbler	-	Migrant/Winter visitor
5	<i>Acrocephalus schoenobaenus</i>	Sedge Warbler	هازجة السعد	Resident
6	<i>Acrocephalus scirpaceus</i>	Reed Warbler	هازجة الغاب	Resident
7	<i>Acrocephalus stentoreus</i>	Clamorous Reed Warbler	هازجة القصب الصياحة	Breeding Resident
8	<i>Actitis hypoleucos</i>	Common Sandpiper	طيطوى	Summer visitor
9	<i>Alaemon alaudipes</i>	Hoopoe lark	مكاء	Migrant
10	<i>Alcedo atthis</i>	Kingfisher	صياد السمك	Resident
11	<i>Anas acuta</i>	Pintail	بلبول	Winter visitor
12	<i>Anas clypeata</i>	Shoveler	كيش	Winter visitor
13	<i>Anas crecca</i>	Teal	شرشير شتوى	Winter visitor
14	<i>Anas penelope</i>	Wigeon	طاي	Winter visitor
15	<i>Anas platyrhynchos</i>	Mallard	خضارى	Winter visitor
16	<i>Anas querquedula</i>	Garganey	شرشير صيفى	Winter visitor
17	<i>Anas strepera</i>	Gadwall	سمارى	Winter visitor
18	<i>Anthus campestris</i>	Tawny Pipit	أبو فضية الصحراء	Winter visitor
19	<i>Anthus cervinus</i>	Red-throated Pipit	أبو فضية أحمر الزور	Winter visitor
20	<i>Anthus pratensis</i>	Meadow pipit	أبو فضية الغيط	Winter visitor
21	<i>Anthus spinoletta</i>	Water Pipit	أبو فضية الماء	Winter visitor
22	<i>Anthus trivialis</i>	Tree Pipit	أبو فضية الشجر	Migrant
23	<i>Apus apus</i>	Commun Swift	سمامة	Summer visitor
24	<i>Apus pallidus</i>	Pallid Swift	سمامة باهتة	Migrant
25	<i>Ardea cinerea</i>	Grey Heron	بلشون رمادى	Resident
26	<i>Ardea purpurea</i>	Purple Heron	مالك الحزين	Winter visitor
27	<i>Ardeola ralloides</i>	Squacco Heron	واق أبيض	Resident/Migrant
28	<i>Arenaria interpres</i>	Turnstone	قنبرة الماء	Migrant
29	<i>Aythya ferina</i>	Pochard	حمرى	Winter visitor
30	<i>Aythya fuligula</i>	Tufted Duck	زراقى أبو شوشة	Winter visitor
31	<i>Aythya nyroca</i>	Ferruginous Duck	زراقى احمر	Winter visitor
32	<i>Botaurus stellaris</i>	Bittern	واق او عجاج	Winter visitor
33	<i>Bubulcus ibis</i>	Cattle Egret	أبو قردان	Resident/Migrant
34	<i>Burhinus oedicneumus</i>	Stone-curlew	كروان جبلى	Migrant
35	<i>Buteo buteo</i>	Buzzard	صقر حوام	Migrant
36	<i>Buteo rufinus</i>	Long-legged Buzzard	صقر جراح	Migrant
37	<i>Calidris alba</i>	Sanderling	مدروان	Migrant
38	<i>Calidris alpina</i>	Dunlin	دريجة	Migrant
39	<i>Calidris canutus</i>	Knot	دريجة الشمال	Migrant

40	<i>Calidris ferruginea</i>	Curllew Sand Piper	دريجة كروانية	Migrant
41	<i>Calidris minuta</i>	Little Stint	كروان الماء	Winter visitor
42	<i>Calidris temminckii</i>	Temminck's Stint	فطيرة تمك	Winter visitor
43	<i>Centropus senegalensis</i>	Senegal Coucal	مك أو كوكو	Resident
44	<i>Cercotrichas glactotes</i>	Rufous Bush - Robin	دخلة حمراء	Summer visitor
45	<i>Ceryle rudis</i>	Pied King Fisher	صياد السمك الأبلق	Breeding Resident
46	<i>Charadrius alexandrinus</i>	Kentish Plover	قطقات أبو الرؤوس	Resident
47	<i>Charadrius dubius</i>	Little Ringed Plover	قطقات متوج صغير	Migrant
48	<i>Charadrius hiaticula</i>	Ringed Plover	قطقات متوج كبير	Migrant
49	<i>Charadrius leschenaultii</i>	Greater Sand Plover	قطقات الرمل الكبير	Migrant
50	<i>Chlidonias hybridus</i>	Whiskered Tern	خطاف أبو بطن	Migrant
51	<i>Chlidonias leucopterus</i>	White-winged Black tern	خطاف أبيض الخد	Migrant
52	<i>Chlidonias niger</i>	Black Tern	خطاف أسود	Migrant
53	<i>Ciconia ciconia</i>	White Stork	لقلق أبيض	Migrant
54	<i>Ciconia nigra</i>	Black Stork	لقلق أسود	Migrant
55	<i>Circaetus gallicus</i>	Short-toed Eagle	عقاب أبيض	Migrant
56	<i>Circus aeruginosus</i>	Marsh Harrier	مرزة المستنقعات	Winter visitor/Resident
57	<i>Circus cyaneus</i>	Hen Harrier	مرزة الدجاج	Migrant
58	<i>Circus macrourus</i>	Pallid Harrier	مرزة بغشاء	Migrant
59	<i>Circus pygargus</i>	Montagu's Harrier	أبو شردة	winter visitor
60	<i>Coracias garrulus</i>	Roller	غراب زيتوني	Migrant
61	<i>Corvus bruniceps</i>	Brown-necked Raven	غراب نوحى	Resident
62	<i>Corvus corone cornix</i>	Hooded Crow	غراب بلدى	Resident
63	<i>Coturnix coturnix</i>	Quail	سمان	Winter visitor
64	<i>Cuculus canorus</i>	Cokoo	هوهو / ووقاق	Migrant
65	<i>Cursorius cursor</i>	Cream Colored Corser	الجليل / جروان	Breeding Resident
66	<i>Delichron urbica</i>	House Matrin	سنونو أبيض البطن	Migrant
67	<i>Egretta alba</i>	Great White Egret	بلشون أبيض كبير	Winter visitor
68	<i>Egretta garzetta</i>	Little Egret	بلشون أبيض صغير	Resident
69	<i>Eremophila bilopha</i>	Temminck,s Lark	قنبرة الصحراء	Migrant
70	<i>Falco biarmicus</i>	Lanner	صقر حر	Migrant
71	<i>Falco columbarius</i>	Merlin	ابو رية	Migrant
72	<i>Falco concolor</i>	Sooty falcon	صقر الغروب	Breeding summer visitor
73	<i>Falco naumanni</i>	Lesser Kestrel	عوسق صغير	Migrant
74	<i>Falco pelegrinoides</i>	Barbary's Falcon	شاهين مغربى	Migrant
75	<i>Falco tinnunculus</i>	Kestrel	عوسق	Resident
76	<i>Ficedula albicollis</i>	Collared Flycatcher	خاطف الذباب المطوق	Migrant
77	<i>Ficedula hypoleuca</i>	Pied Flycatcher	خاطف الذباب الأبقع	Migrant
78	<i>Fringilla coelebs</i>	Chaffinch	عصفور ظالم	Migrant
79	<i>Fulica atra</i>	Coot	غر	Resident/Winter visitor
80	<i>Gallinago gallinago</i>	Common Snip	بكاشين	
81	<i>Gallinago media</i>	Great Snipe	شنقب كبير	Migrant
82	<i>Gallinula chloropus</i>	Moorhen	فرخة الماء	Resident/Winter visitor
83	<i>Gelochelidon nilotica</i>	Gull-billed Tern	خطاف نورسى المنقار	Migrant

84	<i>Glareola pratincola</i>	Collared Pratincole	ابو اليسر	Migrant
85	<i>Grus grus</i>	Crane	كركى / غرنوج	Migrant
86	<i>Himantopus himantopus</i>	Black-winged Stilt	أبو المغازل	Winter visitor
87	<i>Hirundo daurica</i>	Red-rumped Swallow	عصفور الجنة أحمر العجز	Resident
88	<i>Hirundo rustica</i>	Swallow	عصفور الجنة	Migrant
89	<i>Hoplopterus spinosus</i>	Spur-winged plover	زقراق بلدى	Breeding Resident
90	<i>Ixobrychus minutus</i>	Little Bittern	واق صغير	Breeding Resident
91	<i>Jinx torquilla</i>	Wryneck	لواء / أم لواء	Migrant
92	<i>Lanius collurio</i>	Red backed Shrike	دقناش أكحل	Migrant
93	<i>Lanius minor</i>	Lesser Grey Shrike	دقناش صردى	Migrant
94	<i>Lanius mridunals</i>	Southern Grey Shrike	دقناش البادية	Breeding Resident
95	<i>Lanius senator</i>	Woodchat Shrike	دقناش أوروبى	Resident
96	<i>Larus fuscus</i>	Lesser Black-backed Gull	نورس دغبة	Migrant
97	<i>Larus genei</i>	Slender-billed Gull	نورس قرطى	Resident
98	<i>Larus ichthyaetus</i>	Great Black-headed Gull	نورس السمك	Winter visitor
99	<i>Larus ridibundus</i>	Black-headed Gull	نورس أسود الرأس	Winter visitor
100	<i>Limosa limosa</i>	Black-tailed Godwit	بويقة سوداء الذنب	Migrant
101	<i>Luscinia megarhinchos</i>	Nightingale	المغناء الأسمر	Migrant
102	<i>Luscinia svecica</i>	Bluethroat	الحسينى	Winter visitor
103	<i>Merops apiaster</i>	Eurasian Bee-eater	وروار أوروبى	Migrant
104	<i>Merops superciliosus</i>	Blue-cheeked Bee-eater	وروار أزرق الخد	Summer visitor
105	<i>Milvus migrans</i>	Black Kite	حداة سوداء	Migrant
106	<i>Monticola saxatilis</i>	Rock Thrush	سكالة / أبوشوك	Winter visitor
107	<i>Monticola solitarius</i>	Blue Rock Thrush	حمامة زرقاء	Winter visitor
108	<i>Motacilla alba</i>	White Wagtail	أبو فصادة أبيض	Winter visitor
109	<i>Motacilla cinerea</i>	Gery Wag Tail	أبو فصادة رمادى	Migrant
110	<i>Motacilla flava</i>	Yellow Wagtail	أبو فصادة أصفر	Migrant
111	<i>Muscicapa striata</i>	Spotted Flycatcher	خاطف الذباب المنقط	Winter visitor
112	<i>Netta rufina</i>	Red-crested Pochard	ونس	Winter visitor
113	<i>Numenius arquata</i>	Curlew	كروان الغيط	Winter visitor
114	<i>Nycticorax nycticorax</i>	Night Heron	بلشون الليل	Winter visitor
115	<i>Oenanthe deserti</i>	Desert Wheatear	أبلىق الصحراء	Migrant
116	<i>Oenanthe hispanica</i>	Black-eared Wheatear	أبلىق أسود الأذن	Migrant
117	<i>Oenanthe isabellina</i>	Isabelline Wheatear	أبلىق أشهب	Migrant/Winter visitor
118	<i>Oenanthe leucopyga</i>	White-crowned Black Wheatear	أبو سليمان	Migrant
119	<i>Oenanthe monacha</i>	Hooded Wheatear	أبلىق أبو طاقية	Migrant
120	<i>Oenanthe oenanthe</i>	Norhten Wheatear	أبلىق أبو بلىق	Migrant
121	<i>Oriolus oriolus</i>	Golden Oriole	عصفور التوت	Migrant
122	<i>Pandion haeliatus</i>	Osprey	نسورى	Migrant
123	<i>Passer domesticus</i>	House Sparrow	عصفور دورى	Breeding Resident
124	<i>Passer hispaniolensis</i>	Spanish Sparrow	عصفور اسبانى	Migrant
125	<i>Phalacrocorax carbo</i>	Cormorant	غراب البحر	Winter visitor
126	<i>Phoenicopterus ruber</i>	Greater Flamingo	البشاروش	Occasional visitor
127	<i>Phoenicurus ochruros</i>	Black Redstart	حميراء سوداء	Winter visitor
128	<i>Phoenicurus phoenicurus</i>	Redstart	حميراء	Winter visitor

130	<i>Phylloscopus bonelli</i>	Bonelli's Warbler	نقشارة صفراء العجز	Migrant
131	<i>Phylloscopus collybita</i>	Chiffchaff	سكسكة / شادية الخمائل	Winter visitor
132	<i>Phylloscopus sibilatrix</i>	Wood Warbler	نقشارة الشجرة	Migrant
133	<i>Phylloscopus trochillus</i>	Willow Warbler	نقشارة الصفاف	Migrant
134	<i>Platalea leucorodia</i>	Spoonbill	أبو ملعقة	Winter visitor
135	<i>Plegadis falcinellus</i>	Glossy Ibis	أبو منجل أسود	Winter visitor
136	<i>Podiceps cristatus</i>	Great Crested Grebe	غطاس متوج	Winter visitor
137	<i>Podiceps nigricollis</i>	Black-Necked Grebe	غطاس أسود الرقبة	Winter visitor
138	<i>Porphyrio porphyrio</i>	Purple Gallinule	فرخة سلطاني	Breeding Resident
139	<i>Porzana porzana</i>	Spotted Crake	مرعة منقطة	
140	<i>Prinia gracilis</i>	Graceful Warbler	فصية / هازجة	Breeding Resident
141	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	قطا أسود البطن	Migrant
142	<i>Pterocles senegallus</i>	Spotted Sand Grouse	قطا ارقت	Migrant
143	<i>Riparia riparia</i>	Sand martin	سنونو الرمل	Resident
144	<i>Saxicola rubetra</i>	Whinchat	قليعى أحمر	Migrant
145	<i>Saxicola torquata</i>	Stonechat	قليعى مطوق	Winter visitor
146	<i>Scotocerca inquieta</i>	Scrub Warbler	هازجة الدغل	Breeding Resident
147	<i>Sterna albifrons</i>	Little Tern	خطاف صغير	Winter visitor
148	<i>Sterna caspia</i>	Caspian Tern	خطاف أبو بلحة	Migrant
149	<i>Sterna hirundo</i>	Common Tern	خطاف البحر	winter visitor
150	<i>Streptopelia decaocto</i>	Collared Dove	قمرى مطوق	Resident
151	<i>Streptopelia senegalensis</i>	Palm dove	قمرى بلدى	Resident
152	<i>Streptotelia turtur</i>	Turtle Dove	قمرى	Resident
153	<i>Sylvia atricapilla</i>	Blackcap	أبو قلنسوة	Migrant
154	<i>Sylvia borin</i>	Garden Warbler	دخلة كحلة	Migrant
155	<i>Sylvia cantillans</i>	Subalpine Warbler	دخلة الصرود	Migrant
156	<i>Sylvia communis</i>	Whitethroat	زريقة فيراني	Migrant
157	<i>Sylvia curruca</i>	Lesser Whitethroat	دخلة فيراني	Migrant
158	<i>Sylvia melanocephalla</i>	Sardinian Warbler	دخلة رأساء	Migrant
159	<i>Sylvia rueppelli</i>	Rueppell's Warbler	زريقة قصابى	Migrant
160	<i>Tachybaptus ruficollis</i>	Little Grebe	غطاس صغير	Winter visitor
161	<i>Tadorna tadorna</i>	Shelduck	شهرمان	Occasional winter visitor
162	<i>Tringa glareola</i>	Wood Sand Piper	طيطوى غياض	Migrant/Winter visitor
163	<i>Tringa nebularia</i>	Greenshank	طيطوى أخضر الساق	Resident
164	<i>Tringa ochropus</i>	Green Sandpiper	طيطوى أخضر	Migrant/Winter visitor

Appendix 3

List of Fish species inside WRPA

No	LATINE NAME	ENGLISH NAME	ARABIC NAME
1	<i>Alestes nurese</i>	Imberi	راي سردين نورس
2	<i>Aphanius disper</i>	Tooth carp	-
3	<i>Aphanius fasciatus</i>	Tominnow – Pastrica	بطريق
4	<i>Altherina boyeri</i>	Silverside	باساريا
5	<i>Altherina spp.,</i>	Silverside	باساريا
6	<i>Bagrus bayad</i>	Forsskal catfish	بياض
7	<i>Bagrus docmak</i>	Catfish	بقر دقماق
8	<i>Bagrus spp.,</i>	Catfish	بياض
9	<i>Barbus bynni</i>	Barbel	بيني
10	<i>Clarias lazera</i>	African catfish	قرموط
11	<i>Ctenopharyngodon idella</i>	Grass carp	ميروك الحشيش
12	<i>Cyprinus carpio</i>	Common carp	ميروك
13	<i>Dicentrarchus labrax</i>	Seabass	قاروص
14	<i>Dicentrarchus punctatus</i>	Spotted seabass	قاروص
15	<i>Haplochromis spp.,</i>	Cichlid	هابلوكرومس قزم
16	<i>Hemichromis bimaculatus</i>	Cichlid	هيموكرومس مخطط
17	<i>Hemiramphus far</i>	Halfbeak	أبو منقار
18	<i>Labeo nilotica</i>	Nile carp	لبيس
19	<i>Lates niloticus</i>	Nile perch	لماش (قشر بياض)
20	<i>Liza aurata</i>	Golden grey mullet	هاليلي
21	<i>Liza ramada</i>	Thinlip grey mullet	طوبار
22	<i>Mugil cephalus</i>	Flathead grey mullet	بوري
23	<i>Oreochromis aureus</i>	Tilapia	بلطي سلطاني
24	<i>Oreochromis niloticus</i>	Tilapia	بلطي ابيض
25	<i>Sardinella spp.,</i>	Sardin	راي سردين
26	<i>Sarotherodon galilaeus</i>	Tilapia	بلطي جليلي
27	<i>Sparus auratus</i>	Gilthead seabream	دنيس
28	<i>Synodontis schall</i>	Barbel	شيلان
29	<i>Tilapia zillii</i>	Green tilapia	بلطي اخضر (حجاري)

Appendix 4

List of Insect species inside WRPA

SPECIES	FAMILY	ORDER
<i>Agelena lepida</i>	Agelenidae	Araneida
<i>Argiope trifasciata</i> , <i>Argiope lobata</i> , <i>Cyrtophora citricola</i>	Araneidae	
<i>Cheiracanthium sp.</i>	Clubionidae	
<i>Dictyna sp.</i>	Dictynidae	
<i>Stegodyphus sp.</i>	Eresidae	
<i>Pterotricha schaefferi</i> , <i>Haplodrassus sp.</i> , <i>Setaphis sp.</i>	Gnaphosidae	
<i>Trochosa sp.</i> , <i>Pirata sp.</i> , <i>Evippa unguolata</i>	Lycosidae	
<i>Peucetia sp.</i> , <i>Oxyopes sp.</i>	Oxyopidae	
<i>Philodromus sp.</i> , <i>Thanatus sp.</i> , <i>Ebo sp.</i>	Philodromidae	
<i>Mogrus bonnetii</i>	Salticidae	
<i>Tetragnatha nitens</i>	Tetragnathidae	
<i>Theridion sp.</i>	Therididae	
<i>Thomisus onustus</i>	Thomosidae	
<i>Buthacus leptochelys</i> , <i>Androctonus amoreuxi</i>		Scorpionida
<i>Olpium kochi</i>	Olpiidae	Pseudoscorpionida
<i>Geleodes graecus</i>		Solpugida
Suborder Ixodides		Acarida

Appendix 5

Littoral and sub-littoral fauna collected from Wadi El-Rayan Lakes during the period from July 1984 to October 1986. (M. M. Foda and M. A. Saleh, 1988)

Littoral		Sub-Littoral	
Ants:	<i>Monomorium pharaonis</i> <i>Cataglyphis bicolor</i>	Oligochaetes	<i>Chaetogaster</i> sp.
Ant-lions	<i>Myrmeleon</i> sp.	Dragonflies	<i>Crocotheaes</i> sp. <i>Heaianex ephipigger</i> <i>Orthetrus chrysostiosa</i>
Spiders	Agelenidae	Damselflies	<i>Ischnura senegalensis</i>
Tiger-Beetles	<i>Cicindela</i> sp.	Mayflies	<i>Baetis</i> sp. <i>Centropilua</i> sp.
Ear-wigs	<i>Labidura riparia</i> <i>Euborella annulipes</i>	Midges	<i>Chironoaus</i> sp. <i>Spaniotota</i> sp.
Crickets	<i>Gryllotalpa gryllotalpa</i> <i>Liogryllus bimaculatus</i> <i>Gryllus domesticus</i>	Caddisflies	<i>Trichoptera</i>
Housefly	<i>Musca domestica</i>	Crustacea	<i>Gammarus</i> sp.
Sand-beetles	Tenebrianidae	Rotifera	<i>Brachinous</i> sp.
Blood-sucking fly	<i>Tabanus</i> sp. <i>Siphona</i> sp.	Foraminifera	<i>Rotatia beccarii</i>
Mantids	<i>Sphodromantis</i> sp. <i>Mantis</i> sp.	Gastropoda	<i>Melanoides tuberculatus</i> <i>Physa acuta</i> <i>Cleopatra bulinoides</i> <i>Theodorus niloticus</i> <i>Bulinus truncatus</i>
		Bivalvia	<i>Anodonta</i> sp. <i>Unio</i> sp.
		Diving-beetles	<i>Cybister</i> sp.
		Water-bugs	<i>Anisops sardea</i>
		Water-scorpions	<i>Ramatra vicina</i>
		Water-boatmen	<i>Corixa hierglyphica</i>
		Nematodes	<i>Onocholainus</i> sp.

Appendix 6

List of Mammal species inside WRPA

No	LATIN NAME	ENGLISH NAME	ARABIC NAME
1	<i>Hemiechinus auritus auritus aegypticus</i>	Long-eared hedgehogs	قنفذ طويل الأذن
2	<i>Crocidura flavescens deitac</i>	Giant musk shrew	
3	<i>Crocidura floweri</i>	Flower's shrew	
4	<i>Gerbillus pyramidium pyramidium</i>	Greater gerbil	
5	<i>Gerbillus andersoni andersoni</i>	Anderson's gerbil	
6	<i>Gerbillus gerbillus gerbillus</i>	Lesser gerbil	
7	<i>Dipodillus amoenus amoenus</i>	Charming dipodil	
8	<i>Meriones lybicus lybicus</i>	Libyan jird	
9	<i>Arvicanthis niloticus niloticus</i>	Field rat	فأر الغيط
10	<i>Rattus rattus</i>	House rat	الفأر المنزلي
11	<i>Rattus norvegicus</i>	Brown rat	الفأر البنّي
12	<i>Nesokia indica suilla</i>	Bandicoot rat	
13	<i>Jaculus jaculus</i>	Desert jerboas	يربوع حر
14	<i>Mus musculus</i>	House mouse	الفأر المنزلي
15	<i>Canis aureus lupaster</i>	Golden jackal	الذئب
16	<i>Fennecus zerada</i>	Fennec fox	ثعلب الفنك
17	<i>Vulpes vulpes Aegyptica</i>	Red fox	الثعلب الاحمر
18	<i>Vulpes ruepelli Ruepelli</i>	Ruppell's sand fox	ثعلب الرمل
19	<i>Felis sylvestris libyca</i>	African wild cat	القط البري الافريقي
20	<i>Gazella dorcas Dorcas</i>	Dorcas gazelle	الغزال المصري
21	<i>Herpestes ichneumon</i>	Egyptian mongoose	النمس المصري
22	<i>Mustela nivalis</i>	Weasel	العرسه
23	<i>Lepus capensis Rothschildi</i>	Cape hare	أرنب الكاب
24	<i>Felis chaus nilotica</i>	Jungle cat	قط الأدغال
25	<i>Gazella leptocerus leptocerus</i>	Slender horned gazelle	الغزال الأبيض

Appendix 7

List of Plant species inside WRPA

No	Latin Name	Common Name	Arabic Name
1	<i>Adiantum capillus-veneris</i>	Kozbaarit el-beer	البير كزبرة
2	<i>Alhagi graecorum</i>	Aqool	عاقول
3	<i>Arthrocnemum macrostachyum</i>	Shinaan	شنان
4	<i>Calligonum polygonoides sub. comosum</i>	Arta/Risoo	رصو/أرطه
5	<i>Ceratophyllum demersum</i>	Nakshoosh el-hoot	الحوت نخشوش
6	<i>Cornulaca monocantha</i>	Shoak ed-deeb	الديب شوك
7	<i>Cressa cretica</i>	Nadwa	ندوه
8	<i>Cynanchum acutum</i>	Olleiq	عليق
9	<i>Cynodon dactylon</i>	Nigeel	نجيل
10	<i>Cyperus laevigatus</i>	Sead	سعد
11	<i>Desmostachya bipinnata</i>	Halfa	حلفا
12	<i>Haloxylon salicornicum</i>	---	---
13	<i>Imberata Cylindrica</i>	Halfa deil el-qott	القط ديل حلفا
14	<i>Juncu rigidus</i>	Samaar morr	مر سمار
15	<i>Juncus acutus</i>	Samaar morr	مر سمار
16	<i>Launaea nudicaulis</i>	---	---
17	<i>Melilotus indicus</i>	Hendaqooq morr	مر حندقوق
18	<i>Myriophyllum spicatum</i>	Hamool el-maia	الميه حامول
19	<i>Najas armata</i>	Hamool	حامول
20	<i>Nitraria retusa</i>	Gharqad/Ghardaq	غردق/غرقد
21	<i>Phoenix dactylifera</i>	Hagna	حجنة
22	<i>Phragmites australis</i>	Nakheel el-balah	البيلج نخيل
23	<i>Pluchea dioscoridis</i>	Barnoof	برنوف
24	<i>Polypogon monospliensis</i>	Deil el-qott	القط ديل
25	<i>Potamogeton pectinatus</i>	Hamool el-maia	الميه حامول
26	<i>Ranunculus sceleratus</i>	Zaghlanta	زغلنته
27	<i>Rumex dentatus</i>	Khilla	خله
28	<i>Salsola imbricata subsp. Gaetula</i>	Khareet/Kreesh	كريش/خريط
29	<i>Scirpus maritimus</i>	---	---
30	<i>Sonchus maritimus</i>	---	---
31	<i>Spergularia marina</i>	Samaar	سمار
32	<i>Sporopolus spicatus</i>	Nigeel shoaky	شوكي نجيل
33	<i>Stipagrostis ciliata</i>	Homareet	حمريط
34	<i>Tamarix nilotica</i>	Abal/Tarfa	طرفه/عبل
35	<i>Typha domingensis</i>	Halfa/Bardi	بردي/حلفا
36	<i>Zygophyllum album</i>	Rotrait	رطريط
37	<i>Zygophyllum coccineum</i>	Rotrait	رطريط
38	<i>Hyocyamus muticus</i>	Sakaran	سكاران

Appendix 8

List of Reptile species inside WRPA

No	SCIENTIFIC NAME	ENGLISH NAME	ARABIC NAME
1	<i>Ptyodactylus hasselquistii</i>	Fan-footed Gecko	برص أبو كف
2	<i>Cerastes cerastes,</i>	Lesser Ceraster Viper	حيه قرعاء
3	<i>Cerastes vipera</i>	Horned viper	حيه مقرنه
4	<i>Psammophis schokari</i>	Sshokari Sand Snake	هرسين
5	<i>Lytorhynchus diadema</i>	Diademed Sand Snake	بسباس
6	<i>Malpolon moilensis</i>	Moila Snake	أبو العيون
7	<i>Varanus griseus</i>	Desert Monitor	ورل صحراوي
8	<i>Mesalina rubropunctat</i>	Red Spotted Lizered	سقنقر منقط كبير
9	<i>Acanthodactylus scutellatus</i>	Nidua Lizered	سقنقر الرمل الكبير
10	<i>Tropiocolores steudneri</i>	Steudners Gecko	برص تحت الحجر
11	<i>Tarentola annularis</i>	Egyptian Gecko	برص رباعي النقط
12	<i>Stenodactylus</i>	Peteries Gecko	برص واسع العين
13	<i>Stenodactylus stenodactylus</i>	Elegant Gecko	برص واسع العين
14	<i>Sphenops sepsoides</i>	Audouins Sand skink	سحليه نعامه

Appendix 9

List of Invertebrate and Vertebrate fossils of WRPA

SPECIES	CLASS	FAMILY	GENUS	Author
<i>Ancalceetus simonsi</i>	Mammalia	Basilosauridae	Dorudon osiris	Gingrich, 1996
<i>Basilosaurus isis</i>	Mammalia	Basilosauridae	Basilosaurus	Cope, 1868
<i>Zeuglodon osiris</i>	Mammalia	Basilosauridae	Dorudon osiris	Dames, 1894
<i>Shark teeth</i>	Elasmobranchii	Mitsukurinidae	Scapanorhynchus	Woodard, 1889
<i>Cardita viquesneli</i>	Bivalvia	Carditidae	Cardita	Oppenheim, 1903
<i>Carolia plicunoides</i>	Bivalvia	Anomiidae	Carolia	Cantraine, 1838
<i>Drepanocheilus wagihi</i>	Gastropoda	Aprrhaidae	Drepanocheilus	Abass, 1963
<i>Lucina fajumensis</i>	Bivalvia	Lucinidae	Lucina	Oppenheim, 1903
<i>Mesalia fasciata</i>	Gastropoda	Turritellidae	Mesalia	Lamarck, 1830
<i>Nautilus mokattamensis</i>	Cephaloposda	Nautiloidea	Nautilus	Food, 1787
<i>Nicaisoloph clot-beyi</i>	Bivalvia	Ostreidae	Nicaisoloph	Bellardi, 1854
<i>Ostrea elegans</i>	Bivalvia	Ostreidae	Ostrea	Linne, 1758
<i>Pycnodonta gigantea</i>	Bivalvia	Gryphaeidae	Pycnodonte	Solnder, 1766
<i>Turritella carinifera</i>	Gastropoda	Turritellidae	Turritella	Cossmann, 1901
<i>Turritella pharaonica</i>	Gastropoda	Turritellidae	Turritella	Deshayes, 1824
<i>Vulsella crispata</i>	Bivalvia	Carditidae	Vulsella	Fisher, 1870

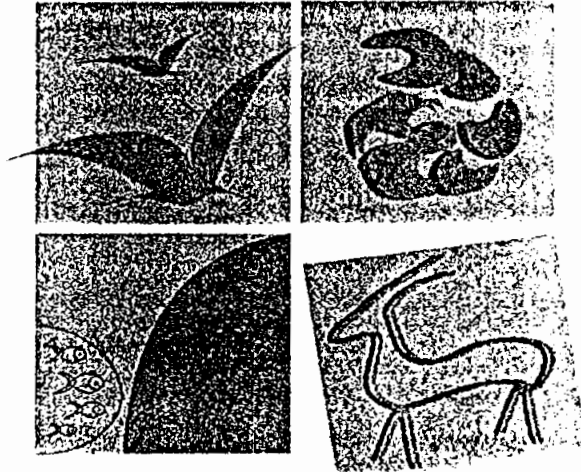
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OPERATING PLAN

WADI EL-RAYAN PROTECTED AREA

محمية وادى الريان



WADI EL-RAYAN PROTECTED AREA

Prepared by
Wadi El-Rayan Protected Area staff
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July 2003 – June 2004

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List of abbreviations

DGCD	Directorate General Co-operation Development (Italian Foreign Ministry)
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
EIEP	Egyptian Italian Environmental Program
GOE	Government Of Egypt
IUCN	World Conservation Union
NCS	Nature Conservation Sector
PA	Protected Area
PAMU	Protected Area Management Unit
PCU	Program Coordination Unit
TA	Technical Assistance
TOR	Terms of References
UTC	Unita Tecnica Centrale (DGCD)
UTL	Unita Tecnica Locale (DGCD)
WRPA	Wadi El-Rayan Protected Area
WRPAMU	Wadi El-Rayan Protected Area Management Unit

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PART 1

1. Introduction

1.1. THE OPERATING PLAN

This plan has been drawn up in accordance with the management planning system for the protected areas of Egypt. This operating plan is a one-year work program whose objective is the implementation the Wadi El-Rayan Protected Area Management Plan (2002 – 2006). The operating plan is fully aligned with the management plan and the format of the operating plan follows the format of the management plan.

1.2. PREPARATION OF THE OPERATING PLAN

It is the responsibility of Protected Area Manager to prepare the annual operating plan.

The background, site description and evaluation, management issues and constraints of Wadi El-Rayan Protected Area (WRPA) are described in the Management Plan document and are not repeated here in order to keep the operating plan document brief.

1.3. APPROVAL OF THE OPERATING PLAN

After preparing the plan the Protected Area Manager submits it to the NCS/EEAA for approval. After the approval of the operating plan and its budget by NCS, the approved operating plan is used by the Protected Area Manager as his work plan for the year.

1.4. REPORTING

Reports on the protected area prepared by the Protected Area Manager will follow the format of the operating plan and will report on progress in achieving the objectives set out in the management plan.

1.5. PROJECT SECOND PHASE

The WRPA project was funded by the Italian-Egyptian Environmental Program in the first phase (March 1998 - February 2001) and implemented by EEAA with international technical assistance from the World Conservation Union (IUCN). The transition phase of the WRPA project started in June 2001 and ceased in December 2002. As one of the components of a broader support programme to the Egyptian Environmental Affairs Agency (EEAA), Nature Conservation Sector (NCS), funded by the Development Co-operation General Directorate (DGCS) of the Italian Foreign Ministry, the second phase of WRPA project is due to commence in 2003.

PART 2

2. Management Goals and Objectives

OVERALL GOAL AND OBJECTIVES

The overall management goal of the protected area is the protection of the natural resources in accordance with the declaration decree of the protected area (943/1989) and follows the general protection rules of the law 102/1893.

The protected area as a whole has been identified to follow two broad conservation management objectives using the category classification system of IUCN and these are category II and VI (see management plan). Each category has its own management objectives. Details are given in the management plan.

The operating plan is the main annual tool to implement and achieve the management objectives of the management plan for each category.

PART 3

3. Zone Plan

Table (1) Zoning system of WRPA

Protection Level	Name of Zone	Activities permitted
Zero impact A	<input type="checkbox"/> Special Protection Zone <input type="checkbox"/> Strict Natural Zone	<input type="checkbox"/> Under investigation. <input type="checkbox"/> Visitor use and educational plan is urgently needed <input type="checkbox"/> Studies and research under specific authorization and control. <input type="checkbox"/> Habitat exploitation is prohibited. <input type="checkbox"/> Tourism and Economic activities are not allowed.
Low impact B	Reserve Protection Zone	<input type="checkbox"/> Studies and research under specific authorization and control <input type="checkbox"/> Eco-tourism only after authorization of WRPA.
Moderate impact C	Recreational Zone	<input type="checkbox"/> Tourism and tourism facilities and recreation <input type="checkbox"/> Bird watching <input type="checkbox"/> Camping <input type="checkbox"/> Pathway for the traditional fishing activities
High impact D	Development Zone	<input type="checkbox"/> Controlled habitat exploitation <input type="checkbox"/> Long-term high impact projects of the black and grey lists (according to the Egyptian settings) <input type="checkbox"/> High-density tourism is allowed.

Details of the zone plan are given of the management plan (Figure 1)

PART 4

4. Management Strategies and Actions

Development of clear strategies for the management of WRPA is one of the desired outputs of the management plan covering the period 2002-2006. The strategies as well as the future well-studied actions will contribute to the process of effective environmental management in the protected area.

4.1. SPECIFIC MANAGEMENT STRATEGIES

4.1.1. Collaborative management will be given a high priority.

At a special meeting with the Governor of Fayoum, Professor Saad Nasaar, held on 14 October 2002, the Governor expressed his appreciation to the WRPA Manager for initiating the management planning process for WRPA. He described the Management Plan as an essential tool to achieve the required level of coordination between the various public agencies active in the Protected Area and undertook to advise all the relevant departments in the Governorate that they should give the Management Plan their full support.

The following departments have already given their formal support endorsement of the Management Plan.

- ❖ The Irrigation and Water Resources Department
- ❖ The Tourism Department
- ❖ The General Authority for Development of Fish Resources.
- ❖ The Water and Environmental Police
- ❖ Security Department

A first meeting was held with the Security Department on 15 October 2002 to discuss the Management Plan.

Meetings with other key stakeholders will follow a definite schedule (2002-2003)

Seasonal meetings with the key governmental and non-governmental stakeholders will be given a high priority. The meetings will have the purpose of 1) updating the stakeholder with the new management achievements and constraints and 2) giving awareness to WRPA towards the new plans or changes of the activities related to a definite stakeholder inside WRPA. Meetings are expected to be organized on January, April, July and October of 2003. The outputs of those meetings will support and feed the management of the protected area.

List of Stakeholders

Governmental

- ❖ Ministry of Irrigation and Water Resources (The Irrigation and Water Resources Department)
- ❖ Ministry of tourism (The Tourism Department)

- ❖ Ministry of Agriculture and Land Reclamation (The General Authority for Development of Fish Resources - Land Reclamation Sector for Northern Upper Egypt)
- ❖ Ministry of Interior (Security Department - The Water and Environmental Police)
- ❖ Ministry of Defence
- ❖ Ministry of Petroleum (Quarun Petroleum Company)
- ❖ Governorate of Fayoum

Private Sector

- ❖ Intensive Fish Farm
- ❖ Extensive Fish Farm
- ❖ Cafeterias
- ❖ Safari Camp

A copy of the management plan will be delivered to each of the stakeholders

4.1.2. Special attention will be given to improving control over water use in the lake system.

Inflow into the tunnel that feeds the upper lake is the surplus runoff water from the El-Fayoum irrigation system and the amount varies depending on the amount of water recycled for irrigation before it reaches the tunnel. According to the Water Resources Department the extraction and evaporation of water from the lake system is currently greater than the inflow, and the allocation to each user will have to be reduced.

It is also their recommendation that the Nature Conservation Sector should request a technical meeting on water supply to the Wadi El- Rayan lakes, held under the chairmanship of the Governor of Fayoum. The meeting will discuss the water allocations to the different water users in the system. WRPA staff supports the recommendation and will request NCS to arrange the meeting.

As the fact that the water resources of the protected area, which represented mainly in the water of the Rayan lakes, are now under severe danger of depletion due to their overuses, a great attention paid for the management of these resources.

Several meetings were held in that sense:

- Dutch project supporting the irrigation department in Fayoum
- Under secretary of irrigation department in Fayoum

The major outputs from these sides had been recommend to the higher ministerial level stopping of all the activities related to land reclamation or fish farming activities inside Wadi El-Rayan area. A stage of data importing from these sides has been established and realization of the current situation is going to be ready through the next couple of weeks.

Data on lake water levels from Fayoum Irrigation Department confirms that the lake levels are decreasing.

4.1.3. Adaptive management will be applied to ensure that the plan objectives are achieved.

Results obtained from the monitoring programs will be continuously evaluated and the management actions will be adapted where necessary to ensure that the management objectives set out in the management plan are being achieved. A system of annual reporting for the monitoring activities is acting and feeding the management unit with the new inputs insuring satisfactory management achievements.

4.1.4. Management actions will cover the three core protected area functions of natural resources protection, public use and public awareness and community outreach.

Each function is described in the management plan and the specific actions are described in section 4.3. of this plan.

4.1.5. Management will be focused at the management zone level

Each zone has its own unique management objective, and management actions will be focused mainly at the management zone level to ensure that the specific management objectives of each zone are achieved.

4.2. GENERAL ACTIONS

4.2.1. Law Enforcement & Patrolling

The regulations and rules are listed in the management plan

Law Enforcement

This item is divided into three stages as follows:

1. Enforcement of law 102/1983 and its executive decrees terms inside the protected area
2. Judicial procedures
3. Penalties implementation

1. Enforcement of law terms inside the protected area

The protected area manager will keep a copy of all licenses in the office.

Any violations occurred during the daily activity (patrolling) meet with police report submitted by WRPA to the water police station.

In case of major violation, violator and equipment or tools is being under arrest to be accompanied to the water police station. Coordination between WRPA and water police is taking place to arrest violators. Rangers will record each violation in the law enforcement form.

2. Judicial procedures

After submitting the police report to the water police, they transmit it to the main police station in Abshaway district then to the prosecutor and finally to the court.



3. Penalties implementation

According to the criminal procedures law the implementation of all crimes penalties decided by the court is entrusted to the investigation bureau (police detectives dept.), less considered given to environmental cases by that bureau in comparison with the big responsibilities given to that bureau.

Patrolling

Patrolling is the direct way to assess the general changes and violations towards the resources of the protected area. Patrolling is an essential tool to achieve the law enforcement procedure that ensures keeping respect for the natural & cultural resources and natural beauty of the area. The following patrolling system for patrolling will be followed for the different key areas of the protected area:

Area	No of Patrols/Week
Spring Area	2
Fossil Area	3
Second Lake	3
First Lake	3
Land Reclamation Drainage system	1
Oil Company	1
Water Falls Area	7
Fish Farms	2

Patrolling will be done by foot, by vehicle and by boat

The usual legal procedure must be taken against the different violations in different areas of the protected area by the lawyer of WRPA.

Patrolling will be done according to the procedure manual

4.2.2. Monitoring Programs

Scientific monitoring is the main way to assess the minute and major changes of the available natural resources of the protected area. As biotic and abiotic elements of resources have been existed in WRPA, the following management programs had been adopted:

- I. Biodiversity Monitoring Program (Achieve through Biodiversity Unit of WRPA)
- II. Resource Monitoring Program
- III. Economic Activities Monitoring Program

I. Biodiversity Monitoring Program

I.1. Vegetation Monitoring

Sampling Program

Stratified Sampling methods were used that the vegetation is divided up before samples are chosen according to variations within it, on the basis of difference in vegetation structure and variation in dominant species.

Five main terrestrial habitats were selected as the study area for the monitoring program in which sampling sites were selected to cover five main natural habitats all over WRPA.

A total of 12 stands were selected to represent the variations in the vegetation communities inside the area. The stands were distributed among the main important sectors of the protected area as explained by the table:

Sector	No. of Stands
Fossil Area (FA)	2
Upper Rayan Lake (UL)	2
Lower Rayan Lake (LL)	2
Spring Area (SA)	5
Rowayan Area (R)	1
TOTAL	12

The abundance of each plant species in each stand (Line intercept method) was estimated during the period from 1st Nov. to 8th Nov. 2001

The area of each stand was determined as 100 m².

Species identification and species names were according to Tückholm (1974) and Boulos (1995), and mainly identified through the herbarium of WRPA.

Methodology

The vegetation cover was estimated on the bases of mean absolute cover of certain sp. inside the 100 m² area of each stand. The quadrat was divided into 10 tapes of 10 m long for each. The value of absolute cover of certain sp. was obtained by measuring the distance cut by the sp. for each of the 10 tapes. The mean of the sum of all the measured distances cut by a sp. for all the tapes of 100 m long was represented the mean absolute cover for the sp. The relative cover of each species was calculated through the equation: absolute cover of the sp. / total absolute cover of all the sp. multiplied by 100.

I.2. Mammal Monitoring

Time of Monitoring

Four time per year (Seasonal monitoring)

- Spring (from 21 April to 20 May).
- Summer (from 21 July to 20 August).
- Autumn (from 21 October to 20 November).
- Winter (from 21 January to 20 February).

Transects Locations

Five locations by ten transects to cover the whole protected area:

- Springs area (three transects)
- Rowayan area (one transect)
- Second lake (two transects)
- First Lake (two transect)
- Fossil area (two transect)

Mammals observation (survey)

Two times per each month, We need one car and one driver and we will start the work early from 6 A.M. until 3 P.M. or in the evening from 8 P.M. to 12 P.M.

Methodology

The methodology that the WRPA staff is using with wildlife count is the index count for presence signs along strip transects. These counts will allow to compare differences concerning wildlife abundance between different habitats and to monitor distribution changes seasonally and over long periods of time.

The main features of this method are the following:

Personnel: transects were surveyed using 2-persons team, an observation and a recorded

Equipment: compass, GPS, pencils, binocular and data sheets.

Frequency: Each transects is walked every 3 months (seasonal monitoring) within a defined two-week period.

Method: Transects have been located in a non-random way, because of the non-random distribution of the habitats and, consequently, of the mammals in WRPA (stratified sampling). Each transect is 2 Km in length and 10 meters in wide and it is walked at constant speed of about 3 Km/hour. The observers record the species and the kind of sign (track or feces) that they found inside the transect strip.

I.3. Bird Monitoring

Counting

The WRPA staff used for counting of the most common species of water-bird is the line transect method from the motorboat along fixed transects in the Upper and Lower Lakes. Seasonal dynamics of birds in Wadi El Rayan will be studied by point count throughout fixed stands in protected area different habitats.

Personnel: team of two persons (trained in bird identification)

Equipment: compass, GPS, binoculars, telescope, pencils and data sheets.

Frequency: Each transect is walked twice at quarterly intervals within a defined two-week period, during the first half of the morning.

Method: The selected transects were located in a non-random way, because of the non-random distribution of the habitats and, consequently, of the birds in WRPA (stratified sampling). Each transect is 1 Km in length and the motorboat is driven at constant speed

of about 3 Km/hour. The observers record the species, the direction and the distance of each bird resting on the lake or feeding in a place. For species that occur in flocks, they treat the flock as a single detection and record the flock size. The position recorded for a flock is the "center of gravity" of the flock, not the closest point of the flock to the observer. The flying birds are recorded and analyzed separately: whenever a flying bird (or flock) is detected, the observer wait until it comes abeam of the boat and only then he records its position. In point counts, we record all birds species observed in each point using telescope and this count will be every 15 days during winter and migration seasons.

Ringling

The method used for bird ringling was conducted following the standard of the SEEN program (SE European Migration Network, Bird Migration Research Station, Gdansk Univ. Poland) including measurements (wing length, tail length, wing formula, fat score, and bird weight).

Personnel: four persons are usually working in the ringling station, two from Poland and two Egyptians.

Equipment: Nets, Field guides, rulers, balance, experiments cages, compass, rings and one car.

Methods: The used for bird ringling depends on birds catching especially passerines using especial nets (mist net) with certain mesh size according to the encountered group of birds. All the birds caught were identified, sexed, and aged. And birds' measurements will be taken and migrants directional preference will be tested,

Frequencies: this work is carried out during the migration seasons (spring 1st of Mar. - end of Apr. and autumn, 1st of Sep. - end of Oct.) the wok is starting (from 6:30 to 11: 00 o'clock) in the morning and (from 17.00 to 19: 30 o'clock) in the evening.

I.4. Fish Monitoring

Traditional Fishing

Three time per year (Seasonal monitoring)

- Autumn (the period from 13 to 17 October).
- Winter (the period from 13 to 17 January).
- Spring (the period from 13 to 17 April).

Methodology

Data about fish (breeding season, size and weight) and nets (mesh size, net length and net depth) will be collected by field survey to the fishermen and boats.

Another data collection method will done in an official way from the General Authority for Development of fish Resources to record the total harvest of fishes for the both of Rayan lakes at the opening season for fishing.

Location

Field survey

Upper Lake

- 1- The main fish collection unit.

- 2- Abo Rokba fish collection unit.
 3- Bacarat fish collection unit.
 Lower lake
 1- Waterfall fish collection unit.
 2- Horria fish collection unit.

II. Resource Monitoring Program

II.1. Water Quality Monitoring Program

Sampling Program & Methodology

Each of the 2 lakes and the junction canal has 1 permanent station from which the samples were collected. Those permanent stations are one in the 1st lake (near the tunnel), one in the 2nd lake (near the fish cages) and one in the junction canal (after the output of the fish farm). One station was added to record the quality of the original wastewater income to Rayan lakes. This new station was fixed at the 1st point receiving the water (end of the tunnel, which represents the start point of the upper lake). The 4 stations could be increased for each lake and the canal, and the mean values of the results recorded. WRPA staff collected subsurface grab water samples, once for each season from these 4 stations (December, March, June, and September). Collected water samples immediately transferred to the EEAA laboratory in Cairo to be analyzed.

Materials

- Motor boat
- 4WD car
- Plastic bottles
- Ice box
- Field sheet
- Marker pen
- EEAA central laboratory for sample analyses

The tested water quality parameters are as follows:

PARAMETER	SYMBOL	UNIT OF MEASURE
Hydrogen ion conc.	pH	Units
Biological oxygen demand	BOD ₅	Mg/L
Chemical oxygen demand	COD	Mg/L
Total suspended solids	TSS	Mg/L
Total dissolved salts	TDS	Mg/L
Ammonia	NH ₄ ⁺	Mg/L
Nitrites	NO ₂	Mg/L
Nitrates	NO ₃ ⁻	Mg/L
Phosphates	PO ₄ ⁻	Mg/L
Total nitrogen	TN	Mg/L
Total phosphorus	TP	Mg/L
Lead	Pb	Mg/L
Mercury	Hg	Mg/L

Cadmium	Cd	Mg/L
Manganese	Mn	Mg/L
Arsenic	Zn	Mg/L
Ferrous	Fe	Mg/L
Copper	Cu	Mg/L
Mercury	Hg	Mg/L
Magnesium	Mg	Mg/L

II.2. Paleontology Monitoring Program

Methodology

A. Photo Monitoring

Each fossil site has been mapped, photographed and numbered. The routine patrolling is realized by EEAA researchers in the fossil area twice per week (during the weekend, when normally the area is visited by the tourists), once per month the condition of each fossil site is verified through the comparison with the photo. And once every three months to check the condition of each fossil site and to repair the broken parts of the skeletons.

The main features of the photo monitoring are the following:

Personnel: 2 rangers, 1 community guard and 1 driver

Equipment: 4X4 car, digital camera, GPS, data sheets, pencil, compass, the file of the fossil photos.

Frequency: once per month

B. Fossils Sits Description and Repairing

The procedure that has been used to repair the fossils is following:

- Removing the sand from the fossils;
- Looking for all the skeleton's components;
- Cleaning the fossil constituents.
- Mending the broken parts of the skeleton.
- Painting the fossil component with a hardener substance (polyvinyl acetate).
- Arranging the different parts of the skeleton in the right position and detecting the missing ones.

Personnel: 1 researcher (geologist), 1 researcher trained on fossil repair methodology, 2 community guards

Equipment: 1 pale, 2 brushes, polyvinyl acetate, glue Vinavil

Frequency: every three months and when needed

III. Economic Activities Monitoring

FIRST: Site Inspection

Waste Monitoring Methodology

personnel	Equipment	Frequency	Object
2 Ranger	Data Sheet	Every 3 months	Control of landscape pollution

Human activities inside WRPA:

- 1- Oil Extraction
- 2- Land reclamation
- 3- Intensive fish farm
- 4- Fish cages
- 5- Pump Station
- 6- Ice Factory
- 7- Police Station
- 8- Coptic Monastery
- 9- Cafeterias & Safari Camp

Data Collection System:

We always go to the **Human Activity Site** and asking the people there (whatever owners or workers) about the waste treatment system they used, we record all of this data they tell us on the specific data sheet, then we inspect the site to make a comparison between what they said and the fact. The specific data sheet includes the following:

DATA SHEET FORM.

Date	Type of activity	Collection (Y/N)	Treatment	Frequencies of treatment	Recycling	Landscape pollution	Comments

SECOND: Photo Monitoring and Site Plan Realization

Methodology

personnel	Equipment	Frequency	Object
2 Ranger	GPS, camera	Every 6 months	Point out and locate the new infrastructures.

Work System:

We go to the activity site, we pick photos for the entire site to find out if there are any new infrastructures, and of course in case of existing new infrastructures we take the points with the GPS.

TYPE OF ACTIVITIES:

The same listed in the first section.

NOTE:

The photo monitoring of the economic activities is under realization and no modifications to the original infrastructures has been produced **except in 4 economic activity sites, Oil extraction - Land reclamation - Safari camp - Coptic monastery.**

4.2.3. Documenting

- Monitoring reporting

- Management reporting
- Progress reporting
- Updating of all zone maps

4.3. SPECIFIC ACTIONS

4.3.1. Zone A: Special Protection Zone

Fossil Area (Wadi El-Hitan)

Natural Resources Management

Actions

General

Periodical Fossil and paleontological monitoring will be acting throughout the year in the way that discussed above.

Normal patrolling will follow the pre-mentioned system. 3-day patrolling or camping system will be followed. The normal procedure of law enforcement will be applied against any violation.

Group visits will be done after having authorization from NCS/EEAA and WRPA and under the complete control of the protected area staff.

Specific

The area of this zone is sensitive enough towards the uncontrolled sorts of exploitation or eco-tourism. The staff of the protected area together with outside specialists will produce a site plan for developing the area from the eco-tourism point of view parallel with the education and conservation purposes.

Site plan

The plan depends mainly on a well-organized infrastructure and staff system that ensures the suitable control of the area and optimum protection for the natural and cultural wealth of the amazing enormous number of fossilized whale skeletons.

Outpost (HQ for WRPA, inside the valley)

The outpost will be mainly established for the permanent existence of WRPA staff inside the zone. 6 guards in shifts will be in charge for permanent stay in the area. 2 environmental researchers will supervise and ensure the smooth flow of activities.

Checkpoints (Inside the valley)

Located at the start- and endpoints of the valley are the two checkpoints. They will ensure application of the area rules and deal with the possible violations and violators via their communication and transport equipment.

Parking and Camel resting sites (outside the valley)



The two places, joined with WRPA checkpoints, will be designated for vehicle parking outside the valley. From these sites a visitor can decide whether to make his tour using camels or on foot.

Ec lodge (outside the valley)

A private sector will invest in designated area, just outside the valley, for an ec lodge serving the clear eco-tourism purposes.

Open Air Museum

A definite area had been selected to establish the open air museum inside Wadi El-Hitan Valley. The most integral whale skeletons will be selected to keep inside glass containers in their natural habitat.

Public Use

Rules

The proposed outpost and checkpoints with the relevant WRPA staff will ensure the application of the general rules of the area.

Public Awareness and community outreach

The program is including targets mainly outside the protected area which are represented in the local and foreigner visitors.

To develop a strategy plan for environmental education and awareness in WRPA, the Land Reclamation, Petroleum company, cafeterias, fishermen, and monks has to held for a several workshops about WRPA.

More than 150,000 visitors visit WRPA each year more than 95% of them are Egyptians. Most of visitors being in the beach area, a few number being in the fossil area and south of the 2nd lake (usually foreigners). In order to manage the visitors inside different zones, WRPA staff cerate a special kind of monitoring based on the type of the zone.

4.3.2. Zone A: Strict Natural Zone

Spring and Rowayan Areas

Natural Resources Management

Monitoring program for different biotic elements had been developed and modified to be more efficient. Two types of biodiversity monitoring are operating inside this zone which are: vegetation monitoring & mammal monitoring

Public Use

The only sort of human presence in this area is the Coptic monastery with the monks. An agreement form had been done between the monks, as an essential stakeholder, and the protected area staff since 2001. The agreements were including specific rules have to be operated and respected from the side of the monks in collaboration with the WRPA to protect the area. The coming actions are going to be acted:

- The application and operation of those rules are going to be monitored by the ranger responsible for economic activities monitoring.
- The ranger has to provide a monthly report about the degree of application of these rules and has to report any violation noticed or stated by any of other acting staff of WRPA.
- A simplified form was designed to report the degree of the application of the protected area rules by the Coptic monastery members.

Specific rules were appointed to protect the natural resources inside the areas of this zone.

Public Awareness and community outreach

The public awareness program in this zone has only one target and should be directed for the monks of Coptic monastery. The program must involve different communication channels between their side and that of the protected area, identifying what is new for both and what are the different means to support the collaboration of the different programs of the protected area as the monitoring program.

The public awareness should be considered as crucial to reach the following main objectives:-

- Promoting WRPA as a valuable and educational area.
- Creating communication channel between the monks and WRPA.
- Identifying the mean of protected area (mahmia), its importance, rules and the meaning of special zone.
- Involving the monks in conservation and different monitoring especially in mammals and birds.

To achieve this objectives:-

- lectures
- Regular meeting (4-monthly meetings)
- Posters
- Pamphlets
- Training about the monitoring of mammals, plants, geology and the birds.

4.3.3. Zone B: Reserve Protection Zone

The Area South of the Lower Rayan Lake and the fourth spring

Natural Resources Management

The normal patrolling and Biodiversity monitoring programs are acting throughout the year ensuring the right protection of the place.

Bird monitoring, mammal monitoring and vegetation monitoring programs are partly operating seasonally in this zone. The no-fishing area will be demarcated.

Public Use

Patrolling and monitoring activities will ensure the application of the rules inside the area of this zone. The bird watching sites and the foot-path will be maintained

Public Awareness and community outreach

The primary target of the program in this zone is the local communities of the main villages surrounding the protected area and the fishermen as a sub-target. The protected area roles have to be forced down to this target. The program must involve the concept of the protected area parallel with the collaborative management issues.

It's the most important zones inside WRPA because its works as a window to the world.

The public awareness should be considered as crucial to reach the following main objectives:-

- Showing the importance of the fossil area as world heritage site.
- Showing the importance of the south of the 2nd lake as a bird watching site.
- Promoting WRPA as a valuable recreational and educational area.
- Making regular tourist monitoring inside fossil area.

To achieve this objectives:

- Information panels
(3 information and education panels were needed for the different zones of the fossil area)
- Posters
- Pamphlets

4.3.4. Zone C: Recreational Zone

The Area of Rayan Lakes and their Destinations

Natural Resources Management

The natural resources in this zone are directed to the purposes of eco-tourism under the protection of the law 102/1983 by the WRPA staff. Monitoring programs for vegetation, mammals, birds, fish and water quality are acting through the whole year as described earlier.

No more investment for the natural resources in the area of this zone is allowed except for the planned eco-tourism spots.. WRPA eco-tourism facilities (camping site, bird watching sites, tracks and signposts) will be partly renewed to ensure a satisfactory visitor use.

WRPA education facilities (visitor center, brochures and posters..etc. and different information facilities) will support enough awareness of with the resources of the area

Public Use

Two sorts of public use are acting inside this zone, which are the ecotourism and economic activities.

Ecotourism

Visitor center, cafeterias, safari camp, camping site and newly provided W.C. facilities will be the acting ones to support the eco-tourism in this zone.

A detailed map for the proposed eco-tourism spots inside WRPA will be provided. The proposed ecolodges will be done according to the study of El-Kammash, 2001. The study was prepared and presented to the EEAA/Egyptian Italian Project of WRPA. The specifications of the eco-tourism facilities will follow the previous study and the rules of the designated zone inside WRPA. (Figure 2).

Economic Activities

The traditional fishing activities as well as general pathways for the traditional fishermen around the lakes are the operating activities inside this zone. An efficient patrolling system is the main way ensuring the control of these activities.

Patrolling and law enforcement will ensure the application of area rules

Public Awareness and community outreach

The primary targets of this program have been identified as local communities around the protected area and the local and international visitors (outside the PA). Fishermen and owners of economic activities (inside the PA) are representing sub-targets. The main visitor area (waterfall area) is included in this zone.

The public awareness should be considered as crucial to reach the following main objectives:-

- Creating communication channel between the fishermen and WRPA.
- Identifying the mean of protected area (mahmia), its importance, and rules.
- Improving the visitor center.
- Making regular visitors monitoring.
- Creating communication channel among WRPA, schools & universities.

To achieve this objectives:-

- Regular meeting with fishermen. (4-monthly meetings)
- lectures
- Posters
- Pamphlets
- Establish permanent office inside the visitor center with a computer.

4.3.5. Zone D: General Use Zone

Spots of intensive economic activities around Rayan Lakes

Natural Resources Management

The management plan has developed strong and effective rules ensuring the sustainability of the area natural resources within the investment areas of this zone. The existing economic activities are subjected to obey these rules. In order to increase the applicability practices of these rules the WRPA staff held several meetings with the related stakeholders on the local level on the preparation period of WRPA management plan. The Governor has been supported the management plan and the collaborative management strategy of the protected area to keep the sustainability of natural resources. The monitoring system of the biotic and abiotic elements of natural resources of the area is supporting the collaborative management system to produce a sound management strategy for natural resources.

Public Use

Eco-tourism, economic activities and human settlement are representing the three forms of public use that currently existed within the areas of this zone. The existing economic activities are fully under licence of the EEAA either on an institutional level e.g. Oil extraction and land reclamation programs (according to prime-ministerial or ministerial agreements) or on the level of NCS/EEAA e.g. fish farms, fish cages, cafeterias.

Actions

- The monitoring program for the existing economic activities will be continued.
- No more economic activities will be accepted inside the protected area for two reasons: 1) the area percentage of economic activities inside the protected area is now reaching almost 10% of the total area of the protected area, and according to the prim-ministerial decree, the percentage of the activities must not exceed 10% of the total area of the protected area & 2) the monitoring program showed that the activities should have no more expansion to ensure the integrity of the ecosystem inside WRPA.

The Normal patrolling activities and monitoring of economic activities will ensure the right use of the area:

Public Awareness and community outreach

The program has many targets identified inside the protected area, as follows:

Land Reclamation

- Creating appropriate communication channel between WRPA management and the settlements.
- Collaboration with them, helping the WRPA management in a different tasks according to our program, present enough information about the value and the benefit of bio-agriculture, raising the level of public awareness for schools to create new generation able to help us in a good way.

- Identify the needs of the settlements.

To achieve this objectives:

- Regular meeting with settlements (3 meetings)
- Festival
- Trips for school children & for the settlements according to our facilities (3 Trips)
- Establish permanent office inside land reclamation
- Posters
- Pamphlets

Oil Company & Aquacultures

- Identifying them with the effective of their activities for WRPA.
- Making targets of environment education and awareness program by WRPA staff.
- Improving the accountability of licenses holders operating inside WRPA.

To achieve this objectives:-

- Regular meeting with settlements (4-monthly meetings)
- Work shops
- lectures
- Posters
- Pamphlets

PART 5

5. Management tools

The long-term application of the management strategy is being achieved through using the following management tools; monitoring and research, GIS and remote sensing, EIA, environmental regulations and law enforcement and documenting.

The tools are described in the management plan.

RECOMMENDED RESEARCH PROJECTS

Zone A: Special Protection Zone

- Visitor use and education plan for the fossil area (Wadi El-Hitan).

Zone A: Strict Natural Zone

- Study of captive breeding or reintroduction possibilities for the dorcas gazelle in WRPA.
- Study of the main environmental correlations between the vegetation and environment inside the area. (for future management of the area).

Zone C

- Study of the maximum discharge limits for the elements on the water of Rayan Lakes. (water quality, hydrology)
- Study of the carrying capacity of the lakes for more fisheries investment.
- Establishing of the center for Migratory Bird Studies

PART 6

6. MANAGEMENT RESOURCES

The critical resources for the management of WRPA can be identified under three main categories, which are infrastructure and equipment, financing and staffing. The resources are described in the management plan.

6.1. INFRASTRUCTURE AND EQUIPMENT

The proposed equipment for the next three years is suggested below, (Table 2).

Table (2) Suggested needs of equipment and field tools

Equipment	Number
Vehicles	
4WD Cars	4
Motorbikes	3
Radio Station	
Basic unit	6
Mobile Walki-Talkie	10
Scientific and Field Supplies	
GPS	3
Personal computers with complete accessories	4
Laptop	2
Weathering station	1
Water Quality Control Lab.	Standard
Digital camera	2
Video camera	1
Camera trap system	2
Binoculars	15
Telescope	3
Complete housing furniture of the existing management infrastructures	

6.2. FINANCING

The total proposed budget of the second phase of WRPA project is 6,024,000 L.E. until December 2005 shared with the NCS/EEAA.

WRPA project: budget		Expenditure (L.E.) July 2003 - June 2004					
Code	Budget Items						
TECHNICAL ASSISTANCE							
1.1	International TA						
	Co-manager / Technical Advisor	m/m	12	23,500	282,000		282,000
	Support to CM agreements	m/m	0.5	33,000	16,500		16,500
	Ecotourism and marketing	m/m	0.5	33,000	16,500		16,500
	Information, Education, Communication	m/m	0.5	33,000	16,500		16,500
	Biodiversity Monitoring & Evaluation	m/m	0.5	33,000	16,500		16,500
	Design of open-air museum	m/m	1	33,000	33,000		33,000
	International Travel	n	5	3,300	16,500		16,500
	TOTAL INTERNATIONAL TA	m/m	15		397,500		397,500
1.2	National TA						
	Infrastructure	m/m	3	15,000	45,000		45,000
	Legal / Institutional	m/m	1	15,000	15,000		15,000
	Ecotourism	m/m	1	15,000	15,000		15,000
	Information, Education Communication	m/m	1	15,000	15,000		15,000
	Collaborative management	m/m	2	15,000	30,000		30,000
	Unallocated	m/m	1	15,000	15,000		15,000
	TOTAL NATIONAL TA	m/m	17		135,000		135,000
	TOTAL TA				270,000		270,000
OPERATION & MAINTENANCE							
2.1	Project Expenditure.						
2.1.1	Camp & Outposts Operating Expenses	m	12	3,500	18,000	24,000	42,000
2.1.2	Office & Scientific Expenses	m	12	1,500	6,000	12,000	18,000
2.1.3	Visitor Centre Operating Expenses	m	12	1,000		12,000	12,000
2.1.4	Vehicle operating expenses	lump	1		30,000	60,000	90,000
2.2	WRPA Personnel						
2.2.1	Allowances existing EEAA staff	m	12	4,600	55,200		55,200
2.2.2	Ticket collectors (2)	m/m	24	0,600	14,400		14,400
2.2.3	Accountant	m/m	12	1,700	20,400		20,400
2.2.4	Community guards (n.6)	m/m	72	0,500	36,000		36,000
2.2.5	Support staff (n. 2)	m/m	24	0,600	14,400		14,400
2.2.6	Local travel	lump	1	4,000	4,000		4,000
	TOT. OPER. & MAINT.				198,400	108,000	306,400

3.1	Fossil Area Outpost	lump	1	150.000		150.000	150.000
3.2	PAMU staff accommodation facilities	lump	1	500.000		500.000	500.000
3.3	Tracks and signposts	lump	1	30.000		30.000	30.000
3.4	Environmental school	lump	1		200.000	220.000	420.000
3.5	Upgrading Eco-centre	lump	1	15.000	15.000		15.000
3.6	Ecotourism facilities	lump	1	25.000		25.000	25.000
3.7	N.3 Vehicles	n	1	225.000	125.000	200.000	325.000
3.8	N.3 Motorbikes (off-road 250cc)	n	2	15.000	15.000	15.000	30.000
3.9	N.6 Camels	n	6	6.000	20.000	16.000	36.000
3.1	Communication equipment	lump	1	67.000	67.000		67.000
3.11	Scientific & office equipment	lump	1	50.000	50.000		50.000
3.12	Field equipment	lump	1	30.000	30.000		30.000
	TOT. EQUIP. & SUPPLIES					522.000	1156.000
	ACTIVITIES						
4.1	Training and production of manuals	lump	1	150.000	150.000		150.000
4.2	Support to CM agreements	lump	1	50.000	50.000		50.000
4.3	Ecotourism and marketing	lump	1	50.000	50.000		50.000
4.4	Information, Education, Communication	lump	1	100.000	100.000		100.000
4.5	Support to Wadi Hitan initiative	lump	1	25.000	25.000		25.000
4.6	Support to EEAA Fayoum local office	lump	1	100.000	100.000		100.000
4.7	Monitoring, evaluation and research	lump	1	25.000	25.000		25.000
	TOTAL ACTIVITIES					500.000	500.000
	GRAND TOTAL					1490.400	2764.400

Encouraging and supporting the program of organic agriculture in the land reclamation scheme inside the protected area. Eco-label (organized and done by WRPA management unit) can be attached to the harvest, which can guarantee high income. WRPA can then have a reliable financing source from these returns.

6.3. STAFFING

The current status of WRPA staff is as the following:

JOB	NUMBER
Protected Area Manager.....(PAM)	1
Environmental Affairs Researcher (ranger)(EAR)	9
Legal Affairs Officer(LAO)	1
Accountant.....(Acc)	1
Financial Affairs Officer.....(FAO)	1
Ticket Collector.....(TC)	3
Guards.....(Gd)	7
Secretary.....(Sec)	1
Driver.....(Dvr)	2
Supporting Staff (House watching).....(SS)	2

The entire staff is lacking of the permanent recruitment by EEAA except the protected area manager and the two drivers. Table (3) shows the name, title and specific tasks for each of the management staff.

Table (3) Current profile of WRPA staff

Name	Title	Specific tasks
Hossam Kamel	PAM	General coordination
Zakaria	Acc	Accounting
Mohamed Mayhoob	FAO	Financial Affairs
Arafa El-Sayed	EAR	Coordinator of public Awareness program
Mohamed Ismail	EAR	Coordinator of Ecotourism program
Wed A. Latif	EAR	Coordinator of Biodiversity Monitoring
Mohamed Talaat	EAR	Coordinator of Manegement & Effectiveness Monitoring /vegetation monitoring / water quality & fish farms monitoring
Haitham Nabeeh	EAR	Biodiversity monitoring
A. Nasser Yasen	LAO	Legal Affairs
Mohamed Sameh	EAR	Geology and Paleontology monitoring
Mohamed Ali	EAR	Water Quality
Mohamed Effat	EAR	Spring area/Fish monitoring
Walid Ahmed	EAR	Public awareness/Visitor center
Mohamed A. Mola	Gd	Guarding/HQ
Mohamed Hussin	Gd	Guarding/visitor area

Mohamed Saleh	Gd	Guarding/spring area
Ali Ahmed	Gd	Guarding/boat driving
Mefreh Nagi	Gd	Guarding/car driving
Essam Mohamed	Sec	Secretary
Hamdy A. Sattar	Gd	Guarding/spring area
Nadi	Gd	Guarding/visitor area
Reef Allah A. Saleh	Gd	Guarding/spring area
Nafaa A. Mohsin	Dvr	Driving
Mohamed Abbas	Dvr	Driving
Musa A. Musa	TC	Ticket collection
Helmy Mohamed	TC	Ticket collection
Husni A. Wahab	TC	Ticket collection

For establishing of more stable management staff inside WRPA, the following actions need to be implemented:

- Permanent recruitment of the entire skeleton of the staff, to ensure the long-term sustainability of WRPA management staff.
 - Ensuring the long-term permanence of the staff by supporting the establishment of a stable social life for the staff coming from outside Fayoum area.
 - Offering by EEAA of additional money (for the staff coming from outside Fayoum area) to facilitate and make ease for overcoming the additional living loads as communications, transportation, health care, etc.
 - Offering the long-term and international high level training to support the capability of the staff for the collaborative management and make strength of the management abilities of the staff. The staff with high management abilities will be able to manage the proposed network of protected areas especially those of similar habit as Siwa and White desert protected areas of the Western desert of Egypt.
- ❖ Recruitment of following human resources

Job Description	Number	Specialization
Environmental Affairs Researcher	4	Bachelor degree
Guard	8	Preferred with diploma degree
Ticket Collectors	3	At least diploma degree

Duty hand book for WRPA staff

- ❖ Handbook of the duties of the researchers has been finished and will be implemented.
- ❖ Participation of the key staff in the preparation and application of the national strategy and planning of the protected area. A smooth continuous communications among the key staff, NCS and other stakeholders (inside and outside Fayoum



governorate and other authorities) is a must, ensuring a strong and effective full-time collaboration among all involved sides.

7. Implementation of the second Phase of the EIEP Project.

In 2003 is foreseen the initialisation of the second phase of the Egyptian Italian Environmental Program (EIEP), WRPA project.

**MONITORING
REPORT**

MONITORING REPORT

ON THE THIRD YEAR OF THE MONITORING PROGRAM

WADI EL-RAYAN PROTECTED AREA

Presented by
Wadi El-Rayan Protected Area staff



Coordination & Preparation
By
Mohamed Talaat El-Henawy
M.Sc. Ecology
Senior Coordinator of Management
& Effectiveness Monitoring

JANUARY
2002

Prepared by

Task Group

Wadi El-Rayan Protected Area staff

General Coordination

Eng. Hossam Kamel

Preparation and Organization

Mohammed Talaat

GIS

Arafa El-Sayed

Mohammed Sameh

Supplementary data

by

Ahmed Eidy Ahmed
Mohammed Mayhoob
Arafa El-Sayed
Mohamed Talaat
Wed Abdel Latif
Abdel Nasser Yaseen
Mohamed Sameh
Haitham Nabeeh
Mohammed Ali
Walid Ahmed
Mohamed Effat

PAMU
WRPA
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EXECUTIVE SUMMARY

Wadi El Rayan Protected Area (WRPA), situated in the Fayoum Region of the Western Desert of Egypt, has been declared by prime ministerial decree N. 943 in 1989.

The current work is the third report on the monitoring activities and introduced by WRPA staff. More advanced and organised presentations of monitoring activities had introduced by WRPA personnel, each in his field. The author did the overall presentation and reporting of this work. The third year of the monitoring activities inside WRPA was organised mainly and practised by WRPA staff after the ending over of the 1st phase of the Egyptian-Italian project with reduced presence of the Italian side at the interface period (the time of this work). The report included the following:

Introduction, including the basic information, specific aims and total achievements.

Mapping, Topographic, infrastructure and habitat & land-use maps were produced and their continuous updating are presented.

Biodiversity monitoring, including the different practices and methodologies applied and the results interpretation of the third year of scientific monitoring programs of WRPA. These programs included the available aspects of biodiversity as vegetation, birds and mammals.

Resource and Environmental monitoring, including the methodologies, results and assessment of the natural resources. Monitoring of geology and paleontology, aquatic resources (water quality of the 2 lakes), the economic activities inside the

WRPA and their impacts on the environment of the protected area and visitor monitoring were provided in this part.

THIS REPORT about the third year of the monitoring program has introduced by WRPA research officers (rangers) who became reliable source of collecting and presenting data and be able to evaluate and stand on the proper way to keep the protected area well organized and managed.

PART I

1. INTRODUCTION

1. INTRODUCTION

1.1. Background

Wadi El Rayan Protected Area has been declared by prime ministerial decree N. 943 in 1989 according to Law No. 102/1983 of the protected areas. The protected area, covering 1759 km² as a part of Fayoum Governorate, south-west of Cairo.

1.2. Location and geomorphology

Wadi El-Rayan occupies a depression in the northern part of the western desert of Egypt, situated between longitude 29°00' 00" & 29° 24' 11" E and latitude 30°00' 00" & 30° 34' 00" N. Wadi El-Rayan protected area located 210 km right angle south to the Mediterranean coast at co-ordinates of 30°00' N & 30°18' E, (Figure 1). The deeper portion of the depression is occupied by 2 man-made lakes connected by 3-4 km long channel. Other water supplies are present as the underground water, and 4 natural sulphured water springs.

The two lakes were created (in the seventies) in the lower portion of Wadi El Rayan sub-depression to channel out excess agricultural drainage water in order to slow-down the increase of the water-table in the Fayoum main depression and in Qarun lake. The creation of a large body of water in this hyper-arid area had a striking ecological impact: new species of plants, mammals, birds and invertebrates moved to Wadi El Rayan area. (IUCN, 2000a)

1.3. Climate

The climate is typically Saharan, hot and dry with scanty winter rain and bright sunshine throughout the year. The area is hyper-arid with mild winters and hot summers (Zahran, 1989). The annual average of the precipitation rate is 10.1 mm. The highest rainfall occurs in December (40 % of annual rain) and the lowest (0%) in August. The average ambient relative humidity is 51%. The direction of the wind is, for most of the year, from the North, varying North-West or North-East, After Saleh, (1988).

Table: Summary of the monthly means of 50 years of temperature records (Saleh, 1988)

TEMPERATURE VALUES	WINTER	SUMMER
Mean	13.7°C	28.5°C
Absolute minimum/maximum	-1.2°C	48.8°C
Mean amplitude of diurnal fluctuations	14.2°C	17°C

Monitoring status and trends in biodiversity resources and the performance of management activities, is increasingly recognised as an essential tool for planning and implementation of biodiversity conservation and sustainable development (WCMC, 1996). The establishment of a comprehensive monitoring system was proposed in the overall work plan as a crucial tool supporting the planning and the management of the protected area (IUCN, 1998a). On January 1999 the IUCN designated technical assistant for the monitoring programme of WRPA, who actively worked and introduced two reports on WRPA monitoring activities.

1.4. Main Purpose of this report

This report is currently presented to:

- Stands on the real situation of the natural resources of the protected area, as a proper task of protected area management.
- Describe the progress had been done for the methodologies applied during the last 2 years of the monitoring programme.
- Realise the applicability of the improved methods to monitor the resources of the protected area, supported by well-presented results, comments and recommendations.

The monitoring activities are carrying out by WRPA personnel, as a part of their routine assignments, under the co-ordination of the 2 senior co-ordinators of management and biodiversity monitoring (WRPA staff), the technical assistant (Italian co-operation) and the WRPA director.

MAPPING FOR WRPA

2. MAPPING

By

Arafa El Sayed Amin

*Senior Coordinator of communication with local stakeholders
and public awareness program, WRPA.*

.....

The GIS software program **MapInfo ver. 4.5** was used to produce the mapping work for WRPA. The Protected Area Management Unit (PAMU) representing in the technical assistant from the IUCN and Italian cooperation with WRPA personnel were working since 1998 to produce the maps for WRPA.

The raster map in scale 1:100 000, printed in 1960 by the American Gro Naqb and reprinted by the Military Survey Management in 1995 has been used as a basis for the topography digitalisation.

The land use map has been realised starting from the satellite photos (Tm 752, 1992-1998) and adding any small spot of vegetation through the field data collection, using the GPS.

Any activity or changes in the infrastructures, roads or tracks have been located using the GPS and then transferred in the digitised map using Map Info.

This report introduces the last versions of WRPA maps, which have minimum or no changes for the past year. They are as follows:

1. Topographic map for WRPA, scale 1:100 000 (Figure 2),
2. Updated infrastructure monitoring map, scale 1:100 000 with the present status of roads, tracks or buildings in WRPA (Figure 3) &
3. Habitat and land use map of WRPA, scale 1:100 000 (Figure 4)

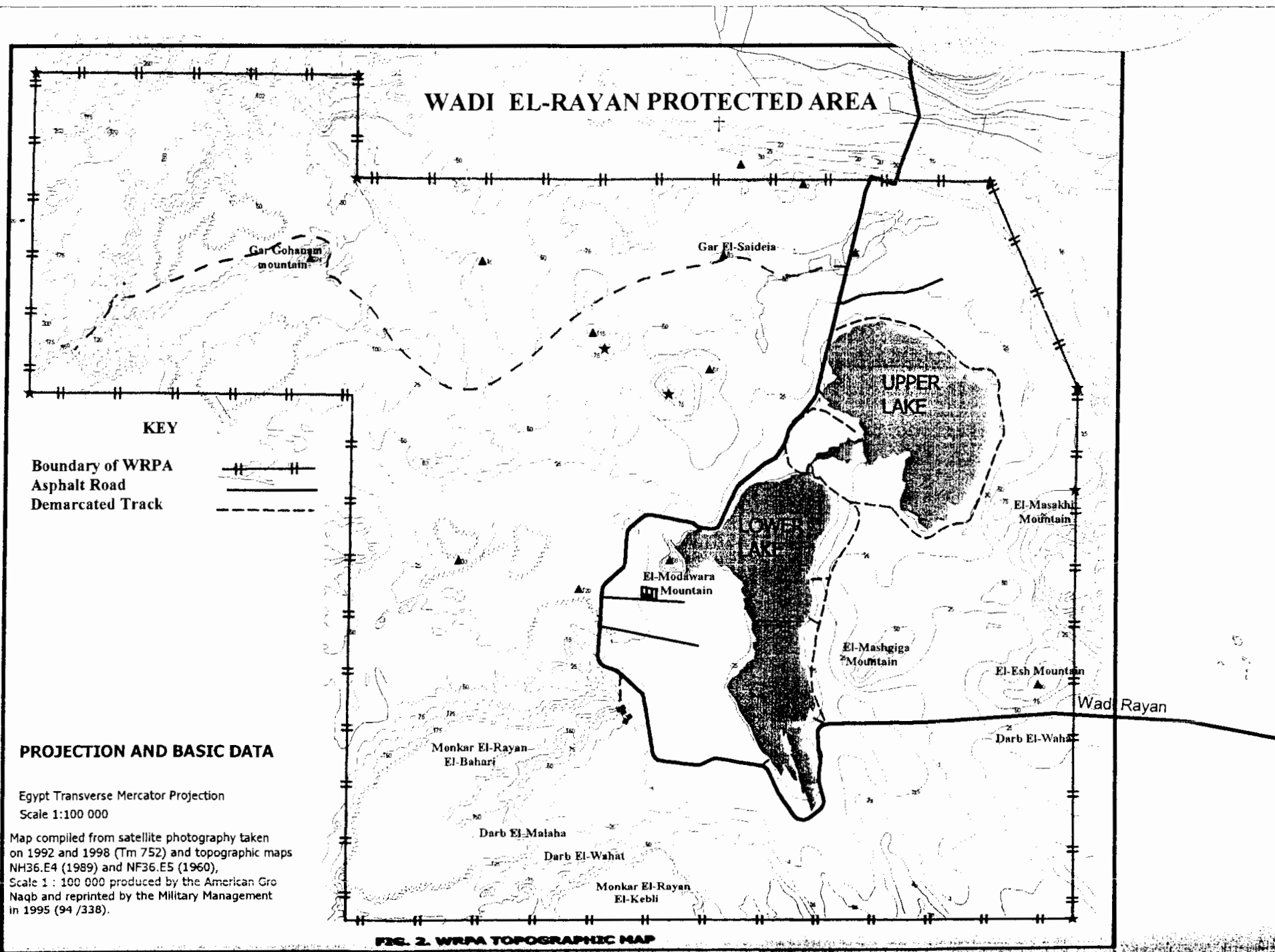
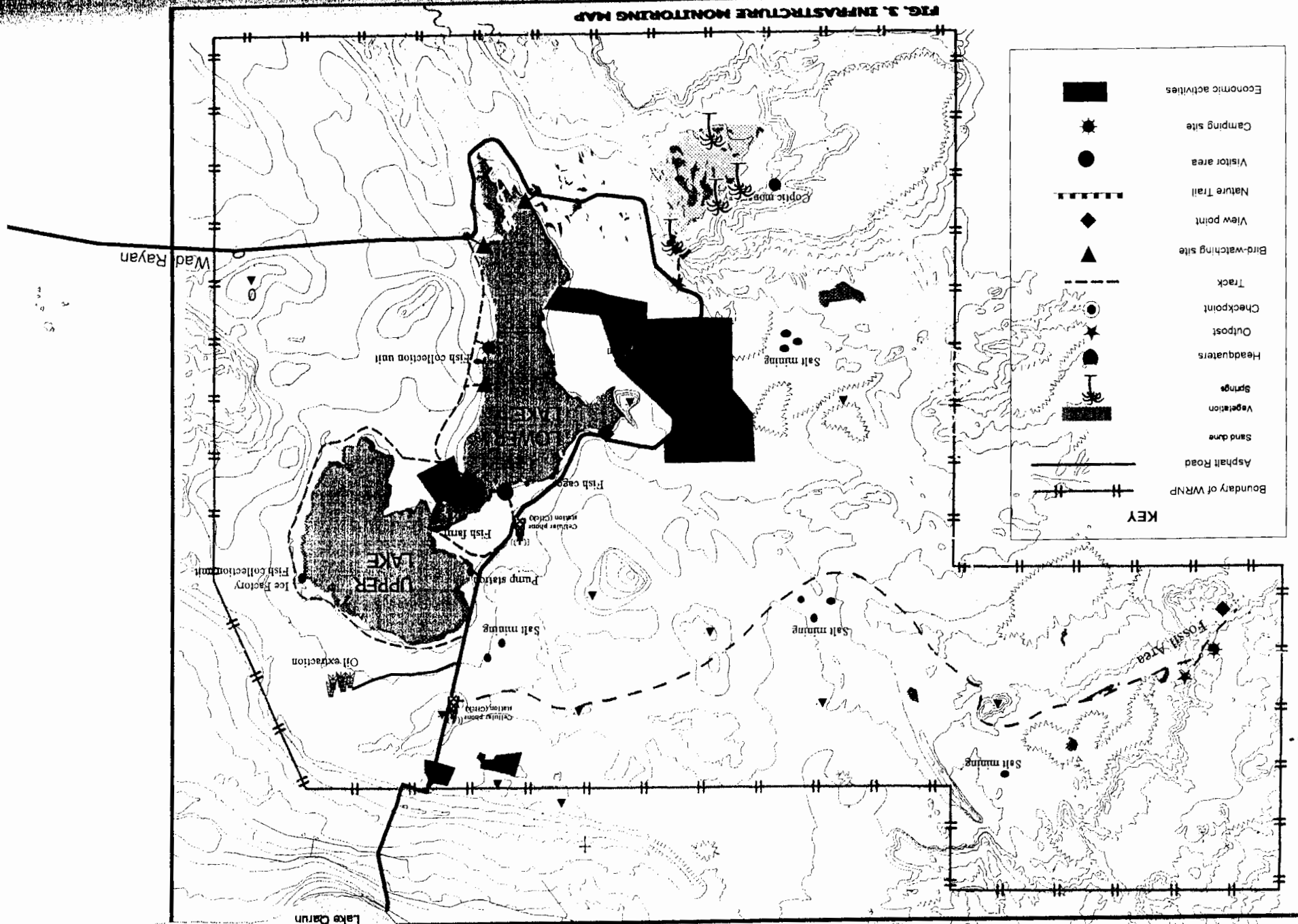


FIG. 2. WRPA TOPOGRAPHIC MAP

FIG. 3. INFRASTRUCTURE MONITORING MAP



Wad Rayan

Lake Qarun

UPPER LAKE

KEY

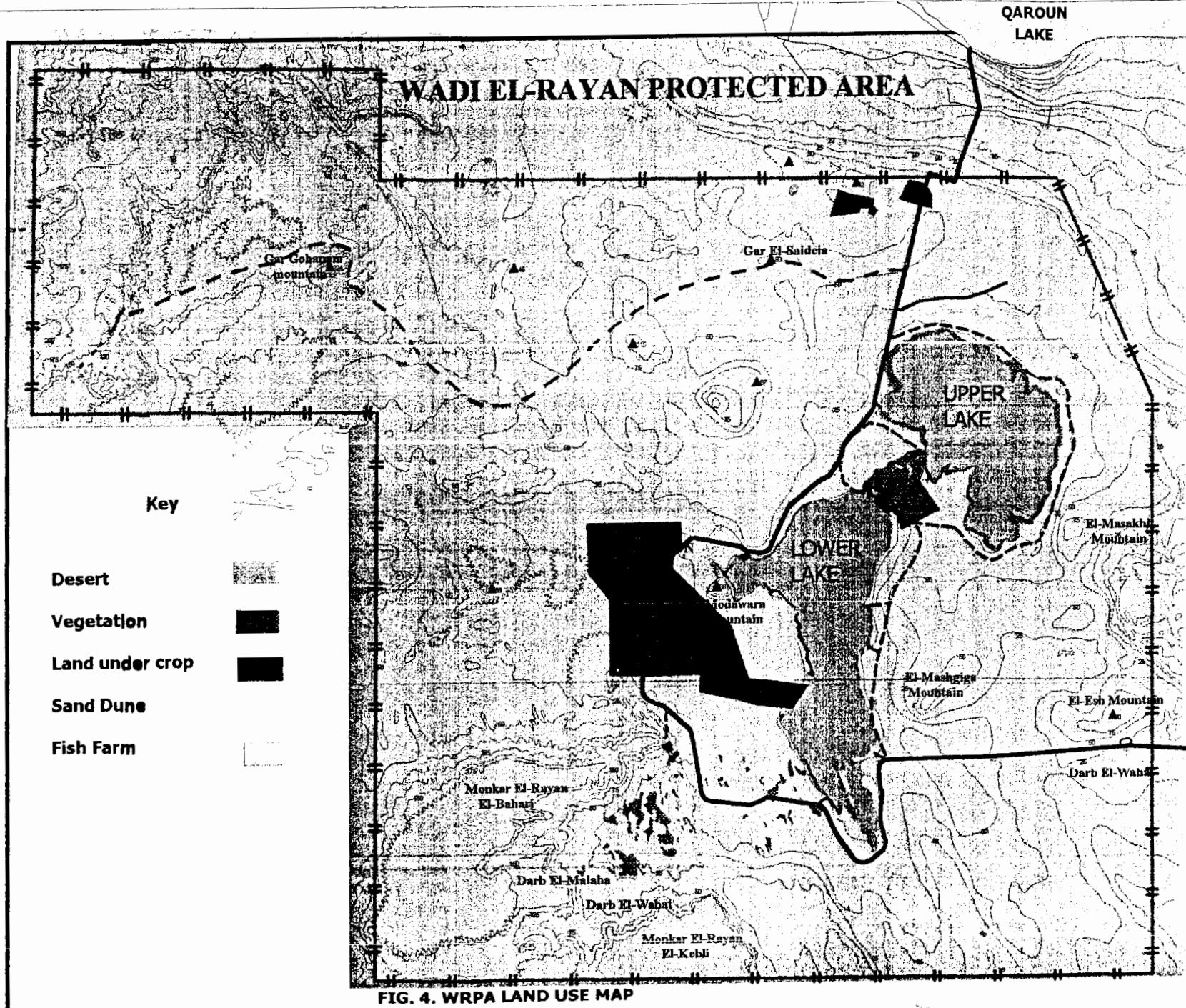


FIG. 4. WRPA LAND USE MAP

PART III

3. BIODIVERSITY MONITORING

3.1. VEGETATION

3.2. BIRDS

3.3. A. MAMMALS

3.3. B. GAZELLES SURVEY

3. BIODIVERSITY MONITORING

According to the time and human resources restriction, the biodiversity monitoring has been focused on the aspects of the WRPA biodiversity which have not been extensively considered in the previous studies: the terrestrial and aquatic invertebrate population (Annexes 1&2), as well as the reptiles one (Annex 3) have not been included in the monitoring program because already investigated in the last 10 years (see IUCN, 2000). Fish monitoring report had not been completed until the moment of introducing this report, so only a realized fish species list is provided in this report by WRPA staff (Annex 4)

BIODIVERSITY UNIT OF WRPA

For the proper monitoring of biodiversity inside WRPA, Biodiversity Unit had been established after the permission from Nature Conservation Sector, EEAA. Three senior rangers are directing the primary activities of the unit. The names and qualifications of these rangers are:

◆ **Name:** *Wed Abdel Latif Ibrahim*

Degree: B.Sc. Environmental Science, finishing his master on the same field.

Duty inside WRPA: Senior Coordinator of Biodiversity Monitoring.

◆ **Name:** *Haitham Nabeeh Bedeer*

Degree: B.Sc. Environmental Science, finishing his master on the same field.

Duty inside WRPA: Senior, Biodiversity monitoring

◆ **Name:** *Mohamed Talaat El-Hennawy*

Degree: M.Sc. Plant Ecology / Fresh Water Ecology, B.Sc. Botany.

Duty inside WRPA: Senior Coordinator of Management and Effectiveness
Monitoring

The members directing the unit of biodiversity did the reporting of biodiversity monitoring. The specific needs and recommendations were simply introduced at the end of biodiversity monitoring part of this report.

VEGETATION MONITORING FOR WRPA

MONITORING REPORT

WINTER 2001

3.1. VEGETATION MONITORING FOR WADI EL-RAYAN PROTECTED AREA

By

Mohamed Talaat El-Hennawy

M.Sc. Plant Ecology - Fresh Water Ecology -

Senior Coordinator of Management and Effectiveness Monitoring

3.1.1. INTRODUCTION

WRPA is located at the western desert of Egypt, and is simply classified under the Oasis and Depression part of the western desert, Zahran (1989). The climatic conditions of Wadi El-Rayan depression are arid one: high temperature, low humidity high evaporation and rainfall is negligible. The artesian underground water is the main water resource of the area. Xerophytes, halophytes and hydrophytes are the main vegetation types recognized in WRPA. These plant communities were found to be distributed among different types of natural habitats. These habitats were represented in: 1) *Reed swamp habitats*, 2) *Salt marsh ecosystem*, 3) *Sand formations and sand dune ecosystem*, 4) *Gravel and nummuletic desert ecosystem* and 5) *Aquatic ecosystem*.

3.1.2. LOCATION AND GEOMORPHOLOGY

Wadi El-Rayan occupies a depression in the northern part of the western desert of Egypt, situated between longitude 29° 00' 00" & 29° 24' 11" E and latitude 30° 00' 00" & 30° 34' 00" N. Wadi El-Rayan protected area located 210 km right angle south to the Mediterranean coast at coordinates of 30° 00' N & 30° 18' E. The deeper portion of the depression is occupied by 2 man-made lakes connected by 3-4 km long channel. The main supply of water other than the 2 lakes is underground water, and 4 natural sulphured water springs.

3.1.5. MATERIALS AND METHODS

3.1.5.1. Sampling program

Stratified Sampling methods were used that the vegetation is divided up before samples are chosen according to variations within the vegetation communities, on the basis of difference in vegetation structure and variation in dominant species.

Five main terrestrial habitats were selected as the study area for the monitoring program in which sampling sites were selected to cover five main natural habitats all over WRPA.

A total of 12 stands were selected to represent the variations in the vegetation communities inside the area. The stands were distributed among the main important sectors of the protected area as explained by the table:

SECTOR	NO. OF STANDS
Fossil Area (FA)	2
Upper Rayan Lake (UL)	2
Lower Rayan Lake (LL)	2
Spring Area (SA)	5
Rowayan Area (R)	1
TOTAL	12

The abundance of each plant species in each stand (Line intercept method) was estimated during the period from 1st Nov. to 8th Nov. 2001

The area of each stand was determined as 100 m².

Species identification and species names were according to Täckholm (1974) and Boulos (1995), and mainly identified through the herbarium of WRPA.

3.1.5.2 Sampling Methods

The vegetation cover was estimated on the bases of mean absolute cover of certain sp. inside the 100 m² area of each stand. The quadrat was divided into 10 tapes of 10 m long for each. The value of absolute cover of certain sp. was

3.1.5. MATERIALS AND METHODS

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- ◆ *Tamarix nilotica*: more distributed inside the spring and Rowayan areas, around the 2nd lake, then at the Fossil area.
- ◆ *Alhagi graecorum*: More distributed inside the spring area.
- ◆ *Salsola imbricata subsp. gaetula*: More distributed inside the Fossil area.
- ◆ *Desmostachya bipinnata*: The main occurrence was represented at the spring area.
- ◆ *Nitraria retusa*: It was found tending to cover the spring area mainly and with less occurrence around the lower lake.
- ◆ *Phoenix dactylifera*: It was occupying mainly the spring area and with minimum occurrence around the 2 lakes.

These species represented the state of dominance among the vegetation species inside the protected area. For each sector of the protected area the main dominant species were explained as shown in the next table:

Table (3): The main dominant plant species inside WRPA

Species	SECTOR		SPRING AREA		FOSSIL AREA		UPPER LAKE		LOWER LAKE		ROWAYAN AREA	
	AC	RC	AC	RC	AC	RC	AC	RC	AC	RC	AC	RC
<i>Alhagi graecorum</i>	126.8	37	-	-	-	-	-	-	-	-	11	7
<i>Arthrocnemum macrostachyum</i>	-	-	-	-	++	-	-	-	-	-	-	-
<i>Calligonum polygonoides sub. Comosum</i>	14.4	5.9	-	-	-	-	-	-	-	-	-	-
<i>Cornulaca monocantha</i>	-	-	16.35	10.4	-	-	-	-	-	-	-	-
<i>Desmostachya bipinnata</i>	37.8	15.62	-	-	-	-	-	-	-	-	-	-
<i>Haloxylon salicornicum</i>	-	-	-	-	++	-	-	-	-	-	-	-
<i>Imberata Cylindrica</i>	+++	-	-	-	+	-	-	-	-	-	-	-
<i>Juncu rigidus</i>	+	-	-	-	+	-	+	-	-	-	-	-
<i>Juncus acutus</i>	+++	-	-	-	10.5	5.6	15	1.6	-	-	-	-
<i>Nitraria retusa</i>	35.6	18.6	-	-	-	-	+++	-	++	-	-	-
<i>Phoenix dactylifera</i>	23.3	14.8	-	-	+	-	+	-	-	-	-	-
<i>Phragmites australis</i>	112	9.7	-	-	135	94.5	750	77.65	-	-	-	-
<i>Salsola imbricata subsp. gaetula</i>	-	-	127.5	31	-	-	-	-	-	-	-	-
<i>Tamarix nilotica</i>	257	13.05	60	38	++	-	200	20.8	-	-	-	-
<i>Zygophyllum album</i>	4.4	8.8	-	-	-	-	++	-	++	-	-	-
<i>Zygophyllum coccineum</i>	+++	-	8.8	20.6	++	-	-	-	-	-	-	-

- ◆ *Tamarix nilotica*: more distributed inside the spring and Rowayan areas, around the 2nd lake, then at the Fossil area.
- ◆ *Alhagi graecorum*: More distributed inside the spring area.
- ◆ *Salsola imbricata subsp. gaetula*: More distributed inside the Fossil area.
- ◆ *Desmostachya bipinnata*: The main occurrence was represented at the spring area.
- ◆ *Nitraria retusa*: It was found tending to cover the spring area mainly and with less occurrence around the lower lake.
- ◆ *Phoenix dactylifera*: It was occupying mainly the spring area and with minimum occurrence around the 2 lakes.

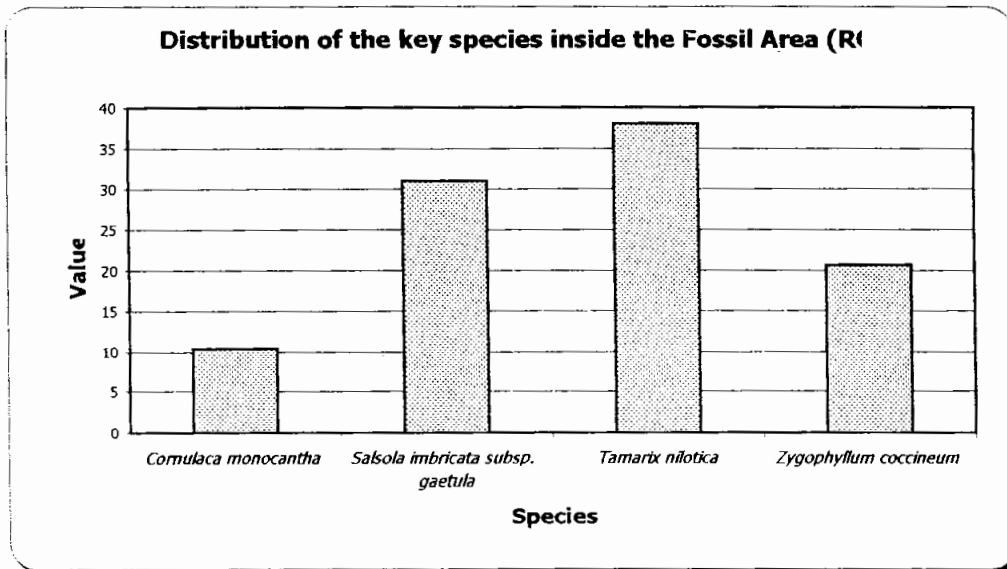
These species represented the state of dominance among the vegetation species inside the protected area. For each sector of the protected area the main dominant species were explained as shown in the next table:

Table (3): The main dominant plant species inside WRPA

Species	SECTOR		SPRING AREA		FOSSIL AREA		UPPER LAKE		LOWER LAKE		ROWAYAN AREA	
	AC	RC	AC	RC	AC	RC	AC	RC	AC	RC	AC	RC
<i>Alhagi graecorum</i>	126.8	37	-	-	-	-	-	-	-	-	11	7
<i>Arthrocnemum macrostachyum</i>	-	-	-	-	++	-	-	-	-	-	-	-
<i>Calligonum polygonoides sub. Comosum</i>	14.4	5.9	-	-	-	-	-	-	-	-	-	-
<i>Cornulaca monocantha</i>	-	-	16.35	10.4	-	-	-	-	-	-	-	-
<i>Desmostachya bipinnata</i>	37.8	15.62	-	-	-	-	-	-	-	-	-	-
<i>Haloxyton salicornicum</i>	-	-	-	-	++	-	-	-	-	-	-	-
<i>Imberata Cylindrica</i>	+++	-	-	-	+	-	-	-	-	-	-	-
<i>Juncu rigidus</i>	+	-	-	-	+	-	+	-	-	-	-	-
<i>Juncus acutus</i>	+++	-	-	-	10.5	5.6	15	1.6	-	-	-	-
<i>Nitraria retusa</i>	35.6	18.6	-	-	-	-	+++	-	++	-	-	-
<i>Phoenix dactylifera</i>	23.3	14.8	-	-	+	-	+	-	-	-	-	-
<i>Phragmites australis</i>	112	9.7	-	-	135	94.5	750	77.65	-	-	-	-
<i>Salsola imbricata subsp. gaetula</i>	-	-	127.5	31	-	-	-	-	-	-	-	-
<i>Tamarix nilotica</i>	257	13.05	60	38	++	-	200	20.8	-	-	-	-
<i>Zygophyllum album</i>	4.4	8.8	-	-	-	-	++	-	++	-	-	-
<i>Zygophyllum coccineum</i>	+++	-	8.8	20.6	++	-	-	-	-	-	-	-

2. **For the Fossil Area**, the dominant sp. is *Tamarix nilotica* and then *Salsola imbricata subsp. gaetula*. *Zygophyllum coccineum* and *Cornulaca monocantha* found to be associated with the dominant species. (Figure 6). Fossil Area is the least sector of the protected area in its water supply. It also represent the place has the most characteristic and valuable geological and paleontological site in Egypt and may be all over the world.

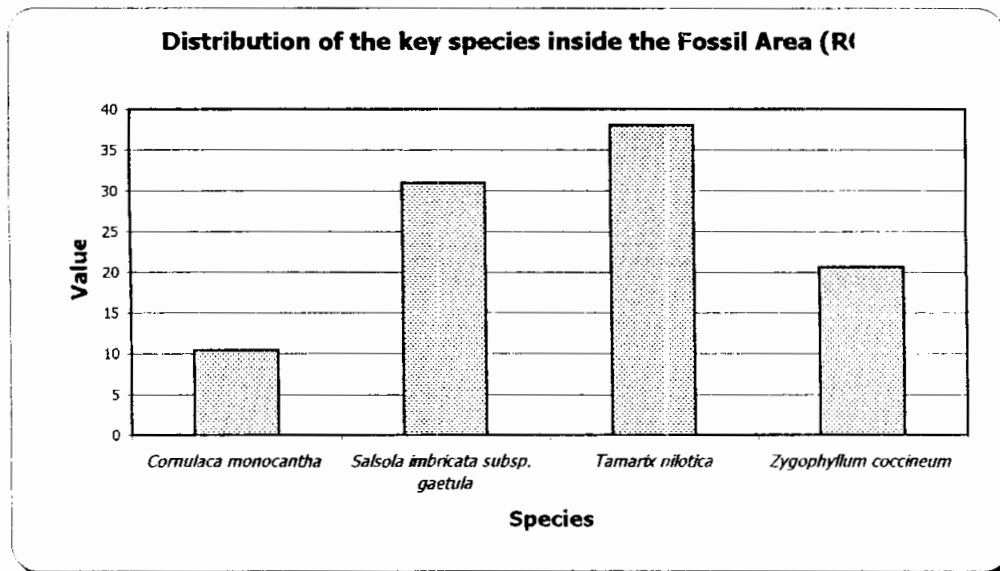
Figure (6): Distribution of the key species inside the Fossil Area (RC)



3. **For the Upper Lake**, The dominant sp. was found to be *Phragmites australis*, the most adaptive and suitable plant species for the nature of the water in Rayan Lakes (Figure 7). The agricultural wastewater of the lakes with the range of total dissolved salts from 1300 mg/L (for the Upper Lake and the channel) to 10.000 mg/L (for some places of the Lower Lake) can be managed naturally by this plant species. This plant species can reduce the most rigorous parameters impacting the water as Suspended Solids (SS) and Biological Oxygen Demand (BOD). *Juncus acutus* was also found to be associated with *Phragmites australis* in one of the most balanced and attracting wetland ecosystems in Egypt. These wetlands support about 163 migratory and resident

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The attached map (Figure 9) shows the distribution of sampling sites and main vegetation covers through WRPA.

3.1.7. CONCLUSION

- ❖ The majority of wild plant species in WRPA is of perennial nature. The monitoring program will be more efficient on the long term that can give us the state of vegetation cover in the area.
- ❖ The Desert species *Alhagi graecorum* and *Nitraria retusa* are the most characteristic species for the core zone spring area of WRPA. The wild life existence especially gazelle communities of *Gazella dorcas dorcas* inhabiting the area and depending on the 2 previous plant species which are more palatable for this gazelle community.
- ❖ The vegetation patches represent the food and shelter for wild life communities that concentrated mainly in the spring area. Of the 37 wild plant species in WRPA, 14 of them were found inside the springs area supporting the presence of mammal communities as Gazelle (*Gazella dorcas dorcas*), Fennec fox (*Fennecus zerda*), red fox (*Vulpes vulpes aegyptica*), Ruppel's fox (*Vulpes ruepelli ruepelli*), Egyptian golden jackal (*Canis aureus lupaster*), African wild cat (*Felis sylvestris libyca*) and others.

3.1.8. RECOMMENDATIONS

- On the level of decision-makers, stopping the decreasing of the water level of the 2 lakes is a must. Decreasing of water level now affecting adversely the occupied area with wetlands which supports the bird and fish life of the area.
- The extension of the land reclamation areas has to stop inside the WRPA. The reclaimed areas are closely located to the spring area, the core zone of the protected area, which is put now under the threat of genetic contamination with the agricultural species. A change in vegetation community might be happened on the long term if the reclamation activities continue, making threat to the wildlife communities inside the area.

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- ❖ The vegetation patches represent the food and shelter for wild life communities that concentrated mainly in the spring area. Of the 37 wild plant species in WRPA, 14 of them were found inside the springs area supporting the presence of mammal communities as Gazelle (*Gazella dorcas dorcas*), Fennec fox (*Fennecus zerda*), red fox (*Vulpes vulpes aegyptica*), Ruppel's fox (*Vulpes ruepelli ruepelli*), Egyptian golden jackal (*Canis aureus lupaster*), African wild cat (*Felis sylvestris libyca*) and others.

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BIRD MONITORING FOR WRPA

**MONITORING REPORT
2001**

BIRD MONITORING FOR WRPA

MONITORING REPORT

2001

Objectives:

1. Updating bird check-List
2. Assessment of abundance and fluctuation of bird species through out the year
3. Identification of bird species that is difficult to identify by normal observation
4. Studying the migration strategies for migrant birds
5. Studying the status of bird species
6. Using the data collected in setting site plan for the area

3.2.2. MATERIALS AND METHODS

3.2.2.1. Counting

The WRPA staff used the line transect method from the motorboat (Buckland *et al.*, 1993) for counting of the most common species of water birds along fixed transects in the Upper and Lower Lakes.

Personnel: team of two persons (trained in bird identification)

Equipment: compass, GPS, binoculars, pencils and data sheets.

Frequency: Each of the transect is walked twice at quarterly intervals within a defined two-week period, during the first half of the morning.

Method: The selected transects were located in a non-random way, because of the non-random distribution of the habitats and, consequently, of the birds in WRPA (stratified sampling). Each transect is 1 Km length and the motorboat is driven at constant speed of about 3 Km/hour. The observers record the species, the direction and the distance of each bird resting on the lake or feeding in a place. For species that occur in flocks, they treat the flock as a single detection and record the flock size. The position recorded for a flock is the “center of gravity” of the flock, not the closest point of the flock to the observer. The flying birds are recorded and analyzed separately: whenever a flying bird (or flock) is detected, the observer wait until it comes abeam of the boat and only then he records its position.

3.2.2.2. Ringing

The method used for bird ringing was conducting following the standard of SEEN program (SE European Migration Network, Bird Migration Research Station, Gdansk Univ. Poland) including measurements (wing length, tail length, wing formula, fat score, and bird weight).

Personnel: four persons are usually working in the ringing station, two from Poland and two Egyptians of WRPA staff (Table 4).

Equipment: Nets, Field guides, rulers, balance, experiments cages, campus, rings and one car.

Methods: Bird ringing depends on the caught birds especially passerines using special nets (mist net) with certain mesh size according to the group of bird will caught by it. After that all the need measurements can easily taken (species identification, sex/age detection and direction of migration by orientation experiment) and putting a ring in the bird leg.

Frequencies: this work was carried out during the migration seasons (spring, 2/3 – 28/4/ 2001 and autumn, 2/9 – 28/10/2001) the wok is starting (from 6:30 to 11: 00 o'clock) in the morning and (from 17.00 to 19: 30 o'clock) in the evening.

3.2.3. RESULTS

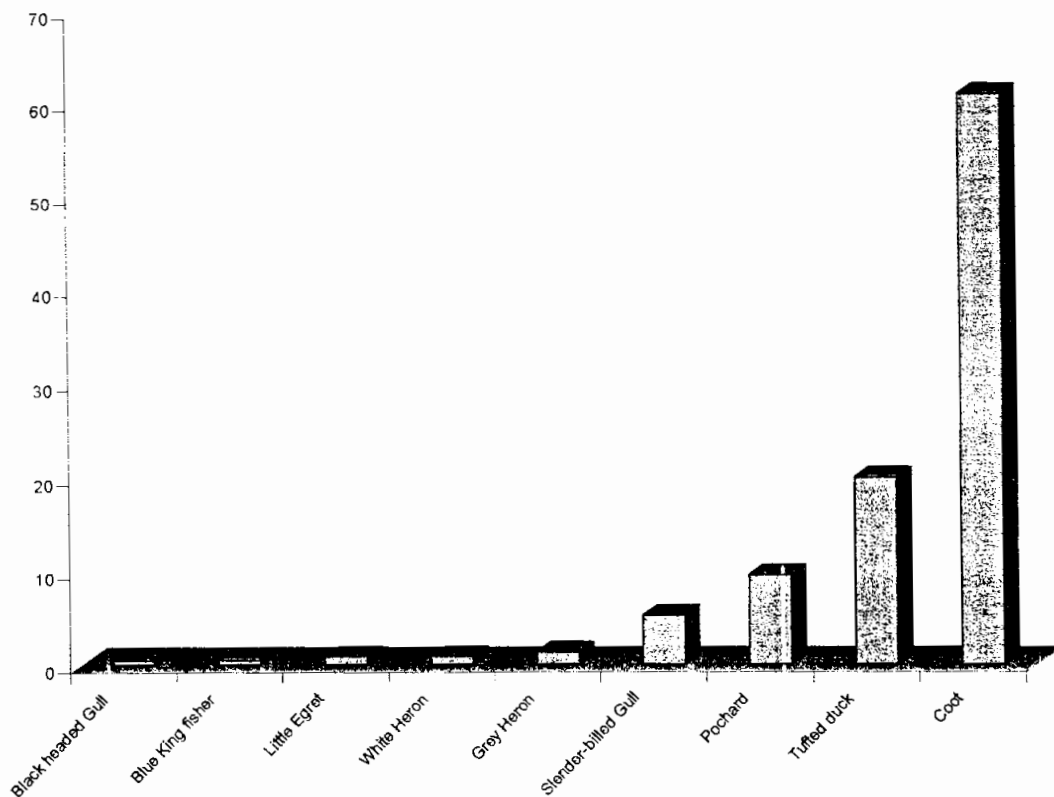
3.2.3.1. Counting

Two transects located in the Upper Lake and three in the Lower Lake, have been chosen to represent all the different type of habitat in the two lakes. The count has been repeated 2 times within 2 weeks, in order to decrease the sampling errors and to reduce the possibility of mistake, only the most common species of water-birds are recorded (Annex 6). The water bird counting has been conducted for three seasons during 2001, which are Autumn, Winter and Spring, however, due to a problem related to the motor boat we could not complete Summer season monitoring. During the summer season a few water birds stayed in Wadi El Rayan because of their migration to their original breeding habitat.

After one year of monitoring we found fluctuation in water bird diversity and number of individuals from season to season through out the year.

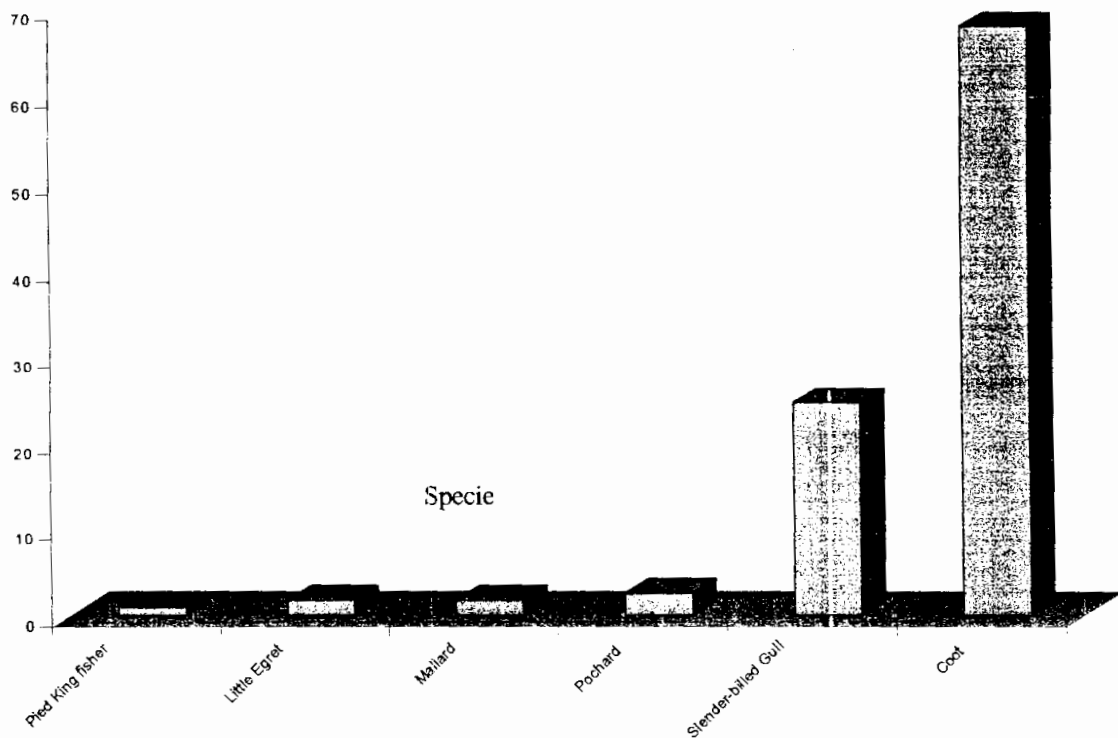
Winter Season: some of the water birds recorded in Autumn may left the place to spend the winter in another place and some of the water birds spend the winter in Wadi El Rayan. During this season counting we recorded 9 species were recorded dominated by Coot (61 %) and followed by Tufted Duck, Pochard, Slender-billed Gull, and Grey Heron, however the least abundant species was Black-headed Gull (0.44 %). (Figure 10).

Figure (10): Abundance of water bird species in Wadi El Rayan Lakes (winter 2001)



Spring Season: during this season the wintering water birds will started to migrate from Wadi El Rayan to their breeding habitats. We counted during this season 6 species dominated by Coot (68 %) followed by Slender-billed Gull, Pochard, and Mallard, while Pied King Fisher represented the least dominant species. (Figure 11).

Figure (11): Abundance of water bird species in Wadi El Rayan Lakes (spring, 2001)



Autumn Season: during this seasons the water birds started to arrive to Wadi El Rayan for stopover to take some rest and food after the long travel through the sea. During this season 12 species have been counted, the most abundant species was Coot which represents 31% of the counted species followed by Mallard, Slender-billed Gull, Grey Heron, and Pochard, while the lest abundant species was Cormorant (1.6 %). (Figure 12)

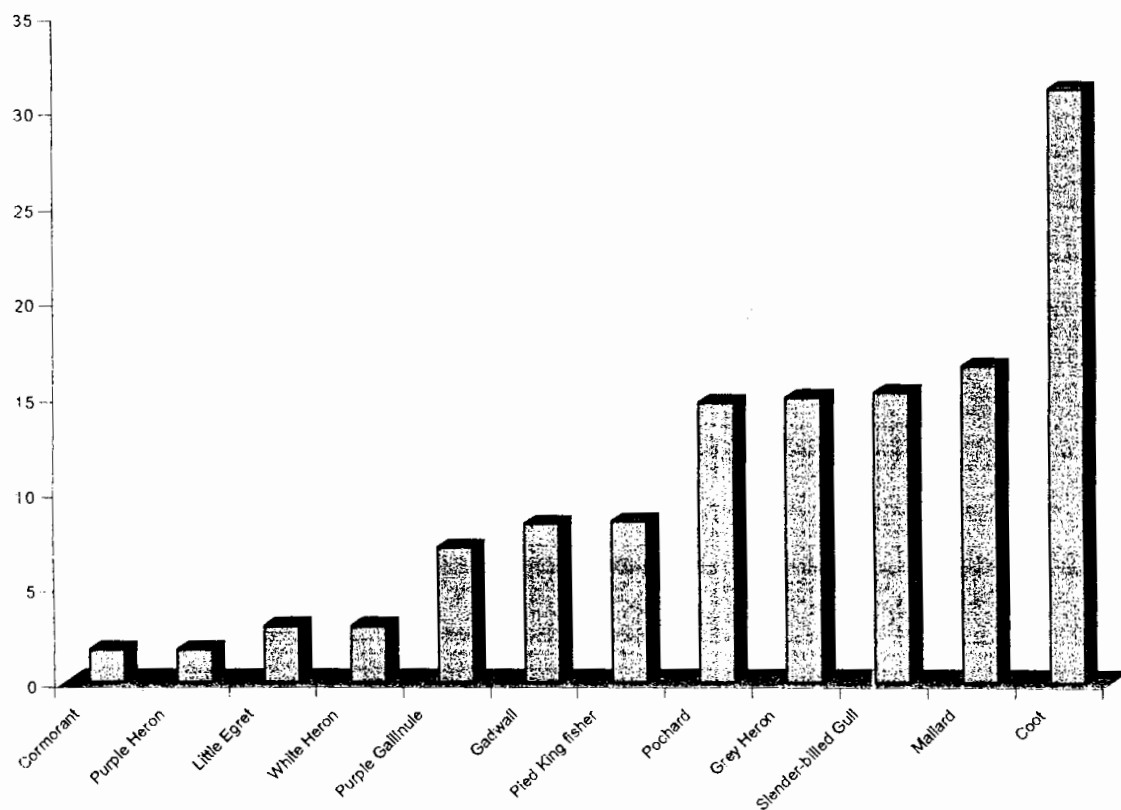
1

2

3

4

Figure (12): Abundance of water bird species in Wadi El Rayan Lakes (autumn, 2001)



3.2.3.2. Ringing

The bird ringing station is located on the shoreline of the lower lake. The bird ringing was conducting in the migration seasons (spring and autumn / 2001), with fixed net positions and number.

In spring season total of 1274 individuals of 44 species were caught, 12 of them were recorded for the first time in Wadi El Rayan. Between these species Reed Warbler (*Ac ser*) was the most common caught where 537 individuals were caught during this season. (Figure 13)

3.2.4. PROPOSAL FOR NEXT YEAR MONITORING

Avoiding some problems faced us during motorboat counting for water birds, we proposed to start another system of bird counting which depend on stands counting, where 12 stations were detected on the two lakes to be fixed stations for water birds counting.

Required equipment: One Car, Good Telescope, Two Good Binoculars, and one photographic Camera with zooming possibilities.

3.2.5. CONCLUSION

The establishment of Wadi El Rayan lakes creates an important microhabitat that is important for resident and migrant birds as well. This new habitat attracted a lot of bird species from different bird groups from passerines, waders, water birds, herons and birds of prey. During the first year of monitoring program (2000). A total number of 143 species have been recorded in Wadi El Rayan, however during the second year of monitoring the total number of bird species becomes 163 birds species from desert birds, reeds birds, waders, water birds, in addition to birds of pery. (Annex 6)

The bird diversity criteria in Wadi El Rayan changes from season to season through out the year due to the change of climatic condition, the seasonal variation of human activities and the needs of bird species passing or visiting the area within the different seasons. In winter and spring seasons, there is a high bird diversity in the area, may be, due to the migrant bird species are in hurry to reach its breeding habitat. They are trying to take the shorter way for migration to arrive early to find a good place for breeding, so they pass Wadi El Rayan going to West Europe. This indicate the importance of Wadi El Rayan as a stopover point, and the collection of more data in different years will give more details about the species variation through out years which will also help in environmental planning of the area and wild life conservation.

3.2.6. RECOMMENDATIONS

- Completing bird-ringing studies with possibilities for financial support to have Egyptian rings instead of Polish ones.
- Establishing Egyptian bird ringing scheme with the same standards of the most expert countries in this field.
- Establishing Ringing stations in other protected areas in Egypt especially those located in bird migration routs.
- Organizing the human activities in and surround the two lakes
- Studying the water level variation of lakes and its effect on the wild life
- Studying the water quality and control fish farms waste water
- Increase the environmental awareness of the fishermen.

Table (4): Persons participated in Bird Ringing Station work in Wadi El Rayan 2001.

NAME	AUTHORITY	DAYS
Prof. Dr. Przemyslaw Busse	SE European Bird Migration Network (Chairman)	15
Dr. Jaroslaw Nowakowski	SE European Bird Migration Network	60
Marzena Nowakowski	SE European Bird Migration Network	30
Pawel Piwowarski	SE European Bird Migration Network	90
Wed Abdel Latif Ibrahim	Wadi El Rayan Staff EEAA	150
Mohamed Ismail Mohamed	Wadi El Rayan Staff EEAA	90
Mohamed Ali	Wadi El Rayan Staff I.P.	60

3.3. A. Mammal Monitoring FOR Wadi El-Rayan Protected Area

By

Wed Abdel Latif Ibrahim
Senior Coordinator of Biodiversity Monitoring

Haitham Nabeeh Bedir
Senior of Biodiversity Monitoring

A.1. INTRODUCTION

In Wadi El Rayan protected area, only few species are well adapted to the extreme conditions of the real desert (Fennec fox). The animal activities are generally concentrated in vegetated area (sand dunes, inter-dunes areas, lake shore, and desert areas). The Monitoring program of mammals in WRPA is concerning The Large Mammals, because they are easy to study with the available equipment, Table (5).

Table (5). Species considered for the index count.

LATIN NAME	ENGLISH NAME
<i>Canis aureus lupaster</i>	Golden jackal
<i>Vulpes vulpes aegyptica</i>	Red fox
<i>Vulpes ruepelli ruepelli</i>	Ruppel's fox
<i>Fennecus zerda</i>	Fennec fox
<i>Herpestes ichneumon</i>	Egyptian mongoose
<i>Felis sylvestris libyca</i>	African wild cat
<i>Gazella dorcas dorcas</i>	Dorcas gazelle

A.1.1. Objectives of the study

- ◆ Studying the large mammal frequencies in Wadi El Rayan.
- ◆ Studying the seasonal variation in large mammal distribution throughout the monitoring time.

- ◆ Monitoring the impacts of human activities on the large mammal activities and distribution.
- ◆ Collecting some data about the large mammal relations with the different habitat criteria.
- ◆ Collecting data about large mammal behaviours by direct observations or the investigation of their traces.
- ◆ Using the collected data in the environmental planning and putting conservation priorities in Wadi El Rayan Protected Area.

A.2. MATERIALS AND METHODS

There are two methods are used for studying the distribution and seasonal changes in mammal activities throughout Wadi El Rayan different habitats. These methods are Strip transect and Arial Survey.

A.2.1. Strip Transect

The methodology is the index count for presence signs along strip transects (Mooty, *et al.*, 1984; Van Dyke *et al.*, 1986). These counts will allow to compare differences concerning wildlife abundance among different habitats and to monitor seasonal distribution changes.

There are five zones were selected for monitoring to represent Wadi El Rayan habitats, Table (6) (Figure 15a).

Table (6): Zones selected for large mammals monitoring in 2001.

Zone	Location	Transect No.
First	Springs area	3
Second	Hatyet Al- Rowyan area	1
Third	Second lake	2
Fourth	First Lake	2
Fifth	Fossil area	2

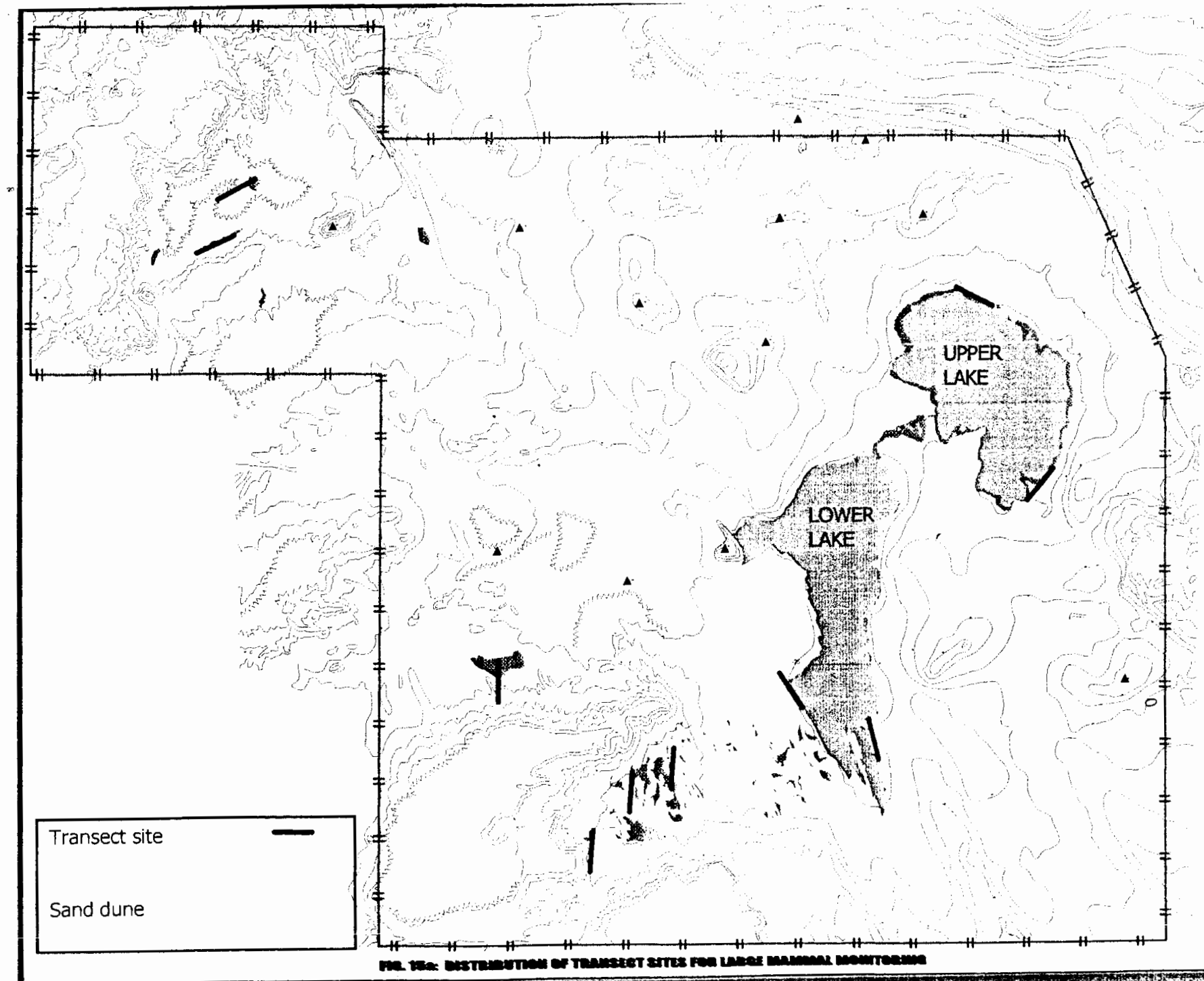


FIG. 15a: DISTRIBUTION OF TRANSECT SITES FOR LARGE MAMMAL MONITORING

Personnel: transects were surveyed by a team of 2 persons for observation and a recording.

Equipment: compass, GPS, pencils, binocular, data sheets, and one car.

Frequency: The monitoring was four times per year (Seasonal monitoring). The time of monitoring was fixed during seasons. Each transect is walked every 3 months within a defined two-week period.

Method: Transects have been located in a non-random way, because of the non-random distribution of the habitats and, consequently, of the mammals in WRPA (stratified sampling). Each transect is 2 Km length and 10 meters wide and it is walked at constant speed of about 3 Km/hour. The observers record the species and the kind of sign (track or feces) that they found inside the transect strip.

A.2.2. Aerial Survey

This survey was done two times per month, using the car. The workday was divided into 2 monitoring times, which are the day monitoring (6 A.M. to 3 P.M.) and night one (8 P.M. to 12 P.M.).

A.3. RESULTS

During the year of monitoring, WRPA staff realized the strip transects for counting of indirect index of presence (tracks and feces) in ten fixed transect, which are covering four different habitats. These habitats are 1) vegetation in the desert, 2) shore of the first lake, 3) shore of the second lake and 4) spring area. The starting and ending points of each transect have been marked, and the walking direction has been noted.

A.3.1. INDIRECT OBSERVATION:

Verification of the presence of the African wild cat and Mongoose (along the shores of the lakes), the fennec and ruppell's fox (in the vegetative areas of desert), dorcas gazelle and Golden jackals (spring's area) were recorded, (IUCN, 2001a). The data collected during the year of monitoring have been analyzed and

the results of this analysis show that there is a variation in species distribution within the seasons and from zone to the other.

A.3.1.1. Large Mammals Distribution during 2001

A.3.1.1.1. Spring Season

Fox (*Vulpes sp.*): Including two species which are Red fox (*Vulpes vulpes aegyptica*) and Ruppell's fox (*Vulpes ruppelli ruppelli*). The Fox was densely present around the first lake (78 %). However, its presence around the second lake was lesser than the first lake, and the presence of the Fox was very low in the Spring Area. No records were done for the fox, during the monitoring time, in the fossil and Al-Rowayan areas.

Fennec fox (*Fennecus zerda*): The Fennec fox is densely present in the fossil area (56 %). The presence of the Fennec fox in the spring area was lesser than in the fossil area, with the least presence around the second lake. No records were done for the Fennec fox, during the monitoring time, around the first lake and in Al-Rowayan area.

Golden Jackal (*Canis aureus lupaster*): The Golden Jackal was densely present only in the spring area, however it was not recorded in the other zones.

Wild Cat (*Felis libyca*), we are not sure that this species is the Wild Cat or the feral cat, which introduced from the surrounding settlement, because the direct observation of it was impossible. The presence was only recorded around the first lake, while during the monitoring time, no records were done for the wild cat in the other zones.

Egyptian Mongoose (*Herpestes ichneumon*): The presence was only recorded around the first lake, but during the monitoring time, no records were done for the Egyptian Mongoose in the other zones.

The distribution of large mammals of WRPA during the spring had been shown in figure (16).

A.3.1.1.2. Summer season

Fox (*Vulpes sp.*), The Fox was densely present around the first lake (64 %). However, its presence around the second lake was lesser than the first lake. The presence of the Fox was very low in the Spring Area. We did not record their presence in the fossil area and Al-Rowayan area.

Fennec fox (*Fennecus zerda*), The Fennec fox was densely present in the springs area (43 %), compared to the other zones. The presence of the Fennec fox in the fossil area was lesser than in the springs area, while the presence of the Fennec fox in Al-Rowayan area was the least. No records were done for the Fennec fox, during the monitoring time, around the lakes.

Golden Jackal (*Canis aureus lupaster*): The Golden Jackal was commonly present in the Springs Area (57 %). The presence of the Golden Jackal in Al-Rowayan area was similar to that around the second lake. The presence of the Golden Jackal around the first lake was lesser than in Al-Rowayan. No records were done for the Jackal in the fossil area.

Wild Cat (*Felis libyca*): The distribution was only recorded around the first lake, while no records were done in the other zones.

Egyptian Mongoose (*Herpestes ichneumon*): It was commonly present around the first lake (86 %). The presence of the Mongoose around the second lake was lesser than that around the first lake. No records were done for the Mongoose, during the monitoring time, in the other zones.

The distribution of large mammals of WRPA during the summer season had been shown in figure (17).

A.3.1.1.3. Autumn Season

Fox (*Vulpes sp.*). The Fox was densely present around the first lake (57 %). However, its presence around the second lake was lesser than the first lake. The

presence of the Fox was very low in the spring area, while no records were done, during the monitoring time, in the fossil and Al-Rowayan areas.

Fennec fox (*Fennecus zerda*), The Fennec fox was densely present in the spring area (58 %). The presence of the Fennec fox in Al-Rowayan was lesser than that in the spring area. The presence of the Fennec fox in the fossil area was the least, and there was no record of its presence around the Lakes.

Golden Jackal (*Canis aureus lupaster*): The Golden Jackal was densely present in the spring area (53 %). The presence of the Golden Jackal around the second lake is lesser than in the spring area, while in Al-Rowayan was lesser than around the second lake, with the least presence around the first lake. No records were done, during the monitoring time, in the Fossils area.

Wild Cat (*Felis libyca*): The wild cat was only present around the lakes (first & second). The presence around the first lake was more than the second lake (10:1). No records were done about its presence in the other zones.

Egyptian Mongoose (*Herpestes ichneumon*): It was densely present around the Lakes .The presence around the second lake was lesser than the first lake (29 % and 71 % respectively). No records were done about its presence in the other zones.

The distribution of large mammals of WRPA during the autumn season had been shown in figure (18).

A.3.1.1.4. Winter Season

Fox (*Vulpes sp.*), The Fox was densely present around the first lake (65.5 %). However, its presence around the second lake was lesser than the first lake. The presence of the Fox was very low in the spring area, while no records were done for the fox in the fossil and Al-Rowayan areas.

Fennec Fox (*Fennecus zerda*), The Fennec fox was densely present in the spring Area (54.3 %). The presence of the Fennec fox in Al-Rowayan was lesser than in

the spring area. The presence of the Fennec fox in the fossil area was lesser than in Al-Rowayan area and the presence of it around the second lake was the least but there was no record of its presence around the first lake.

Golden Jackal (*Canis aureus lupaster*): The presence of the Golden Jackal was the highest in the spring area and around the second lake (around 30%), however the presence of the Golden Jackal around the First lake was lesser than in the spring area and the second lake, with the least presence Al-Rowayan area. We did not record its presence in the Fossils area.

Wild Cat (*Felis libyca*). The wild cat was only present around the lakes (first & second). The presence around the first lake was more than the second lake (94%), but no records about its presence in the other zones.

Egyptian Mongoose (*Herpestes ichneumon*): It was densely present around the Lakes .The presence around the second lake was lesser than first lake (20 % and 80 % respectively), and no records about the presence of the animal were found in the other zones.

The distribution of large mammals of WRPA during the autumn season had been shown in figure (19).

During The year of monitoring, the Gazelles were present only in the spring area. Where, it lives in the spring area and some time it was visiting Al-Rowyan (during the summer season).

A.3.1.2. Seasonal Mammals Activities

During the monitoring time, seasonal variation was realized in the mammal activities, which may be related to the variation in climatic conditions, animal behaviour and the relationships among these mammals themselves and the other animals as well.

The number of tracks have counted during the monitoring program were founding depending on the mammal activities, (Don E. Wilson *et al.*, 1996). The

Relative percentage of tracks counted during monitoring time has been shown in Table (7).

Table (7): Relative percentage of large mammals' tracks in Wadi El Rayan, 2001.

SEASON	SPRING	SUMMER	AUTUMN	WINTER
SPECIES				
Fennec Fox	7.01	21.40	33.21	38.38
Fox sp.	10.66	21.94	37.62	29.78
Golden Jackal	2.56	17.95	42.31	37.18
Wild Cat	6.82	27.27	25.00	40.91
Mongoose	7.69	26.92	26.92	38.46
Dorcas Gazelle	17.14	54.29	17.14	11.43

The highest activities for Fennec fox was recorded during the winter season, where winter is the breeding season for this species (January to February), (Chris and Tilde S., 1997), however the less activities was recorded in spring season, due to the climatic conditions and food availability, so the Fennec is under low stress, and it does not need spend efforts for food searching. The activities of the Fox show that, it was the highest during the autumn and winter because they representing the breeding periods for this species (December to January), (Chris and Tilde S., 1997), while the less activities was recorded in the spring season. The Golden Jackal was highly active during autumn and winter seasons (Estes, 1992), while the activities of this species was the least during the spring season. The highest activities of both Wild Cat and Egyptian Mongoos were recorded in the winter season, however it was less active during the spring season. Dorcas Gazelle activities were the highest in the summer season, due to the shortage of water in their resting place among the mountains, so they inter to the spring area for the spring water, while the least activities were recorded in winter season.

It was concluded that the least activities for the large mammals in Wadi El Rayan was in the spring season, however, all the activities of mammal species (except Dorcas Gazelle) were mainly concentrated in autumn and winter seasons.

A.3.2. DIRECT OBSERVATIONS

In the spring season, Red fox and Egyptian mongoose (on the shoreline of the first lake) were observed. While in the summer season Fennec fox (In Al-Rowayan area) and Dorcas gazelle (in the spring area) were observed. In autumn Fennec fox (in the spring area) and Red Fox (on the shorelines of the first lake) were observed, see table (8).

Table (8): Wild large mammal species observed in WRPA by the protected area staff. (2001)

SPECIES	ENGLISH NAME	DIRECT OBSERVATION	INDIRECT OBSERVATION
<i>Canis aureus lupaster</i>	Golden jackal	◆	◆
<i>Fennecus zerda</i>	Fennec	◆ Su ,Au	◆
<i>Vulpes vulpes Aegyptica</i>	Red fox	◆ Sp ,Au	◆
<i>Vulpes ruepelli Ruepelli</i>	Ruppell's sand fox		◆
<i>Felis sylvestris libyca</i>	African wild cat		◆
<i>Gazella dorcas Dorcas</i>	Dorcas gazelle	◆ Su	◆
<i>Herpestes ichneumon</i>	Egyptian mongoose	◆ Sp	◆

Sp: spring season

Su: summer

Au: autumn

3.3. B GAZELLE SURVEY MAY 2000 TO DECEMBER 2001

B.1. MATERIALS AND METHODS

The survey was done by non-randomly selected position which depended on knowing the distribution of gazelles in WRPA, so we selected two places, the first one in Al-Rowayan area and the other in the spring area. It is necessary to investigate all the vegetation in the selected areas and record the GPS points and number of individuals observed and Gazelle tracks and feces that have been found. During this period there was no timetable for survey.

B.2. RESULTS

B.2.1. Direct observation

Direct evidences of the Dorcas gazelle (*Gazella dorcas*) presence have been recorded in WRPA. There was no direct observation for the Slender Horned Gazelle (*Gazella Leptocerus Leptocerus*) (IUCN, 2001a). After the present survey there was no direct observation of Slender Horn gazelle and also no one recorded it since long time (more than 15 years) in WRPA. (Saleh, 1987). The population of the Slender Horn gazelle could be migrated from WRPA where, this species of Gazelle is strongly nomadic (Estes, 1992).

During more than one year (May 2000 until December 2001), the data included only six direct observations for Dorcas Gazelle. The direct observations included five times in the spring area (two times a group of three adults, two times a group of two adults and the fifth time was one adult) and the sixth time was in Al-Rowayan (one adult). The observations have been shown in table (9). (Figure 15b)

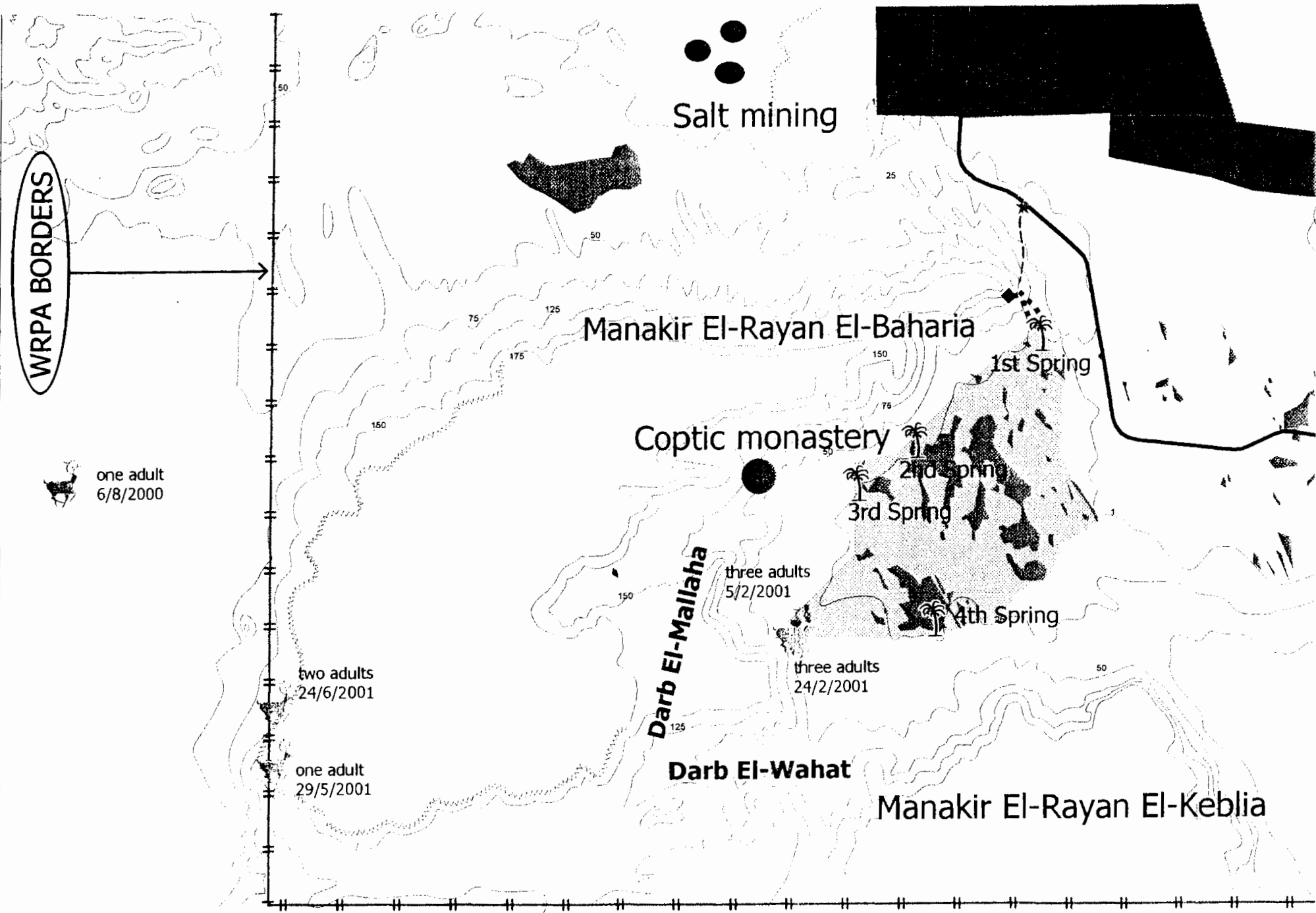


FIG. 151 THE DIRECT OBSERVATION POINTS OF THE DORCAS GAZELLE

Table (9): The direct observation of the Dorcas gazelle inside WRPA from May 2000 until May 2001

NO.	PLACE	DATE	TIME	GPS POINT	ESCAPING DIRECTION	OBSERVATION
1	AL-ROYANE	6/8/2000	7:30 A.M.	N: 29 0726 0 E: 30 1340 2	165 S-E	Only one adult dorcas gazelle
2	SPRINGS AREA	5/2/2001	12:45 P.M.	N: 29 04727 E: 30 27590	250 S-W	Three adults dorcas gazelle
3	SPRINGS AREA	24/2/2001	10:40 A.M.	N: 29 04657 E: 30 27750	260 S-W	Three adults dorcas gazelle
4	SPRINGS AREA	29/5/2001	9:30 A.M.	N: 29 02471 E: 30 17578	150 S-E	Only one adult dorcas gazelle
5	SPRINGS AREA	24/6/2001	11.00 A.M.	N: 29 03471 E: 30 17578	170 S-E	Two adults
6	SPRINGS AREA	30/6/2001	10.10 A.M.	NOT RECORDED	180 S-E	Two adults

B.2.2. Indirect observation

Many indirect evidences about the presence of gazelle individuals have been found in the selected study area and data collected are shown in table (10).

Table (10): The indirect observation of the Dorcas gazelle in WRPA from December 2000 until May 2001

NO.	PLACE	DATE	GPS POINT	OBSERVATION
1	AL-ROWYANE	26/5/2000	N: 29 12650 E: 30 23302	Tracks and feces
2	AL-ROWYANE	3/6/2000	N: 29 12545 E: 30 23280	Tracks and feces
3	AL-ROWYANE	1/7/2000	N: 29 1085 E: 30 2333	Tracks and feces
4	SPRINGS AREA	17/8/2000	N: 29 0302 .9 E: 30 1443 .0	Tracks and feces
5	SPRINGS AREA	3/9/2000	N: 29 3 .7 E: 30 1453 .7	Tracks and feces
6	SPRINGS AREA	1/10/2000	N: 29 259 .5 E: 30 1455 .1	Tracks and feces
7	SPRINGS AREA	15/12/200	N: 29 3 .7 E: 30 15 .5	Tracks and feces
8	SPRINGS AREA	12/2/2001	N: 29 0302 .9 E: 30 1443 .0	Feces only
9	SPRINGS AREA	23/3/2001	N: 29 259 .5 E: 30 1455 .1	Feces only
10	SPRINGS AREA	10/4/2001	N: 29 257 .8 E: 30 1505 .1	Tracks and feces
11	SPRINGS AREA	10/4/2001	N: 29 254 .9 E: 30 1515 .6	Tracks only
12	SPRINGS AREA	30/4/2001	N: 29 04827 E: 30 27562	Tracks of three individual and feces
13	AL-ROWYANE	1/5/2001	N: 29 12743 E: 30 23853	Feces only
14	AL-ROWYANE	1/5/2001	N: 29 12581 E: 30 22299	Feces only
15	SPRINGS AREA	5/8/2001	N: 29 04955 E: 30 27645	Tracks only

16	AL-ROWYANE	7/8/2001	NOT RECORDED	Track only
17	SPRINGS AREA	3-11-2001	N: 29 04782 E: 30 27712	Tracks and feces
18	SPRINGS AREA	30/11/001	N: 29 04815 E: 30 27685	Feces only
19	SPRINGS AREA	5/12/001	N: 29 05105 E: 30 28022	Tracks and feces
20	SPRINGS AREA	11/12/001	N: 29 04709 E: 30 27820	Track of one individual only

The data shows that the total surface area that is used by the gazelle is around 17000 ha. No evidences about its presence have been found outside this territory, (IUCN, 2001a). This small population of Dorcas gazelles (from 3 to 6 individuals) lives in the spring area and sometimes visits Al-Rowayan area (especially during the summer season). This population spending the daytime feeding on the vegetation because all the direct observation times was recorded between 7:30 AM to 12:45 PM. The night time can be in the S-W mountains in the spring area.

The hunting stress in the past (ten years ago) in the spring area led to decreasing the number of gazelle population, that the strong gazelle individuals might be migrated to other place outside WRPA (Acacia forest in the western desert, 100 km far from the spring area).

While the direct and indirect observations gazelle was observed among the plant populations of *Nitraria retusa*, *Calligonum polygonoides* and *Alhagi graecorum*. One of these direct observations, the gazelle was found eating *Alhagi sp.* So there is direct relation between the presence of these plant species and the presence of the gazelle community that depending on this plant species as a food source.

Figure (16): Distribution of Large Mammals species in Wadi El Rayan during spring season 2001.

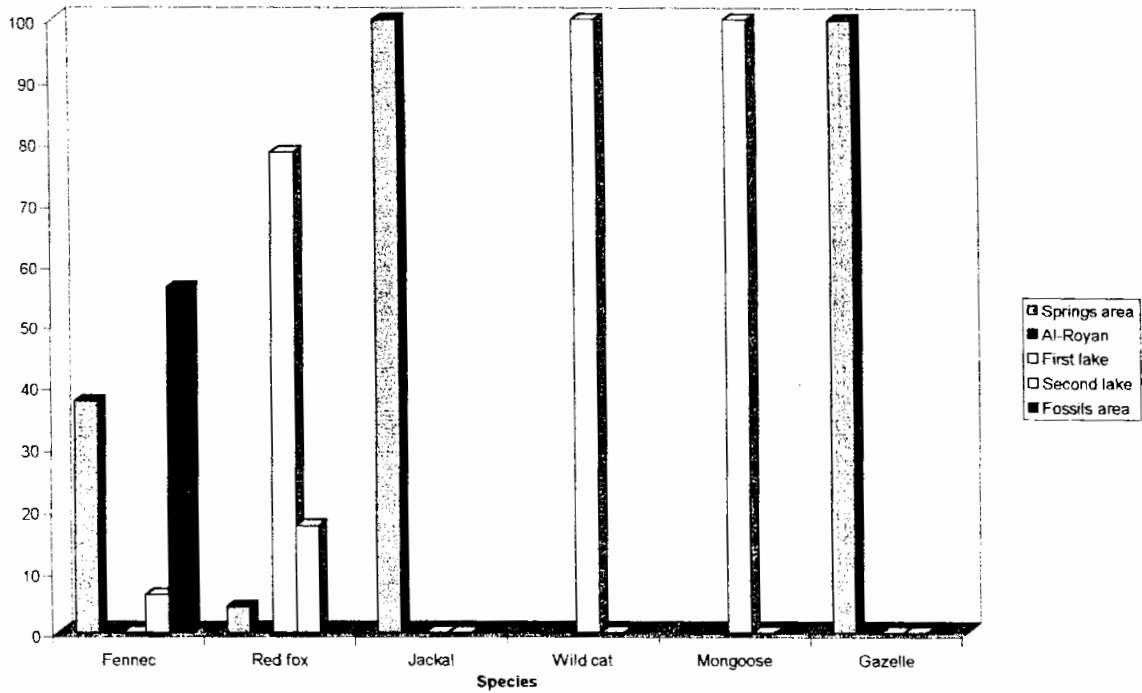


Figure (17): Distribution of Large Mammals species in Wadi El Rayan during Summer season 2001.

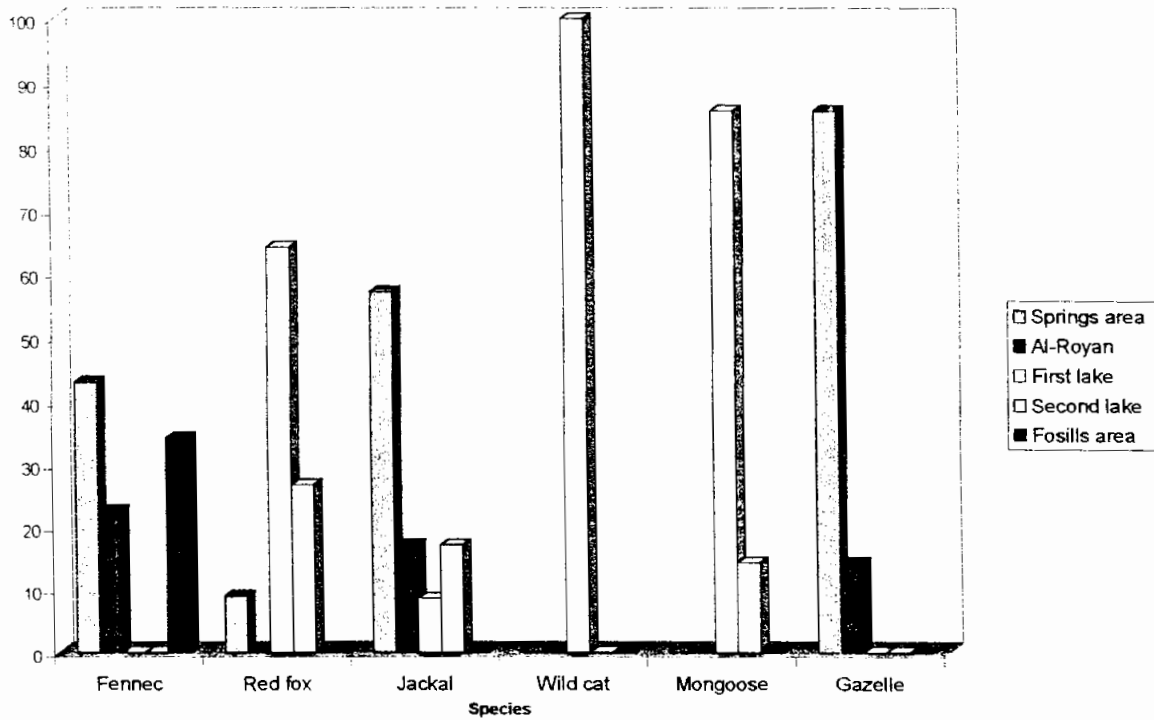




Figure (18): Distribution of Large Mammals species in Wadi El Rayan during Autumn season 2001.

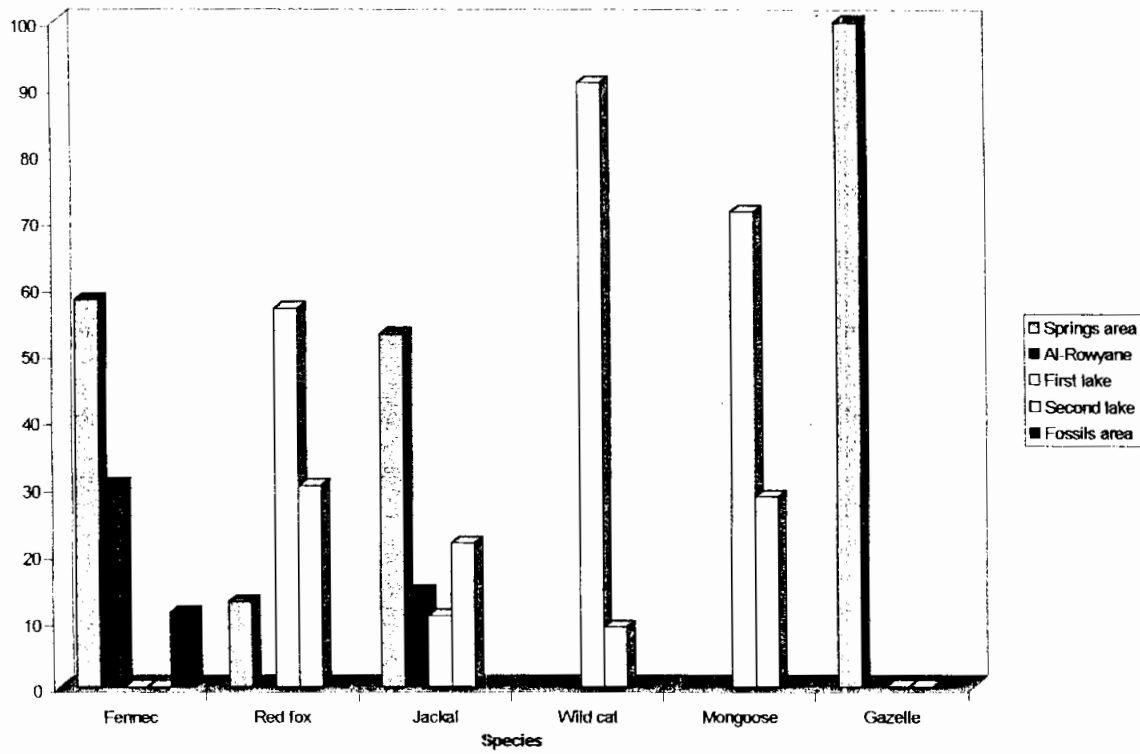
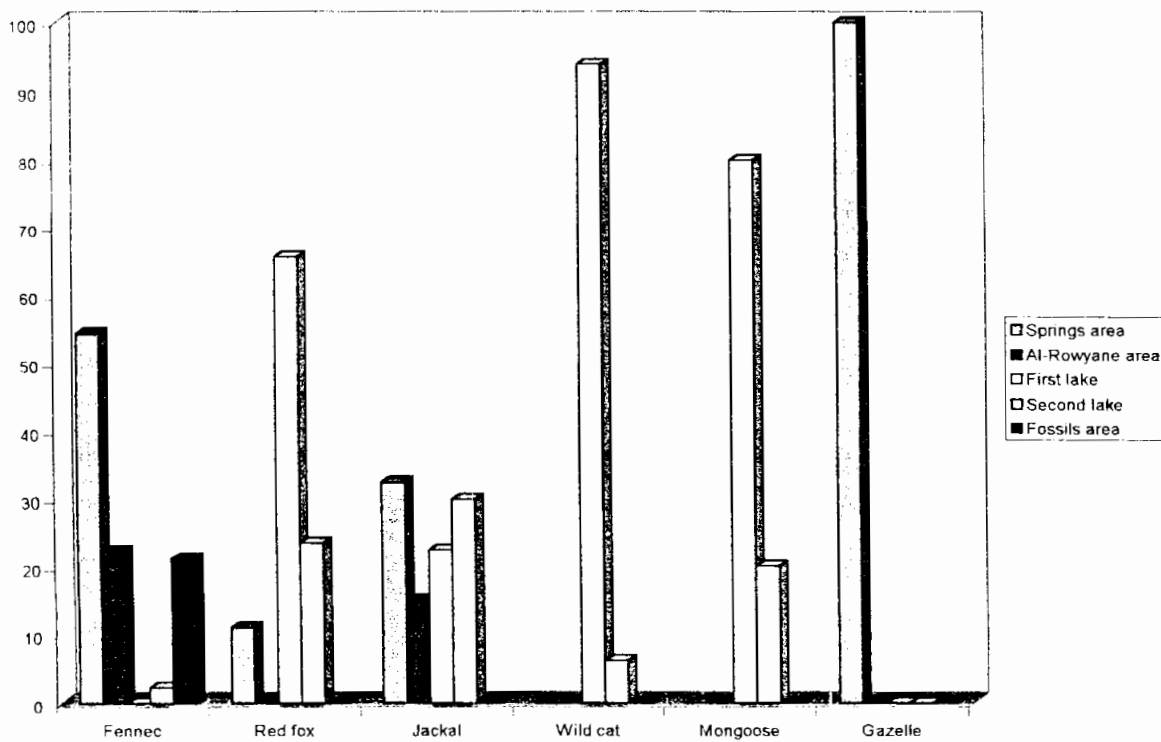


Figure (19) Distribution of Larger Mammals species in Wadi El-Rayan during Winter season 2001-2002.



B.3. CONCLUSION

- ◆ The fennec fox is the most adapted animal to the real desert environment. The fennec fox was densely present in the fossil area during the spring season, while in the other seasons it was frequent in the spring area. In general this species was highly active during the winter season (breeding period).
- ◆ The fox sp. (Red and Ruppel), during the four seasons, were densely present around the first lake, and were highly active during the autumn season.
- ◆ The Golden Jackal has high record of activities during autumn, with a frequent record inside the spring area in all the seasons of the year.
- ◆ The presence of animal had found to increase while the period of closing the two lakes for fishing, due to the fewer disturbances coming from fishing activities.
- ◆ There was no record about the Slender Horned Gazelle in WRPA.
- ◆ The number of Dorcas gazelle individuals in WRPA is not more than six individuals. The highest activities for the dorcas gazelle were recorded during the summer season due to the food and water availability inside the spring area.
- ◆ Both Wild Cat and Mongoos are common around the lakes (especially the first lake).
- ◆ The most important season for the large mammals is the winter, and the important habitat for them is the spring area.

B.4. RECOMMINDATION

- ◆ The gazelle survey must be continued in order to monitor the effects of the hunting control and their territory protection on the population size.

- ◆ It is important to use other methods for large mammal monitoring (Camera trap to know exactly the condition of the gazelle individuals and to be sure about the presence of Slender Horned Gazelles).
- ◆ The regular collection of the track sizes should be used to distinguish the different individuals in order to assess the population composition and dynamic.
- ◆ Restricting the human access to the spring area and the southern part of the second lake.

PART IV

**4. RESOURCE &
ENVIRONMENTAL MONITORING**

4.1. GEOLOGY AND PALEONTOLOGY MONITORING

4.2. A. WATER QUALITY MONITORING

**4.2. B. WATER QUALITY AND FISH FARMS IN WADI
EL-RAYAN PROTECTED AREA**

**4.3. IMPACT MONITORING OF THE ECONOMIC
ACTIVITIES**

SITE INSPECTION: WASTE MONITORING:

4.4. VISITOR MONITORING

GEOLOGY AND PALEONTOLOGY MONITORING FOR WRPA

**MONITORING REPORT
(DECEMBER 2001)**

4. RESOURCE & ENVIRONMENTAL MONITORING

4.1. GEOLOGY AND PALEONTOLOGY MONITORING

By

Geologist Mohamed Sameh M. Anter
Senior of Geology and Paleontology Monitoring

4.1.1. INTRODUCTION

Fossil area (Wadi El-Hitan) is considered one of the most attractive zones in Wadi El-Rayan Protected Area. It is characterized by its magnificent Saharan scenes and considered as one of the most interesting paleontological sites not only in Egypt but probably also in the world.

The valley of Wadi El-Hitan is about 7 sq. Km and located 12 Km W.S.W of the Garet Gohannam formation. This area is characterized by the presence of interesting vertebrate fossils which are skeletons of whales date back to about 40 million years ago, scattered in Wadi El-Hitan and embedded in a thin layer of sand and parts of them are exposed to the surface.

Geology of Wadi El-Hitan

Wadi El-Hitan is about 12 km WSW of the hill Garet Gohannam, this valley was covered by Eocene sea for about 2 million years (39-41 million years ago). Isolated hills, hillocks of peculiar shape sculptured by the weathering action of the wind and rains also earth pillars are found in many places.

Three kinds of geological formations are exposed in the fossil area: -

1. The lowest (oldest) is the Gohannam formation dating back to about 40-41 million years ago. It consists of white marly limestone and gypseous clays. This formation yields many skeletons (*Basilosaurus isis*, *Zeuglodon osiris*), beside plenty of the micro foraminifers (*Nummulites frassi*, *Nummulites beaumensis*), and macro invertebrates (*Vusella crispata*, *Lucina fajumoni*).

2. Birket Qarun Formation that yields also remains of the Eocene whales skeletons. This formation consists of sandstone, clays and hard calcareous limestone which almost invariably weathered giving rise to peculiar shape of rock. This formation yields the gastropod (*Drepanocheilus wagihi*, *Nautilus*).

3. The highest (younger) is the Qasr El Sagha Formation of late Eocene age, it yields (*Turritella carinifera*, *Nicaioloph clot-beyi*, *Pycnodonte gigantea*, *Turritella pharaonica*, *Ostrea elegans*). This formation consists of limestone and this area shows a shallow marine environment that suggests different environment than in northern Fayoum depression where it shows fluvial marine environment.

4.1.2. MATERIALS AND METHODS

4.1.2.1. Photo monitoring

In order to protect this fossil site from the non-aware visitors and to control the fossil condition a photo- monitoring system has been established.

Each fossil sit has been mapped, photographed and numbered. The routine patrolling is realized by EEAA researchers in the fossil area twice per week (during the weekend, when normally the area is visited by the tourists), once per month the condition of each fossil site is verified through the comparison with the photo and once every three months to check the condition of each fossil sit to repair the broken parts of the skeletons.

The main features of the photo monitoring are the following:

Personnel: - 2 personnel, 1 community guard and 1 driver

Equipment: 4WD car, digital camera, GPS, data sheets, pencil, compass, the file of the fossil photos.

Frequency: once per month

4.1.2.2. Fossil sites repairing procedure

The procedure that has been used to repair the most interesting fossil sites is the following:

- Removing the sand from the fossils.
- Looking for the entire skeleton component.
- Cleaning the fossil constituents.
- Mending the broken parts of the skeleton.
- Painting the fossil component with a hardener substance (polyvinyl acetate).
- Arranging the different parts of the skeleton in the right position and detecting the missing ones.

Personnel: 1 EEAA researcher (geologist), 1 researcher trained on fossil repair methodology, 2 community guard

Equipment: 1 pale, 2 brushes, polyvinyl acetate, glue Vinavil

Frequency: every three months and when needed

4.1.3. RESULTS

4.1.3.1. Photo monitoring

35 fossils have been photographed and numbered. Every month the comparison between the photos and the sites has been made. Until now no damages have been discovered only small movements of the skeletons pieces.

4.1.3.2. Fossils sites description and repair.

A total of 25 fossils sites have been identified and described (El Bedewy, 2000). Cetaceans are the most dominant vertebrates in Wadi El-Hitan in addition to sharks (fossil shark teeth). Eocen whales were different from those of the modern groups and are placed in a separate suborder Archaeoceti. The body was

very long up to 21 meter long and apparently thinner than modern whales, the skull was long and the nostril was some way back.

The teeth are very interesting that they were of the normal mammalian number (44) and show some signs of the heterodont arrangement.

The most common mammal fossils skeletons found in the area is the *Basilosaurus isis*, mammal of 12-24 meters and more than 7 tons of weight common in Eocene oceans. Three skeletons of this species have been repaired. One fossil skeleton of *Zeuglodon osiris* has been transferred near the visitor center of WRPA. The protected area researchers have completed the restoration of site number 14 and added anew five pieces.

4.1.3.3. Description of the restored fossil sites

Three sites have been restored, and described as follows: (Beadnell, 1905; after El-Bedewy, 2000)

Site No. 8

Scientific name: *Basilosaurus isis*

The skeleton consists of cervical, thoracic and caudal vertebrae in a good state of preservation and 14 vertebrae displayed until now and attain a length of 9 meters.

Site No. 14

Scientific name: *Basilosaurus isis*

The skeleton consists of partial skull and cervical, thoracic and caudal vertebrae in a good state of preservation and 16 vertebrae displayed until now and attain a length of 10 meters.

Site No. 20

Scientific name: *Basilosaurus isis*

The skeleton consists of cervical, thoracic and caudal vertebrae in a good state of preservation and 10 vertebrae displayed until now and attain a length of 6.5 meters.

4.1.3.4. Vertebrate fossils

Table (11): Vertebrate fossils of Wadi El-Hitan (El Bedewy, 2000)

SPECIES	CLASS	FAMILY	GENUS	NAME AFTER
<i>Ancalocetus simonsi</i>	Mammalia	Basilosauridae	<i>Dorudon osiris</i>	Gingrich, 1996
<i>Basilosaurus isis</i>	Mammalia	Basilosauridae	<i>Basilosaurus</i>	Cope, 1868
<i>Zeuglodon osieis</i>	Mammalia	Basilosauridae	<i>Dorudon osiris</i>	Dames, 1894

4.1.3.5. Shark teeth:

Table (12): Shark teeth (El Bedewy, 2000)

SPECIMEN	CLASS	FAMILY	GENUS	NAME AFTER
Shark teeth	Elasmobranchii	Mitsukurinidae	Scapanorhynchus	Woodard, 1889

4.1.3.6. Mangrove

Another kinds of fossils have been found in Wadi El Hitan that fossilized plant, its Mangrove (*Rhizophora*, *Sonneratia*).

Mangrove communities can be traced back to Early Tertiary, 55 million years ago, largely by means of palynology. There is a gradual expansion in the diversity and association of mangrove genera from Earliest Eocene time. Pollen grains from the black mangrove genera, *Nypa* and *Browlowia* occur together in the Lower Eocene of Borneo. Mangroves appear in successive epochs include *Rhizophora* pollens in the Early Oligocene, *Sonneratia* pollens in the Early Miocene. Pollen assigned to *Rhizophora*, *Sonneratia* and *Nypa* had been described from the Middle Eocene.

4.1.3.7. Invertebrate fossils

The macroinvertebrate faunas are commonly found in three major rocks; shales, compact white limestone and sandy hard brown limestone.

The preservation mode of fossils is widely varied in these types of rocks. In most cases the specimen occurs as mold obscuring their internal structure, in most cases their external features. The following table summarizes the invertebrate species of fossils that have been identified.

Table (13): Invertebrate fossils of Wadi El-Hitan (El Bedewy, 2000)

SPECIES	CLASS	FAMILY	GENUS	NAME AFTER
<i>Cardita viquesneli</i>	Bivalvia	Carditidae	Cardita	Oppenheim, 1903
<i>Carolia placunoides</i>	Bivalvia	Anomiidae	Carolia	Cantraine, 1838
<i>Drepanocheilus wagihi</i>	Gastropoda	Aprrhaidae	Drepanocheilus	Abass, 1963
<i>Lucina fajumensis</i>	Bivalvia	Lucinidae	Lucina	Oppenheim, 1903
<i>Mesalia fasciata</i>	Gastropoda	Turritellidae	Mesalia	Lamarck, 1830
<i>Nautilus mokattamesis</i>	Cephaloposda	Nautiloidea	Nautilus	Food, 1787
<i>Nicaisoloph clot-beyi</i>	Bivalvia	Ostreidae	Nicaisoloph	Bellardi, 1854
<i>Ostrea elegans</i>	Bivalvia	Ostreidae	Ostrea	Linne, 1758
<i>Pycnodonte gigantea</i>	Bivalvia	Gryphaeidae	Pycnodonte	Solnder, 1766
<i>Turritella carinifera</i>	Gastropoda	Turritellidae	Turritella	Cossmann, 1901
<i>Turritella pharaonica</i>	Gastropoda	Turritellidae	Turritella	Deshayes, 1824
<i>Vulsella crispata</i>	Bivalvia	Carditidae	Vulsella	Fisher, 1870

4.1.4. RECOMMENDATIONS

In order to improve the monitoring program the following actions should be taken:

- ◆ Studying fossil content (vertebrate, macroinvertebrate, and microfossil).
- ◆ Studying the paleoenvironment of the area in details.
- ◆ Establishing an out post in a strategic location.
- ◆ Establishing an open-air museum.
- ◆ Geomorphological and drainage maps with suitable scale.

WATER QUALITY MONITORING & FISH FARMS IN WRPA

MONITORING REPORT

WINTER 2001

KEY OF ABBREVIATIONS

BOD₅	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
OECD	Organisation de Cooperation et de Developpment Economiques, France
TSS	Total Suspended Solids
TDS	Total dissolved Salts
T-P	Total Phosphorus
TN	Total Nitrogen
WRPA	Wadi El-Rayan Protected Area

4.2. A. WATER QUALITY MONITORING FOR WADI EL-RAYAN PROTECTED AREA

By

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A.1. INTRODUCTION

Wadi El-Rayan is a depression located southwest Cairo, western desert, Egypt. In 1973, this depression has started to receive by a tunnel the excess agricultural drainage water from Fayoum Governorate. This depression acts as a reservoir of the drainage water. As there is a difference in the elevation through this depression, the received water from the tunnel creates a good system of running water in the upper Rayan Lake until reaching the big reservoir (lower Rayan Lake). A good vegetation cover along the shores of the lakes has been created in a naturally balanced ecosystem allowing to:

1. Purification of the water in the lakes to a satisfactory level, to be added to the self purification capacity of the running water, and
2. Creation of one of the most important wetland ecosystems in Egypt, with national and international importance for resident and migratory birds (144 bird species).

The program of water quality monitoring enables WRPA staff to stand on the quality of the water in the two Rayan lakes and their junction canal. The parameters analyzed and the frequency of the sample collection follow the guidelines given by the IUCN water quality experts mission (IUCN, 1999b)

The closed lower Rayan Lake receives the entire pollution load coming from different sources:

1. The upper Rayan Lake and the junction canal, (2300 feddans of authorized fish farms, from which 1000 feddans are actually acting and producing),

2. The inorganic load coming from the fertilization residues of agriculture activities, and
3. The pollution load of the lower lake itself, which comes from the fish cages and traditional fishing activities.

A.2. CLIMATE

The climate is typically Saharan, hot and dry with scanty winter rain and bright sunshine throughout the year. The area is hyper-arid with mild winters and hot summers (Zahran, 1989). The annual average of the precipitation rate is 10.1 mm. The highest rainfall occurs in December (40 % of annual rain) and the lowest (0%) in August. The average ambient relative humidity is 51%. The direction of the wind is, for most of the year, from the North, varying North-West or North-East. After Saleh *et al*, (1988). (see the next table)

Table: Summary of the monthly means of 50 years of temperature records (Saleh, 1988)

TEMPERATURE VALUES	WINTER	SUMMER
Mean	13.7°C	28.5°C
Absolute minimum/maximum	-1.2°C	48.8°C
Mean amplitude of diurnal fluctuations	14.2°C	17°C

A.3. MATERIALS AND METHODS

Materials

- Motor boat
- 4WD car
- Plastic bottles
- Ice box
- Field sheet
- Marker pen
- EEAA central laboratory for sample analyses

Methods

Each of the 2 lakes and the junction canal has 1 permanent station from which the samples were collected. Those permanent stations are one in the 1st lake (near the tunnel), one in the 2nd lake (near the fish cages) and one in the junction canal (after the output of the fish farm). One station was added to record the quality of the original wastewater income to Rayan lakes. This new station was fixed at the 1st point receiving the water (end of the tunnel, which representing the start point of the upper lake). The 4 stations could be increased for each lake and the canal, and the mean values of the results recorded. WRPA staff collected subsurface grab water samples, once for each season from these 4 stations (December, March, June, and September). Collected water samples immediately transferred to the EEAA laboratory in Cairo to be analyzed. (See table 14)

Table (14): The tested water quality parameters

PARAMETER	SYMBOL	UNIT OF MEASURE
Hydrogen ion conc.	pH	Units
Biological oxygen demand	BOD ₅	Mg/L
Chemical oxygen demand	COD	Mg/L
Total suspended solids	TSS	Mg/L
Total dissolved salts	TDS	Mg/L
Ammonia	NH ₄ ⁺	Mg/L
Nitrites	NO ₂	Mg/L
Nitrates	NO ₃ ⁻	Mg/L
Phosphates	PO ₄ ⁻	Mg/L
Total nitrogen	TN	Mg/L
Total phosphorus	TP	Mg/L
Lead	Pb	Mg/L
Mercury	Hg	Mg/L
Cadmium	Cd	Mg/L
Manganese	Mn	Mg/L
Arsenic	Zn	Mg/L
Ferrous	Fe	Mg/L
Copper	Cu	Mg/L
Mercury	Hg	Mg/L
Magnesium	Mg	Mg/L

A.4. RESULTS

3 groups of results were obtained for the 2 Rayan lakes and their junction canal as shown in the table (15) that showed the physico-chemical parameters. These groups were completely analyzed in the central Laboratory of the Egyptian Environmental Affairs Agency (EEAA). Metals were twice analyzed at 9/9/2000 and 11/12/2001 as shown in table (16).

Table (15): Physico-chemical parameters of water samples for Rayan lakes

Date	Stations	pH	TDS	TSS	BOD	COD	TP	TN	NH ₄	NO ₃	NO ₂	Po ₄
13/10/99	Upper Lake	6.4	1218	-	15	30	-	-	-	-	-	-
	Junction Canal	7.8	1420	-	30	46	-	-	-	-	-	-
	Lower Lake	8.5	4936	-	31	55	-	-	-	-	-	-
9/9/00	Upper Lake	-	1509	11.3	-	-	0.34	1.2	-	-	-	-
	Junction Canal	-	1552	11.3	-	-	0.26	1.24	-	-	-	-
	Lower Lake	-	5632	8.7	-	-	0.28	1.3	-	-	-	-
11/12/01	Tunnel	8.0	769	114	1.2	5.3	1.72	1.454	0.044	1.05	N.D.	0.14
	Upper Lake	8.5	1618	3	5.2	15.8	0.11	1.817	0.007	1.31	N.D.	0.03
	Junction Canal	8.0	1597	6	4.5	14.1	0.37	2.91	N.D.	1.51	N.D.	0.05
	Lower Lake	8.0	6264	39	6.5	21.1	0.61	1.38	N.D.	1.1	N.D.	0.06

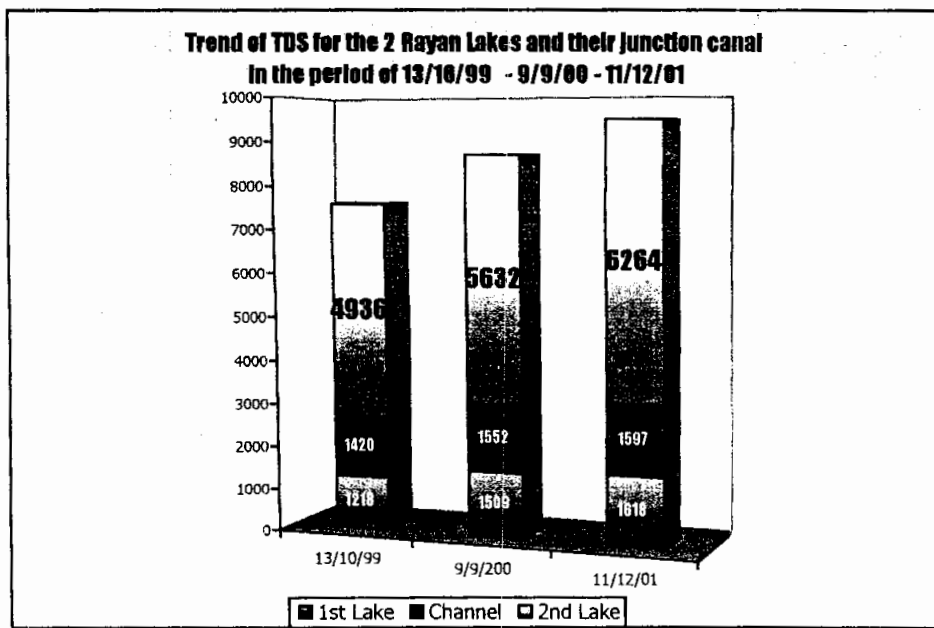
Table (16): Metal analyses of water samples for Rayan lakes

Date	Stations	Mn	Cr	Cu	Fe	Cd	Pb	Zn	Hg	Mg
9/9/00	Upper Lake	0.0022	N.D.	N.D.	0.04	N.D.	0.01	0.017	-	-
	Junction Canal	N.D.	N.D.	N.D.	0.206	N.D.	N.D.	0.019	-	-
	Lower Lake	N.D.	N.D.	N.D.	0.07	N.D.	N.D.	0.02	-	-
11/12/01	Tunnel	-	-	0.008	2.268	0.002	N.D.	0.034	N.D.	36.4
	Upper Lake	-	-	0.004	0.214	N.D.	N.D.	0.016	N.D.	341.6
	Junction Canal	-	-	0.003	0.255	0.002	N.D.	0.021	N.D.	286.0
	Lower Lake	-	-	0.005	0.257	0.002	N.D.	0.020	N.D.	270.0

The water quality of the 1st lake depends mainly on the quality of the received agricultural wastewater from the origin of the main drain. The water quality in this case will depend mainly on the composition of cultivated agricultural crops and their fertilization behavior. Winter crops differ mainly from the summer ones. Figure (1) shows the trend of Rayan Upper and Lower lakes with their junction canal towards the TDS concentrations (Total Dissolved Salts) along the period

from 9/9/2000 to 11/12/2001. The junction canal is doing the main role of the natural purification of the water of the upper Lake. The lower lake doesn't follow a clear trend for the different parameters except the TDS (salinity), see figure (20). The reason is that the lower lake acts as a reservoir receiving the entire chemical constitutes of the water. So the trend will be clearer on the long term.

Figure (20): The trend of TDS for the two Rayan Lakes and their junction canal (13/10/99 to 11/12/01)



◆ **TDS**

The most noticeable effect is the increase of the TDS, which represents the summation of all dissolved elements in the water. The increase is clearer in the lower Rayan Lake, which is of closed nature. The increase of TDS (as a representative of the salinity level) reached 10.1% from the period of 9/9/2000 (5632 mg/l) to 11/12/2001 (6264 mg/l).

◆ **TSS, BOD₅ & COD**

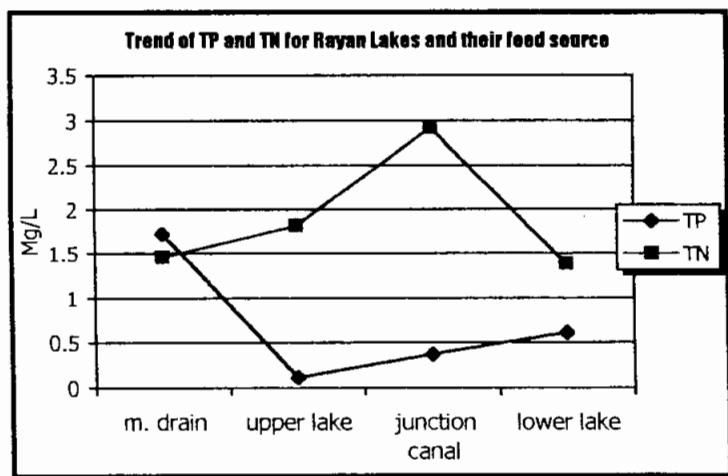
The values of these parameters usually show fluctuations according to the nature of the received water from the original drain. For the most recent sampling time, the wind velocity was high enough to make disturbance for these values.

◆ **TP & TN**

These values of total phosphorus and total nitrogen show important and significant trends. It was found that:

- **For the total phosphorus**, the water income carries 1.72 mg/l from the main drain, which then distributed over the entire area of the upper lake to reach 0.11 mg/l. The value showed an increase at the junction canal, after the discharge of the intensive fish farm to reach 0.37 mg/l. The lower lake showed another increase because of its closed receiving nature (0.61 mg/l), figure (2).
- **For the total nitrogen**, (sum. of nitrate-nitrogen, nitrite-nitrogen, ammonia-nitrogen and organic nitrogen), the water income carries 1.454 mg/l from the main drain. That load of nitrogen had been distributed over the entire area of the upper lake to reach 1.817 mg/l (windy day that increases the turbulence of the lake). The value showed a significant increase at the junction canal, after the discharge of the intensive fish farm to reach 2.91 mg/l. The lower lake showed another increase reached (1.38 mg/l), see figure (21).

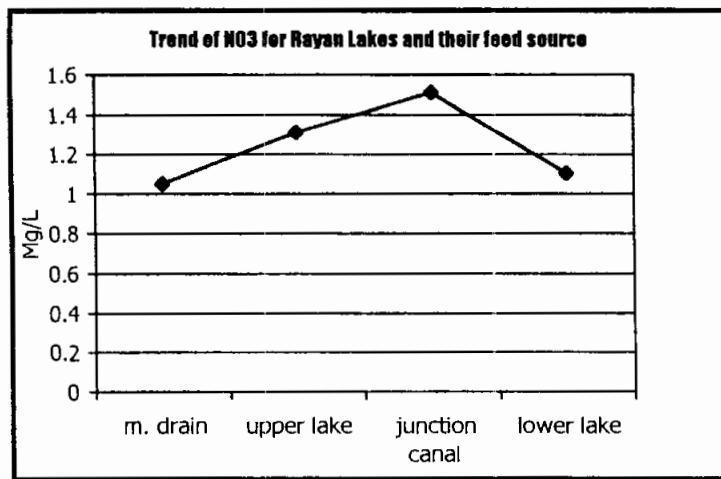
Figure (21): Trends of total phosphorus (TP) and total nitrogen (TN) for Rayan lakes and their water feed source.



◆ **No3-N**

Nitrate concentration showed an increase in its level concerning the upper lake, followed by another increase concerning the junction canal, see figure (22). The increase in the level of nitrate concentration after the discharge of the intensive fish farm is attributed to the reduced farming activities in this cold season (Fish dormancy period). The intensity of farming activities will increase starting from April-May for each year.

Figure (22): Trend of nitrate-nitrogen concentration for Rayan lakes and their water feed source.



◆ **Metals**

Non significant increase for the values of metals copper, iron, cadmium, and zinc. Mercury and lead were absolutely not detected.

A.5. CONCLUSION

The conservation of Rayan lakes ecosystem is very important to keep the integrity of the lakes themselves in addition to other systems linked to the lakes.

The quality of the water in Rayan Lakes is dependent mainly on the receiving feed from the main drain. The source feed depends on the nature of seasonal crops and their fertilization behavior.

There is a decreasing in the water level of Rayan lakes. The decrease in the water level is attributed to: 1) establishing of new two pump stations that operating to pump $4\text{m}^3/\text{sec}$ from the main drain feeding Rayan lakes and 2) increasing the demands of irrigation water for the new land reclamation areas.

The status of the upper Rayan Lake could be Oligotrophic to mesotrophic, but not highly trophic. BOD_5 and COD values for the lake indicating a good self-purification capacity due to the good water mobility through the lake towards the junction canal.

The lower Rayan Lake shows continuous increase in its salinity level with 12.4% for the year 1999/2000 and with 10.1% for the year 2000/2001.

The well developed submerged hydrophyte plant communities in the lower lake indicating a good light ratio penetrating the water of the lake. Light penetration means a high level of water transparency, which could be attributed to some factors. The first acting factor is the limited water currents in the lower lake. The second one is the satisfactory level of water purification a role done by the junction canal through high water current speed and wetland vegetation communities along the banks of the canal. The vegetation community plays a good role of nitrogen and phosphorus removal through the physical and absorption factors played by the roots of natural wetland vegetation community. The high water current speed in the junction canal between the two Rayan lakes plays an important role in reducing BOD_5 value of the water, improving the water quality.

Natural wetland vegetation communities surrounding both of the lakes and their junction canal are exposed now to reduction in their sizes by the continuous reduction of water level in the lakes. The reduction of wetland size could have some adverse effects. These effects can include the following:

1. The water quality of the lower lake
2. The bird community which can find their shelter, nursery and nests in these wetland communities.
3. The fish communities that can also find their source of food and shelter among the enormous area of plant roots and submerged plant communities.

4.2. B. WATER QUALITY AND FISH FARMS IN WADI EL-RAYAN PROTECTED AREA

By

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M.Sc. Plant Ecology - Fresh Water Ecology

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B.1. INTRODUCTION

In the seventies two lakes were created in the lower portion of Wadi El Rayan sub-depression to channel out excess agricultural drainage water in order to slow-down the increase of the water-table in Fayoum main depression and in the Qarun lake. The creation of a large body of water in this hyper-arid area had a striking ecological impact: new species of plants, mammals, birds and invertebrates moved to Wadi El Rayan area (Saleh, 1998).

Although aquacultures represent an ancient practice, they have a weak scientific basis. Aquaculture technologies do not take in consideration the impacts on the whole aquatic and associated systems (especially in a protected area). In Europe, a number of studies have been carried out in order to determine the source and nature of effluents discharged from fish farms and their fate in the receiving water bodies. The kinds and nature of these effluents can be simplified as follows:

1. Effluent water with a high load of fecal matter and waste food.
2. Effluent water loaded with the chemical compounds such as antibiotics and fungicides.
3. Alteration of the lake due to biological deposits above the bed on the hydrodynamic features of the locality (sedimentation and obstruction of coastal flows).
4. Unfavorable environmental conditions due to erroneous choices in the location of aquaculture activities (i.e. insufficient water exchange or lack in the water column depth.).

The waste entering the receiving lake's water from these fish farms consist of solid or soluble wastes. Solid waste products may occur in a suspended form or may accumulate on the sediment, and consist mainly of organic carbon and nitrogen compounds. The soluble wastes are generally derived from 1) the metabolic products of the culture stock, or 2) the solid wastes through decomposition and leaching. The Biochemical Oxygen Demand (BOD₅) of waste material, which is a measure of oxygen required by microorganisms to decompose organic matter, is a valuable parameter to evaluate the extent of pollutant wastes, (IUCN, 1999b).

The impact on the environment is more direct in cage cultures and is more pronounced when large numbers are concentrated in protected areas with an insufficient water exchange. The environmental impact of cage farming has been a subject of scientific attention in recent years, especially in Northern European countries where cage farming of salmonids has become the major industry. (IUCN, 1999b)

B.1.1. Fish farms in WRPA

2300 feddans (966 ha) of fish farms had been authorized by EEAA and given operational licenses from the ministry of agriculture since 1995 and 1996. 1000 feddans (420 ha) of which are representing an acting intensive fish farm and 1300 feddans (546 ha) are representing an under construction extensive one.

B.1.1.1 Intensive Fish Farm

The Fish Farm operating in WRPA at the beginning of the junction canal between the two lakes (position: 30.45°N, 29.2336°W) is a private project founded by the EU. On 1995 this aquaculture project submitted to EEAA the EIA for an extensive fish farm (Grey List in EEAA guidelines) and in March 1995 the EEAA issued the license for 1000 fedans (420 ha) of intensive aquaculture for 25 years. This licence had originally been granted for extensive fish farming (ponds with 1

fish/m³ of water) and was subsequently converted to intensive fish farming (100 fish/m³ of water). The Ministry of Agriculture, Department of Fisheries has released an Operative License.

At the present time the fish farm is operating in a surface of 42 ha with 90 ponds (on 120 foreseen), pumping 1.8 m³/sec. of water from the Upper lake, producing 5 ton of fish per pond two time per year and discharging water in the junction canal. The breaded species are *Tilapia nilotica* (prevalently) and mullet and the declared profit is 800 000 LE per year. 25 people are the permanent staff in the Fish Farm.

B.1.1.2. Extensive fish farm

In March 1996, EEAA licensed for 25 years the Cooperative for Aquaculture in Fayoum to establish a 546 ha (1300 feddan) extensive aquaculture in WRPA. The chairman of the Cooperative submitted to EEAA the EIA. The Ministry of Agriculture, Department of Fisheries has released an Operative License. The exact location of the fish farm was specified neither in the license nor in the EIA, if not with the generic expression "in the East and West Side of the channel between the two lakes". The aquaculture project foreseen the building of 200 ponds, for the realization of 100 farms, each one composed by 1 nursery and 2 ponds. The water input from the Upper Lake will be of 2 m³/sec and the permanent personnel will be 100 farmers. The breaded species will be *Tilapia nilotica* (with a density of 1 fish/m³) and the estimated productivity is 800 ton/year.

B.1.2. Environmental impact of the fish farms

The major impact of the fish farm is related to water consumption and wastewater outputs (IUCN, 1998). Regarding the pollution risk, there are some risk of de-oxygenation and toxicity for the use of hormones and chemicals (formaline, malaquite green and potassium permanganate added only if necessary

and in very small concentration). The main problem could be related to the ammonium and nutrients (phosphorus and nitrogen) concentrations. Even if the Lower Lake appears to be mesotrophic, the experts consider that the phosphorus generated by the fish farm will double the rate of enrichment of this element in the lake.

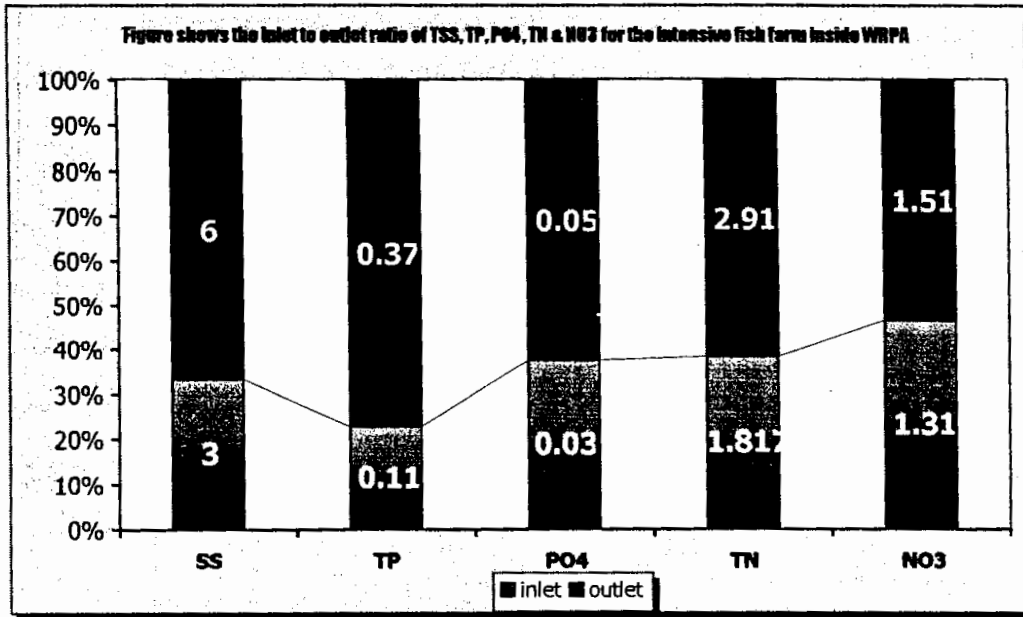
B.2. MONITORING DATA AND RESULTS

The most recent analyses done by Wadi El-Rayan protected area staff, in collaboration with the EEAA central laboratory, (as a part of the continuous seasonal monitoring program for water quality monitoring). The date of analyses was 11/12/2001 and introduced the following results: 1) the inlet to the intensive fish farm, and 2) the outlet of the water and wastewater of the farm. The outlet was taken after 100 m of the point of discharging to the junction canal. Table (17) shows the results of the analyses:

Table (17): The results of the analyses of water samples taken from the inlet and outlet of the intensive fish farm

Parameters	Inlet	Outlet
PH	8.5	8.0
PO ₄ (Mg/L)	0.03	0.05
Total Phosphorus (Mg/L)	0.11	0.37
Nitrates (Mg/L)	1.31	1.51
Total Nitrogen (Mg/L)	1.817	2.91
TDS (Mg/L)	1618	1597
Suspended Solids (Mg/L)	3.0	6.0

Figure (23): The inlet to outlet ratio of the concentrations of TSS, TP, PO₄ & NO₃ for the intensive fish farm inside WRPA



In relation to the present trophic status in the lakes and considering the most recent concentration values of nitrates, the limiting element would appear to be nitrogen. The most recent data on WRPA lower Rayan lake reveal that the primary production of the lake is probably nitrogen dependent, since the nitrogen/phosphorus ratio is almost 0.44. The literature (Mason, 1981; Ambrosetti *et al.*, 1992; Marchetti, 1993) (after IUCN, 2001a) show that eutrophication in lakes is nitrogen dependent only when the nitrogen/ phosphorus ratio is below 10, signifying that an increase in the nitrogen level could cause eutrophic conditions. (IUCN, 1999b).

The data showing that:

1. There is an increase in the level of the total suspended solids concentration for the outlet than the inlet by a ratio of more than 65% (Figure 23)
2. There is an increase in the level of the total phosphorus concentration for the outlet than the inlet by a ratio of more than 75% (Figure 23)

3. There is an increase in the level of the ortho-phosphorus concentration for the outlet than the inlet by a ratio of more than 60% (Figure 23)
4. There is an increase in the level of the total nitrogen content for the outlet than the inlet by a ratio of more than 60% (Figure 23)
5. There is an increase in the level of nitrate concentration for the outlet than the inlet by a ratio of more than 55% (Figure 23)

These results are revealing a significant increase in the previous parameters. The increase is not high, for the reason of the dormant season. Fish farming activities (including fish food supply) are at their minimum. But even at this point the intensive aquaculture still discharging significant concentrations of different parameters that enhancing the change of the trophic state of the water of the Lower Rayan Lake.

The concentration of phosphorus is fairly high in both lakes, compared with the OECD (Organisation de Cooperation et de Developpment Economiques, France) criteria for eutrophication (IUCN, 1998) and with Saleh *et al.*, research figures (1988, 1998). From among all the different factors influencing the productivity of a specific water body, it seems that the increase in the salinity level may represent the most effective limiting factor. (IUCN, 1999b).

- The monitoring report for the quality of water in Rayan Lakes showed continuous increase in the TDS (in turn the salinity) of the lower lake in addition to accumulating of different fractions of phosphorus and nitrogen (the significant elements causing eutrophication). This will affect, dramatically, the lake by the factors of:
 1. Encouraging the growth of toxic algae which are limiting to the economic fish production (as occurred before in the upper lake and recorded by the National Institution of Oceanography and Fisheries – Rayan research branch unit, intensive growth of *Microcystis sp.*).

2. The eutrophic water supports the dense algal growth creating a turbidity of the water that resulting in declining the growth of the submerged hydrophytes as *Myriophyllum spicatum* and *Potamogeton pectinatus*, which depend mainly on the light penetration to the water layers (El-Hennawy, 2000). The submerged hydrophytes represent the main shelter for the fish reproduction (with the roots of the emergent hydrophytes).
3. The eutrophication problem of rayan Lakes could be the 1st enemy for the sustainability of the lakes. The development of all the area is mainly dependent on the presence of this clean aquatic ecosystem (Ecotourism activities, bird watching, traditional fishing dependent people, etc...).

In addition to the previous factors, the evaporation represents the major one affecting the increasing of the salinity of the lower lake. The culture basins of the existing intensive fish farm, and the under-construction extensive one contribute the loss of the water through the evaporation factor, in addition to the direct evaporation from the entire surface of the lower lake itself. The use of the water of the upper lake (fish farms + irrigation of more than 4000 feddans of the land reclamation project) in addition to the evaporation factors is leading now to the concentration of the elements and nutrients in the Lower lake raising its salinity level.

B.3. RECOMMENDATION

- ◆ We strongly recommend stopping any authorization for any new fish farming (either normal aquaculture basins or fish cages) in order to stop the negative impact on the two Rayan lakes. The National Institute of Oceanography and Fisheries, represented in its research unit in Rayan, strongly recommend stopping of any new fish farms and cages after their long studies on the biological assessment of water quality in Rayan.

- ◆ We also strongly recommend for the EEAA to oblige the two existing fish farms (the acting intensive one and the under-construction extensive one) to create artificial wetlands for the natural treatment of their wastewater.
- ◆ In order to reduce the impact of the fish farm on the quality of the water of the lakes, Conte and Picci (IUCN, 1998) suggested that the more effective solution is the constructed wetlands system. According to that, the PMU organized the mission of two experts of constructed wetland that assessed the feasibility of the using the constructed wetland system to the treatment of the fish farm wastewater (IUCN, 1999b). Using as a test the small artificial wetland were 30 ponds of the fish farm are already discharging the wastewater, the experts collected some samples of water on the inlet and on the outlet of the wetland. The results of the analysis reveals very good nitrate removal (98.4%) by means of microbiological action and plants uptake, the removal of 26.7% of total phosphorus due to the processes of sedimentation and a 5.1% removal of soluble phosphates. The expert's conclusion is that the construction of a wetland of approximately 55 ha will be the best solution in order to reduce the impact of the wastewater of the fish farm on the lower lake.
- ◆ Following the recommendations of the experts, on September 1999 an official letter was addressed to the owners of the fish farm by PMU and EEAA asking the realization of the constructed wetland and the submission of a new EIA, specific for intensive fish farm and following the EEAA guidelines.
- ◆ As a result of the reuse of the agricultural drainage water for irrigation purposes, the receiving water quantity by the two Rayan lakes started to decrease. This will increase the impact on the ecosystem of the lakes. The recommendation in this case is a trial to keep the integrity of the ecosystem in Wadi El-Rayan.

**IMPACT MONITORING
FOR ECONOMIC
ACTIVITIES
SITE INSPECTION:
WASTE MONITORING**

MONITORING REPORT

2001

4.3. IMPACT MONITORING OF THE ECONOMIC ACTIVITIES SITE INSPECTION: WASTE MONITORING:

By

Abdel Naser Yasen

Senior of Legal Affairs & Law Enforcement

4.3.1. INTRODUCTION

According to the important presence of economic activities inside its boundaries, WRPA can be considered a Managed Resource Protected Area (IUCN Type VI category; IUCN, 1998). For this reason, a crucial point of the monitoring program is to monitor the human activities in order to ensure compliance with regulations stipulated in existing licenses and to reduce their impact on the environment. Table (18) summarises the human activities existing inside WRPA.

Table (18): The main characteristic of the human activities inside WRPA

TYPE OF ACTIVITY	EXTENSION (HECTARES)	NUMBER OF PEOPLE	ENVIRONMENTAL IMPACT LEVEL (EEAA LISTS)
Oil Extraction	50	23	Black list
Salt Extraction	Negligible	50 approx.	White List
Ice Factory	Negligible	1	
Eco-tourist Services	16.94	11 operators and approx. 150 000 tourists	Black List
Land Reclamation	2600	10 000	Black List
Traditional Fishing	11434 (lakes and chanel)	1777	
Intensive Fish Farm	42	25	Grey List
Extensive Fish Farm	546	1 (construction phase)	Grey List
Fish Cages	Negligible	12	Grey List
WRPA Headquarters	Negligible	22	White List
Coptic Monastery	8	6	White List

4.3.2. MATERIALS AND METHODS

PERSONNEL	EQUIPMENT	FREQUENCY	OBJECT
2 Ranger	Data Sheet	Every 3 months	Control of landscape pollution

WRPA staff always go to the **Human Activity Site** and asking the people there (whatever owners or workers) about the waste treatment system which they follow. All the data were recorded in the specific data sheet, then inspecting the site to make a comparison between what the people said and the fact. The specific data sheet includes the following:

Data sheet form.

Date	Type of activity	Collection (Y/N)	Treatment	Frequencies of treatment	Recycling	Landscape pollution	Comments

4.3.3. RESULTS

4.3.3.1. Oil Extraction

They collect the garbage in plastic bags and transfere it to the waste disposal (we saw the plastic bags contained the garbage).

After any digging processes, the oil company cleans the location and transfere the solid garbage to the waste disposal site outside the protected area. They also remove the oil which might be spelled by vaccum pumb under WRPA regulations.

Sewage treatment: They have solid septic tank discharged weekly.

The degree of landscape pollution (¹) in the Oil Company is 3.

Degree Of Landscape Pollution: 1= High density of rubbish ,2= Medium Density of rubbish , 3= Low density of rubbish , 4= Absence of rubbish

4.3.3.2. Land Reclamation (LR)

The population of The Land Reclamation village is low because their field's soil is bad as land reclamation, so that it needs a lot of money to improve its quality.

In contrary they are very poor and a lot of those people deserted their houses and fields because of this. So the inhabitants in the LR is not more than 500 family not as the charge in the LR told us they are 10 000family.

IN the LR site little quantity of garbage strewn on the sides of the road although the people used to burn their garbage. If the population started to increase it will be a problem for the protected area, so WRPA staff is usually trying to support the land reclamation community by raising their awareness level as a part of public awareness program of WRPA.

IT is not clear if the ADMINISTRATION UNIT of the LR will have a waste treatment facility in the future or not.

Swages treatment: They have a septic tanks closed to each house but it never be full or discharged untill now.

Till now The Degree of Landscape Pollution is 2.

4.3.3.3. Intensive Fish Farm

According to the information that the charge in the fish farm told us they collect daily the garbage and transferred it in the waste disposal, but we saw some garbage in the site (plastics & bottles) especially around their junior compound.

Swages treatment: They have a septic tanks in the site but its in a bad condition and it has a lot of cracks.

WRPA notified them to take a serious procedure towards it.

The degree of landscape pollution is 2.

ACTION:

WRPA submitted a report to the EEAA about the violation of the fish farm

THE Nature Conservation Sector (NCS) chief held many meetings with the owner who undertakes to avoid that matter. Also, PAMU held many meetings with the site manger of the fish farm who carried out our instructions.

4.3.3.4. Fish Cages

Three sites for the fish cages are located in the 2nd lake of WRPA.

- ◆ The 1st site consists of 8 cages (which still under the liscened number which is 50 cages). Garbege were continuously collected and transferred outside the protected area.
- ◆ The 2nd site consists of 4 cages (which also still under the liscened number). Garbege collection follows the same system as mentioned above).
- ◆ The 3rd site consists of 5 cages (also still under the liscened number), with the same system of garbage collection.

Sewage treatment: The three sites are empty from the septic tanks

The degree of landscape pollution is 1.

ACTION:

The fish cages must be transferred to the first lake of WR according to a meeting held between the minister of Agri. & minister of Env. On 28/4/99.

4.3.3.5. Pump Station

After the meeting that PAMU held with the site manger that site now is quite clean

Sewage treatment: There is a septic tank in the site, this tank never discharged, that the staff works only during the day and they leave afternoon and nobody stay permanently except some guards.

The degree of landscape pollution is 2.

4.3.3.6. Ice Factory

No body permanently stayed in ice factory site, only two workers come in the morning and leave afternoon. So the landscape pollution is minimized.

The degree of landscape pollution is 3.

4.3.3.7. Police Station

Garbage is collected in a plastic bags. Because of their depend on the preserved food, there garbage usually contains tins & cans.

Sewage treatment: There is a septic tank in the site that never discharged.

The degree of landscape pollution is 2.

ACTION:

WRPA provided them with plastic bags and arranged with them to collect their solid wastes and transferring it by the cars of the protected area to the waste disposal site outside the area.

4.3.3.8. Coptic Monastery

The monks collect their solid wastes and transferred it outside the protected area, and they have a compost facility.

Sewage treatment: They have septic tanks in the monastery that aren't solid.

The degree of landscape pollution is 3.

4.3.3.9. Cafeterias & Safari Camp

They collect their garbage periodically according to the visitors' number.

Sewage treatment: For the cafeterias, the workers and the visitors use the public W.C. in the visitor area.

For the safari camp, they have private W.C. with a septic tank that discharged periodically by an equipped truck to the nearest station designated for such a purpose.

The degree of landscape pollution is 3.

4.3.4. RECOMMENDATIONS

1- Periodical Meeting between WRPA staff and the human activities owners should be organized, so we can inform them by this way about our environmental viewpoints in the management of the area and to make the possible balance between the Environmental specifications and the economic requirements. Also it will be a good step for the public awareness.

2- Estimation legal committee from EEAA must be organized to visit the area periodically to be involved with the WRPA staff in the problems of the area. As well as, to help the WRPA to take deterrent procedures against violators and to support the WRPA in the judicial authorities to rush them up to carry out the penalties of the law against violators.

3- For the Oil extraction we must have a plan to face any potential disaster that could happen as a result of their activities. This plan must be prepared with coordination between EEAA, WRPA staff , and Qaruon Oil Company.

4- For the land reclamation, the environmental public awareness program should has more support to improve the behaviors of the people.

5- coordinate with administration unit of the land reclamation is a must to offer a waste treatment facility.

VISITOR MONITORING FOR WRPA

**MONITORING REPORT
(DECEMBER 2001)**

4.4. VISITOR MONITORING PUBLIC AWARENESS AND ENVIRONMENTAL EDUCATION

By

Arafa El Sayed

*Senior Coordinator of communication with local stakeholders
and public awareness program*

4.4.1. INTRODUCTION

4.4.1.1. Environmental Awareness

Definition

The standing on the sensitivity and the knowledge of environmental problem reasons and ways for their solution. From the other hand, necessity that the passion and the knowledge sides have to parallel and that the environmental awareness is the first step for the formation of the environmental directions, which control the individual attitude.

4.4.1.2. Environmental Education

Definition

Science of formation of traditions, skills necessary for understanding and estimation of the complex relationships that connect the human with his biophysical surrounding and that explain the necessity of environmental resources conservation. It also the necessity of well investment for the human, keeping his good life and raising his leaving levels.

Objectives

Awareness:

For helping of individuals and communities acquiring awareness and sensitivity towards the integrated environment and its connected problems.

Knowledge:

For helping of individuals and communities to have the basic understanding for the integrated environment and its connected problems and the responsibility of humanity and its role.

Behaviour:

The ways for helping individuals and communities to have the social tradition and strong feeling towards the environment and positive and effective sharing in its loyalty protection and improvement.

Skills

For helping of individuals and communities to have the skills for detecting the environmental problems and their solution.

Sharing

For helping of individuals and communities to develop feeling the responsibility and emergency that related to the environmental problems to be sure about the suitable way for the solution of these problems.

4.4.1.3. Visitor Monitoring

Regular visitor survey

According to IUCN classification of the protected areas, WRPA representing the 6th type as a multi used managed area. Tourism and recreation are of the main purposes of WRPA. Habitat diversity, unique geological features, rare ecosystems with their content of wild life and magnificent saharan senes and aquatic senes attracting many local and foreigner visitors. Simplified ecotourism facilities were established by private sector (simple ecolodge inside WRPA). Interesting camping sites, bird watching sites and some visitor facilities were provided by the protected area in collaboration with the Egyptian Italian project support to WRPA (1998-2001). The protected area staff, with IUCN technical assistance, developed a monitoring program for visitors in order to enhance the

capacity for ecotourism facilities supporting the ecotourism as a wise way for investing the nature. Assessing the impact of the visitors and tourism on the protected area is also one of the main aims of this monitoring program.

Inauguration of WRPA visitor center (June 2001) was one of the achievements of the Egyptian Italian Project that going to raise and support public environmental awareness program of the protected area.

4.4.2. MATERIAL AND METHODS

The EEAA annual tourist's statistics are extrapolate from the protected area entrance tickets. This count didn't take in consideration the big amount of tourists that are exempted to the ticket fees; Schools, Universities and groups of people invited by Fayoum Governorate or by EEAA.

From Feb 1999 the PAMU started a regular count of tourist visiting WRPA. Every month, during random working days and weekend, at the main gate of WRPA or at the asphalt road near the waterfall area, stopping the tourists and recording their number, age, nationality and main transportation to WRPA.

The mean of data recorded during different working days in one month is multiplied by the number of working days of the month. The same operation for the data collected during the weekends and during the national holidays. The next report introducing the most recent data collected during the period from September to January 2002.

Main characteristics of the PAMU tourist survey in WRPA.

PERSONNEL REQUIRED	EQUIPMENT	FREQUENCY	OBJECT
2 personnel	Pencil and data sheets	At least 4 days per month	Collection of vital statistic of WRPA tourists

4.4.3. RESULT

Tables 18, 19 show the percentage of different categories of the visitors coming to WRPA and their age composition for the period from August to December 2001.

Table (18) Statistics of tourists visiting WRPA from 8/2001 to 12/2001.

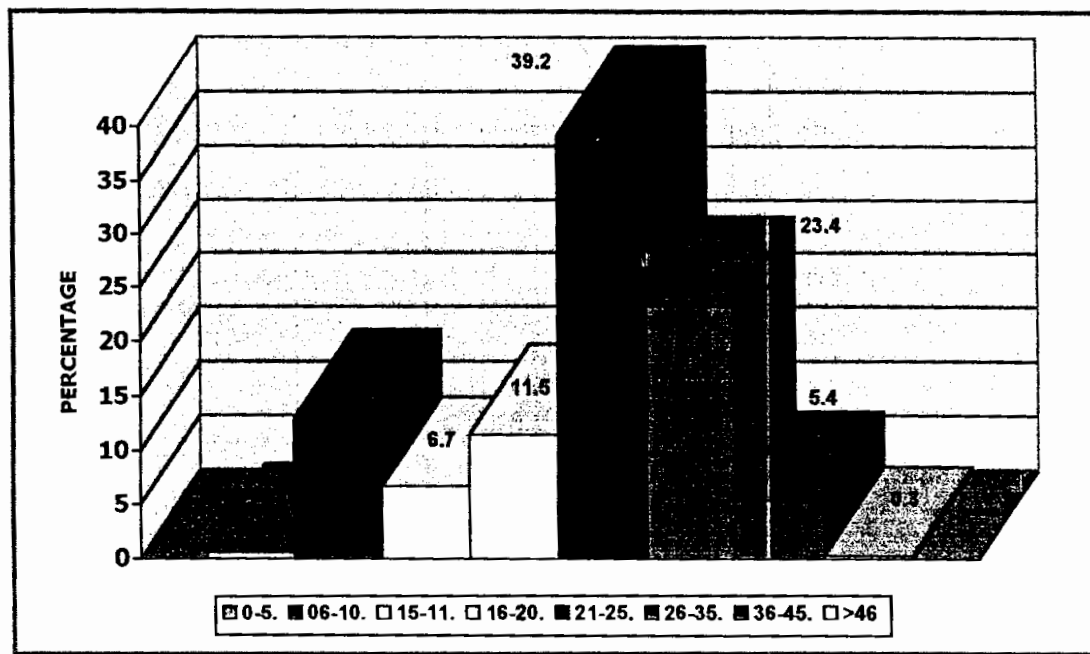
TOURIST'S CATEGORIES	PERCENTAGE	ESTIMATED NUMBER
Residents	99.15	50562.2
Foreigners	0.85	220.8
Adults	79.8	40524.8
Children	20.2	10258.2
Arrived WRPA by private car	46	23360.2
Arrived WRPA by public mean of transportation	54	27422.8
ESTIMATED TOTAL NUMBER OF TOURISTS		50783

Table (19) Age composition of WRPA visitors from 8/2001 to 12/2001.

AGE CATEGORIES	PERCENTAGE	NUMBER
0-5	0.6	305.70
6-10	12.9	6551.00
11-15	6.7	3402.46
16-20	11.5	5840.04
21-25	39.2	19906.94
26-35	23.4	11883.23
36-45	5.4	2742.28
>46	0.3	152.35

Figure (24) shows a histogram explaining the age variation among the different categories of the visitors for WRPA

Figure (24): The variation of ages for WRPA visitors



4.4.4. DISCUSSION

It has been found that the estimated number of visitors to WRPA, In the last 6 months, is less than the first 6 months of the year because of: 1) the hot weather (the temperature sometimes reach to 45), 2) the starting of the 1st semester of the studing year and 3) the fasting season (Ramadan) also included through this period.

The staff direct observations show that the majority of the resident visitors (local people) come mainly to enjoy with the waterfalls (about 90%). The foreigners are coming mainly for their nature interest.

A small percentage of foreigners is beyond-estimation due to their desert navigation that most of them do not enter to WRPA from the main gate, (Figure 25).

20.2% of the public visitors are children (under 15) and 79.8% are adults (under 35). This data confirm the high potentiality of WRPA as a focus area for environmental education. (Figure 26)

Most of the visitors arrive to WRPA by public transportation that there is no fixed transportation to WRPA. (Figure 27)

The majority of the visitors between (21:25 year) about (39.2%) most of them still studying at the university.

Figure (25): Percentage of the foreigner and resident visitors for WRPA

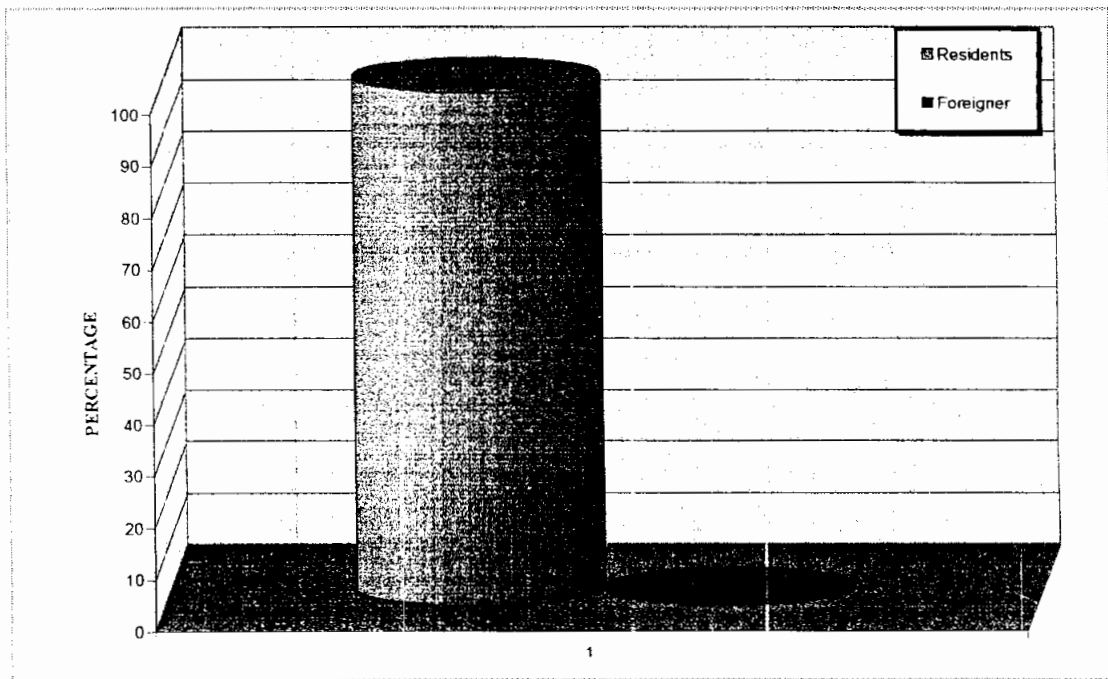


Figure (26): Percentage of the adults and children visitors for WRPA

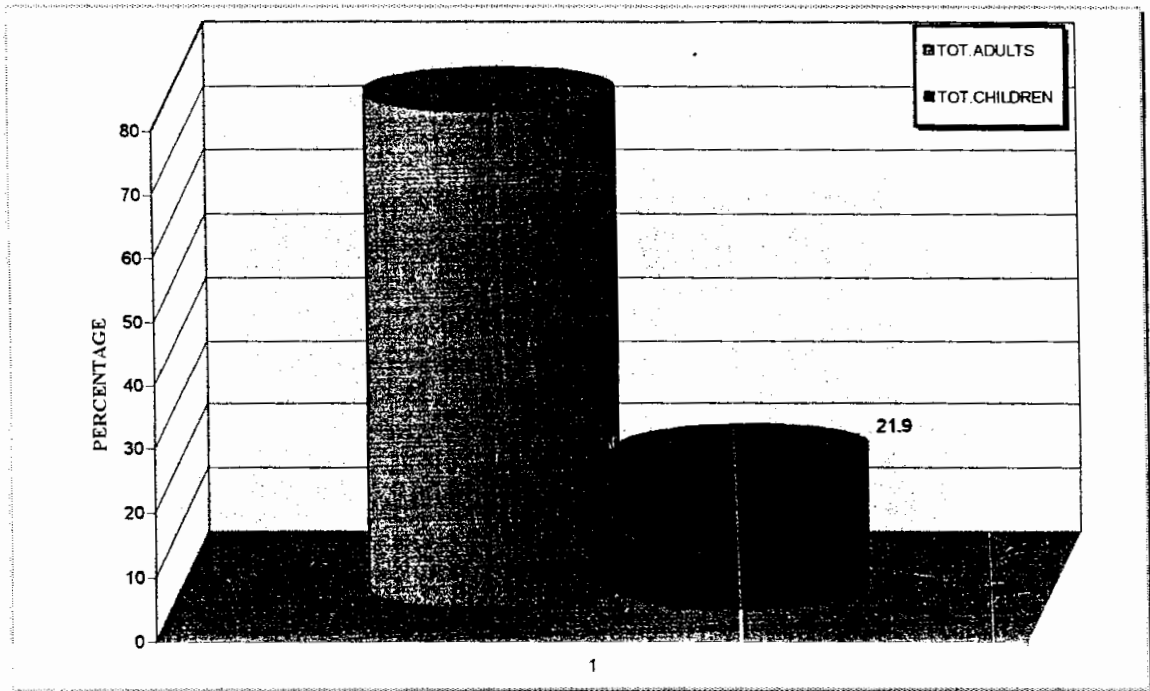
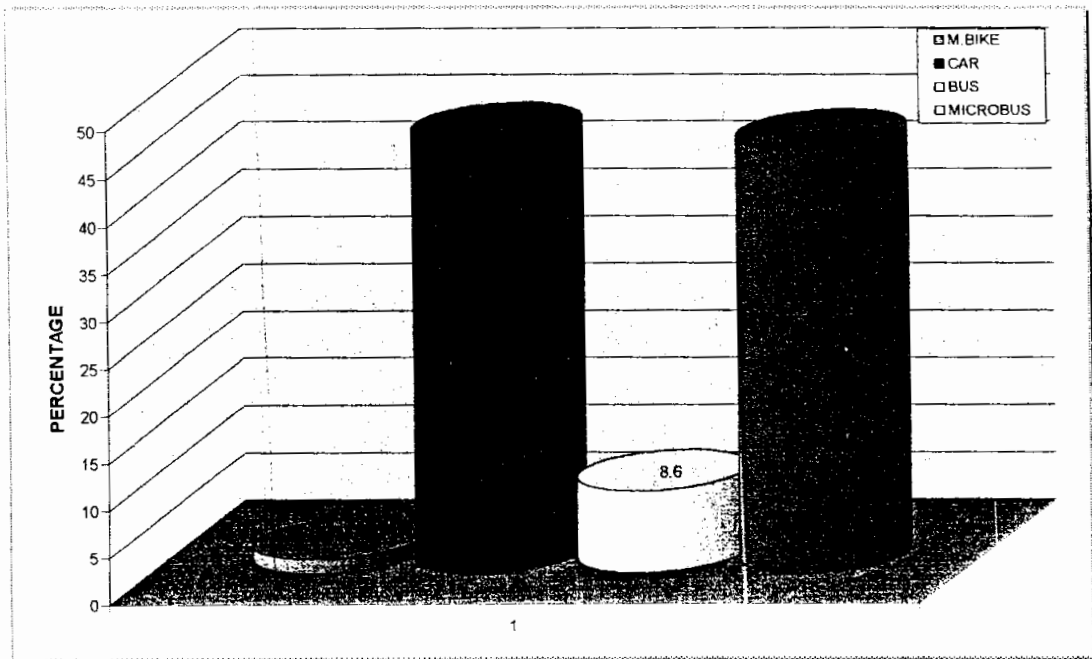


Figure (27): Percentage of different means of transportations to WRPA used by visitors



PART V

5. BIBLIOGRAPHY

&

ANNEXES

5. BIBLIOGRAPHY & ANNEXES

5.1. BIBLIOGRAPHY

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5.2. ANNEXES

Annex 1

List of insect species recorded inside WRPA (after IUCN, 1999)

SPECIES	FAMILY	ORDER
<i>Agelena lepida</i>	Agelenidae	Araneida
<i>Argiope trifasciata</i> , <i>Argiope lobata</i> , <i>Cyrtophora citricola</i>	Araneidae	
<i>Cheiracanthium sp.</i>	Clubionidae	
<i>Dictyna sp.</i>	Dictynidae	
<i>Stegodyphus sp.</i>	Eresidae	
<i>Pterotricha schaefferi</i> , <i>Haplodrassus sp.</i> , <i>Setaphis sp.</i>	Gnaphosidae	
<i>Trochosa sp.</i> , <i>Pirata sp.</i> , <i>Evipa unguolata</i>	Lycosidae	
<i>Pencetia sp.</i> , <i>Oxyopes sp.</i>	Oxyopidae	
<i>Philodromus sp.</i> , <i>Thanatus sp.</i> , <i>Ebo sp.</i>	Philodromidae	
<i>Mogrus bonnetii</i>	Salticidae	
<i>Tetragnatha nitens</i>	Tetragnathidae	
<i>Theridion sp.</i>	Therididae	
<i>Thomisus omustus</i>	Thomosidae	
<i>Buthacus leptochelys</i> , <i>Androctonus amoreuxi</i>		Scorpionida
<i>Olpium kochi</i>	Olpiidae	Pseudoscorpionida
<i>Geleodes graecus</i>		Solpugida
Suborder Ixodides		Acarida

Annex 2

List of aquatic invertebrates inside WRPA lakes (after IUCN, 1999)

CLASS	ORDER	FAMILY/GENUS/SPECIES
Insecta	Diptera	Tipulidae, Chironomidae
	Coleoptera	Dytiscidae
	Odonata	Libellulidae
Mollusca	Gastropoda	<i>Melanoids tuberculata</i> , <i>Theodoxus niloticus</i> , <i>Colesptera bulimoides</i> , <i>Bellamyia unicolor</i> , <i>Semisalsa sp.</i> , <i>Valvata nilotica</i> , <i>Physa acuta</i>
Mollusca	Bivalva	<i>Corbicula fluminralis</i>
Crustacea	Amphipoda	<i>Gammarus sp.</i> , <i>Corophium sp.</i> ,
	Ostracoda	<i>Cyprideis torosa</i>
	Decapoda	<i>Palaemon longinostris</i>
Anellida	Oligochaeta	Lumbricidae, Tubificidae

Annex 3

List of reptile species inside WRPA (afte IUCN, 1999)

No.	SCIENTIFIC NAME	ENGLISH NAME
1	<i>Ptyodactylus hasselquistii</i>	Fan-footed Gecko
2	<i>Cerastes cerastea</i> ,	Lesser Ceraster Viper
3	<i>Cerastes vipera</i>	Horned viper
4	<i>Psammophis schokari</i>	Sshokari Sand Snake
5	<i>Lytorhynchus diadema</i>	Diademed Sand Snake
6	<i>Malpolon moilensis</i>	Moila Snake
7	<i>Varamus griseus</i>	Desert Monitor
8	<i>Mesalina rubropunctat</i>	Red Spotted Lizered
9	<i>Acanthodactylus scutellatus</i>	Nidua Lizered
10	<i>Tropiocolores steudneri</i>	Steudners Gecko
11	<i>Tarrentola amularis</i>	Egyptian Gecko
12	<i>Stenodactylus</i>	Peteries Gecko
13	<i>Stenodactylus stenodactylus</i>	Elegant Gecko
14	<i>Sphenops sepsoides</i>	Audouins Sand skink

Annex 4

List of fish species as recorded by WRPA staff

No.	LATINE NAME	ENGLISH NAME
1	<i>Alestes murese</i>	Imberi
2	<i>Aphanius disper</i>	Tooth carp
3	<i>Aphanius fasciatus</i>	Tominnow – Pastrica
4	<i>Altherina boyeri</i>	Silverside
5	<i>Altherina spp.</i> ,	Silverside
6	<i>Bagrus bayad</i>	Forsskal catfish
7	<i>Bagrus docmak</i>	Catfish
8	<i>Bagrus spp.</i> ,	Catfish
9	<i>Barbus bynni</i>	Barbel
10	<i>Clarias lazera</i>	African catfish
11	<i>Ctenopharyngodon idella</i>	Grass carp
12	<i>Cyprinus carpio</i>	Common carp
13	<i>Dicentrarchus labrax</i>	Seabass
14	<i>Dicentrarchus punctatus</i>	Spotted seabass
15	<i>Haplochromis spp.</i> ,	Cichlid
16	<i>Hemichromis bimaculatus</i>	Cichlid
17	<i>Hemiramphus far</i>	Halfbeak
18	<i>Labeo nilotica</i>	Nile carp
19	<i>Lates niloticus</i>	Nile perch
20	<i>Liza aurata</i>	Golden grey mullet
21	<i>Liza ramada</i>	Thinlip grey mullet
22	<i>Mugil cephalus</i>	Flathead grey mullet
23	<i>Oreochromis aureus</i>	Tilapia
24	<i>Oreochromis niloticus</i>	Tilapia
25	<i>Sardinella spp.</i> ,	Sardin
26	<i>Sarotherodon galilaeus</i>	Tilapia
27	<i>Sparus auratus</i>	Gilthead seabream
28	<i>Synodontis schall</i>	Barbel
29	<i>Tilapia zillii</i>	Green tilapia

Annex 5

List of plant species inside WRPA by WRPA staff

No.	LATIN NAME	COMMON NAME
1	<i>Adiantum capillus-veneris</i>	Kozbaarit el-beer
2	<i>Alhagi graecorum</i>	Aqool
3	<i>Arthrocnemum macrostachyum</i>	Shinaan
4	<i>Calligonum polygonoides</i> subsp. <i>Comosum</i>	Arta/Risoo
5	<i>Ceratophyllum demersum</i>	Nakshoosh el-hoot
6	<i>Cornulaca monocantha</i>	Shoak ed-deeb
7	<i>Cressa cretica</i>	Nadwa
8	<i>Cynanchum acutum</i>	Olleiq
9	<i>Cynodon dactylon</i>	Nigeel
10	<i>Cyperus laevigatus</i>	Sead
11	<i>Desmostachya bipinnata</i>	Halfa
12	<i>Haloxylon salicornicum</i>	---
13	<i>Imberata Cylindrica</i>	Halfa deil el-gott
14	<i>Juncu rigidus</i>	Samaar morr
15	<i>Juncus acutus</i>	Samaar morr
16	<i>Launaea nudicaulis</i>	---
17	<i>Melilotus indicus</i>	Hendaqooq morr
18	<i>Myriophyllum spicatum</i>	Hamool el-maia
19	<i>Najas armata</i>	Hamool
20	<i>Nitraria retusa</i>	Gharqad/Ghardaq
21	<i>Phoenix dactylifera</i>	Hagna
22	<i>Phragmites australis</i>	Nakheel el-balah
23	<i>Pluchea dioscoridis</i>	Barnoof
24	<i>Polypogon monospliensis</i>	Deil el-gott
25	<i>Potamogeton pectinatus</i>	Hamool el-maia
26	<i>Ranunculus sceleratus</i>	Zaghlanta
27	<i>Rumex dentatus</i>	Khilla
28	<i>Salsola imbricata</i> subsp. <i>Coetula</i>	Khareet/Kreesh
29	<i>Scirpus maritimus</i>	---
30	<i>Sonchus maritimus</i>	---
31	<i>Spergularia marina</i>	Samaar
32	<i>Sporopolus spicatus</i>	Nigeel shoaky
33	<i>Stipagrostis ciliata</i>	Homareet
34	<i>Tamarix nilotica</i>	Abal/Tarfa
35	<i>Typha domingensis</i>	Halfa/Bardi
36	<i>Zygophyllum album</i>	Rotreet
37	<i>Zygophyllum coccineum</i>	Rotreet

Annex 6

List of bird species inside WRPA by WRPA staff

No.	LATIN NAME	ENGLISH NAME	STATUS
1.	<i>Tachybaptus ruficollis</i>	Little Grebe	Winter visitor
2.	<i>Podiceps cristatus</i>	Great Crested Grebe	Winter visitor
3.	<i>Podiceps nigricollis</i>	Black-Necked Grebe	Winter visitor
4.	<i>Phalacrocorax carbo</i>	Cormorant	Winter visitor
5.	<i>Ixobrychus minutus</i>	Little Bittern	Breeding Resident
6.	<i>Nycticorax nycticorax</i>	Night Heron	Winter visitor
7.	<i>Ardeola ralloides</i>	Squacco Heron	Resident/Migrant
8.	<i>Bubulcus ibis</i>	Cattle Egret	Resident/Migrant
9.	<i>Egretta garzetta</i>	Little Egret	Resident
10.	<i>Egretta alba</i>	Great White Egret	Winter visitor
11.	<i>Ardea cinerea</i>	Grey Heron	Resident
12.	<i>Ardea purpurea</i>	Purple Heron	Winter visitor
13.	<i>Ciconia ciconia</i>	White Stork	Migrant
14.	<i>Ciconia nigra</i>	Black Stork	Migrant
15.	<i>Plegadis falcinellus</i>	Glossy Ibis	Winter visitor
16.	<i>Platalea leucorodia</i>	Spoonbill	Winter visitor
17.	<i>Phoenicopterus ruber</i>	Greater Flamingo	Occasional visitor
18.	<i>Tadorna tadorna</i>	Shelduck	Occasional winter visitor
19.	<i>Anas penelope</i>	Wigeon	Winter visitor
20.	<i>Anas strepera</i>	Gadwall	Winter visitor
21.	<i>Anas crecca</i>	Teal	Winter visitor
22.	<i>Anas acuta</i>	Pintail	Winter visitor
23.	<i>Anas clypeata</i>	Shoveler	Winter visitor
24.	<i>Anas platyrhynchos</i>	Mallard	Winter visitor
25.	<i>Anas querquedula</i>	Garganey	Winter visitor
26.	<i>Netta rufina</i>	Red-crested Pochard	Winter visitor
27.	<i>Aythya ferina</i>	Pochard	Winter visitor
28.	<i>Aythya fuligula</i>	Tufted Duck	Winter visitor
29.	<i>Aythya nyroca</i>	Ferruginous Duck	Winter visitor
30.	<i>Milvus migrans</i>	Black Kite	Migrant
31.	<i>Circaetus gallicus</i>	Short-toed Eagle	Migrant
32.	<i>Circus aeruginosus</i>	Marsh Harrier	Resident/Winter visitor
33.	<i>Circus pygargus</i>	Montagu's Harrier	Migrant
34.	<i>Accipiter brevipes</i>	Levant Sparrowhawk	Migrant
35.	<i>Accipiter nisus</i>	Sparrowhawk	Migrant
36.	<i>Buteo buteo</i>	Buzzard	Migrant
37.	<i>Buteo rufinus</i>	Long-legged Buzzard	Migrant
38.	<i>Pandion haeliatus</i>	Osprey	Migrant
39.	<i>Falco concolor</i>	Sooty falcon	Breeding summer visitor
40.	<i>Falco biarmicus</i>	Lanner	Resident
41.	<i>Falco naumanni</i>	Lesser Kestrel	Migrant
42.	<i>Falco pelegrinoides</i>	Barbary's Falcon	Migrant
43.	<i>Falco tinnunculus</i>	Kestrel	Resident

44.	<i>Coturnix coturnix</i>	Quail	Winter visitor
45.	<i>Porzana porzana</i>	Spotted Crane	Migrant
46.	<i>Porphyrio porphyrio</i>	Purple Gallinule	Breeding Resident
47.	<i>Gallinula chloropus</i>	Moorhen	Resident/Winter visitor
48.	<i>Fulica atra</i>	Coot	Resident/Winter visitor
49.	<i>Grus grus</i>	Crane	Migrant
50.	<i>Himantopus himantopus</i>	Black-winged Stilt	Winter visitor
51.	<i>Burhinus oedicneumus</i>	Stone-curlew	Migrant
52.	<i>Cursorius cursor</i>	Cream Colored Corser	Breeding Resident
53.	<i>Glareola pratincola</i>	Collared Pratincole	Migrant
54.	<i>Charadrius alexandrinus</i>	Kentish Plover	Resident
55.	<i>Charadrius dubius</i>	Little Ringed Plover	Migrant
56.	<i>Charadrius hiaticula</i>	Ringed Plover	Winter visitor
57.	<i>Charadrius leschenaultii</i>	Greater Sand Plover	Migrant
58.	<i>Hoplopterus spinosus</i>	Spur-winged plover	Breeding Resident
59.	<i>Calidris alpina</i>	Dunlin	Migrant
60.	<i>Calidris temminckii</i>	Temminck's Stint	Winter visitor
61.	<i>Calidris alba</i>	Sanderling	Migrant
62.	<i>Gallinago media</i>	Great Snipe	Migrant
63.	<i>Limosa limosa</i>	Black-tailed Godwit	Migrant
64.	<i>Tringa glareola</i>	Wood Sandpiper	Migrant
65.	<i>Tringa nebularia</i>	Greenshank	Resident
66.	<i>Tringa ochropus</i>	Green Sandpiper	Winter visitor
67.	<i>Tringa stagnatilis</i>	Marsh Sandpiper	Winter visitor
68.	<i>Tringa totanus</i>	Redshank	Winter visitor
69.	<i>Actitis hypoleucos</i>	Common Sandpiper	Migrant
70.	<i>Larus fuscus</i>	Lesser Black-backed Gull	Migrant
71.	<i>Larus genei</i>	Slender-billed Gull	Resident
72.	<i>Larus ichthyaetus</i>	Great Black-headed Gull	Winter visitor
73.	<i>Larus ridibundus</i>	Black-headed Gull	Winter visitor
74.	<i>Gelochelidon nilotica</i>	Gull-billed Tern	Migrant
75.	<i>Sterna albifrons</i>	Little Tern	Winter visitor
76.	<i>Sterna caspia</i>	Caspian Tern	Migrant
77.	<i>Sterna hirundo</i>	Common Tern	Migrant
78.	<i>Chlidonias hybridus</i>	Whiskered Tern	Migrant
79.	<i>Chlidonias leucopterus</i>	White-winged Black tern	Migrant
80.	<i>Chlidonias niger</i>	Black Tern	Migrant
81.	<i>Pterocles orientalis</i>	Black-bellied Sandgrouse	Migrant
82.	<i>Streptopelia decaocto</i>	Collared Dove	Resident
83.	<i>Streptopelia senegalensis</i>	Palm dove	Resident
84.	<i>Streptotelia turtur</i>	Turtle Dove	Resident
85.	<i>Centropus senegalensis</i>	Senegal Coucal	Resident
86.	<i>Cuculus canorus</i>	Cokoo	Migrant
87.	<i>Apus apus</i>	Commun Swift	Migrant
88.	<i>Apus pallidus</i>	Pallid Swift	Migrant
89.	<i>Alcedo atthis</i>	Kingfisher	Resident
90.	<i>Ceryle rudis</i>	Pied	Breeding Resident
91.	<i>Merops apiaster</i>	Eurasian Bee-eater	Migrant

92.	<i>Merops superciliosus</i>	Blue-cheeked Bee-eater	Summer visitor
93.	<i>Coracias garrulus</i>	Roller	Migrant
94.	<i>Upupa epops</i>	Hoopoe	Resident
95.	<i>Jinx torquilla</i>	Wryneck	Migrant
96.	<i>Alaemon alaudipes</i>	Hoopoe lark	Resident
97.	<i>Riparia riparia</i>	Sand martin	Resident
98.	<i>Hirundo daurica</i>	Red-rumped Swallow	Migrant
99.	<i>Hirundo rustica</i>	Swallow	Resident/Migrant
100.	<i>Delichron urbica</i>	House Martin	Migrant
101.	<i>Anthus campestris</i>	Tawny Pipit	Winter visitor
102.	<i>Anthus cervinus</i>	Red-throated Pipit	Winter visitor
103.	<i>Anthus pratensis</i>	Meadow pipit	Winter visitor
104.	<i>Anthus trivialis</i>	Tree Pipit	Migrant
105.	<i>Motacilla flava</i>	Yellow Wagtail	Migrant
106.	<i>Motacilla alba</i>	White Wagtail	Winter visitor
107.	<i>Luscinia megarhinchos</i>	Nightingale	Migrant
108.	<i>Luscinia svecica</i>	Bluethroat	Winter visitor
109.	<i>Phoenicurus ochruros</i>	Black Redstart	Winter visitor
110.	<i>Phoenicurus phoenicurus</i>	Redstart	Winter visitor
111.	<i>Saxicola torquata</i>	Stonechat	Winter visitor
112.	<i>Saxicola rubetra</i>	Whinchat	Migrant
113.	<i>Oenanthe deserti</i>	Desert Wheater	Resident
114.	<i>Oenanthe lugens</i>	Mourning Wheater	Resident
115.	<i>Oenanthe isabellina</i>	Isabelline Wheatear	Winter visitor
116.	<i>Oenanthe leucopyga</i>	White-crowned Black Wheatear	Resident
117.	<i>Oenanthe oenanthe</i>	Wheatear	Migrant
118.	<i>Monticola saxatilis</i>	Rock Thrush	Winter visitor
119.	<i>Monticola solitarius</i>	Blue Rock Thrush	Winter visitor
120.	<i>Scotocerca inquieta</i>	Scrub Warbler	Breeding Resident
121.	<i>Prinia gracilis</i>	Graceful Warbler	Breeding Resident
122.	<i>Acrocephalus arundinaceus</i>	Great Reed Warbler	Migrant
123.	<i>Acrocephalus dumetorum</i>	Blyth's Reed Warbler	Migrant
124.	<i>Acrocephalus schoenobaenus</i>	Sedge Warbler	Winter visitor
125.	<i>Acrocephalus scirpaceus</i>	Reed Warbler	Resident
126.	<i>Acrocephalus stentoreus</i>	Clamorous Reed Warbler	Breeding Resident
127.	<i>Sylvia atricapilla</i>	Blackcap	Migrant
128.	<i>Sylvia communis</i>	Whitethroat	Migrant
129.	<i>Sylvia curruca</i>	Lesser Whitethroat	Migrant
130.	<i>Sylvia rueppelli</i>	Rueppell's Warbler	Migrant
131.	<i>Phylloscopus collybita</i>	Chiffchaff	Winter visitor
132.	<i>Phylloscopus sibilatrix</i>	Wood Warbler	Migrant
133.	<i>Muscicapa striata</i>	Spotted Flycatcher	Winter visitor
134.	<i>Ficedula albicollis</i>	Collared Flycatcher	Migrant
135.	<i>Ficedula hypoleuca</i>	Pied Flycatcher	Migrant
136.	<i>Oriolus oriolus</i>	Golden Oriole	Migrant
137.	<i>Lanius excubitor</i>	Great Grey Shrike	Breeding Resident
138.	<i>Lanius senator</i>	Woodchat Shrike	Migrant
139.	<i>Corvus ruficollis</i>	Brown-necked Raven	Resident

140.	<i>Corvus corone cornix</i>	Hooded Crow	Resident
141.	<i>Passer domesticus</i>	House sparrow	Migrant
142.	<i>Fringilla coelebs</i>	Chaffinch	Migrant
143.	<i>Locustella luscinioides</i>	Savi, s Warbler	Migrant
144.	<i>Hippolais pallida</i>	Olivaceous Warbler	Migrant
145.	<i>Phylloscopus trochilus</i>	Willow Warbler	Migrant
146.	<i>Phylloscopus bonelli</i>	Bonelli,s Warbler	Migrant
147.	<i>Erithacus rubecula</i>	Robin	Migrant
148.	<i>Sylvia cantilans</i>	Subalpine Warbler	Migrant
149.	<i>Acrocephalus melanopogon</i>	Moustached Warbler	Migrant
150.	<i>Anthus spinoletta</i>	Water Pipit	Migrant
151.	<i>Cercotrichas galactotes</i>	Rufus Bush Robin	Migrant
152.	<i>Emberiza hortulana</i>	Ortolan Bunting	Migrant
153.	<i>Oenanthe hispanica</i>	Black-eared Wheatear	Migrant
154.	<i>Otus scops</i>	Scops Owl	Migrant
155.	<i>Asio flammeus</i>	Short-Eared Owl	Migrant
156.	<i>Botaurus stellaris</i>	Bittern	Migrant
157.	<i>Carandrella brahydactyla</i>	Short-toed Lark	Migrant
158.	<i>Circus macrourus</i>	Palid Harrier	Migrant
159.	<i>Eremophila bilopha</i>	Temminck,s Horned Lark	Migrant
160.	<i>Gallinago gallinago</i>	Sinap	Migrant
161.	<i>Lanius minor</i>	Lesser Grey Shrike	Migrant
162.	<i>Philomachus pugnax</i>	Ruff	Migrant
163.	<i>Recurvirostra avosetta</i>	Avocet	Migrant
164.	<i>Sylvia melanocephala</i>	Sardinian Warbler	Migrant

Annex 7

List of mammal species inside WRPA

No.	ENGLISH NAME	LATIN NAME
1	Long-eared hedgehogs	<i>Hemiechinus auritus auritus aegypticus</i>
2	Giant musk shrew	<i>Crocidura flavescens deitae</i>
3	Flower's shrew	<i>Crocidura floweri</i>
4	Greater gerbil	<i>Gerbillus pyramidium pyramidium</i>
5	Anderson's gerbil	<i>Gerbillus andersoni andersoni</i>
6	Lesser gerbil	<i>Gerbillus gerbillus gerbillus</i>
7	Charming dipodil	<i>Dipodillus amoenus amoenus</i>
8	Libyan jird	<i>Meriones lybicus lybicus</i>
9	Field rat	<i>Arvicanthis niloticus niloticus</i>
10	House rat	<i>Rattus rattus</i>
11	Brown rat	<i>Rattus norvegicus</i>
12	Bandicoot rat	<i>Nesokia indica suilla</i>
13	Desert jerboas	<i>Jaculus jaculus</i>
14	House mouse	<i>Mus musculus</i>
15	Golden jackal	<i>Canis aureus lupaster</i>
16	Fennec fox	<i>Fennecus zerada</i>
17	Red fox	<i>Vulpes vulpes Aegyptica</i>
18	Ruppell's sand fox	<i>Vulpes ruppelli Ruppelli</i>
19	African wild cat	<i>Felis sylvestrus libyca</i>
20	Dorcas gazelle	<i>Gazella dorcas Dorcas</i>
21	Egyptian mongoose	<i>Herpestes ichneumon</i>
22	Weasel	<i>Mustela nivalis</i>
23	Cape hare	<i>Lepus capensis Rothschildi</i>
24	Jungle cat	<i>Felis chaus nilotica</i>
25	Slender horned gazelle	<i>Gazella leptocerus leptocerus</i>

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March 17, 2005

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To: *UNESCO World Heritage Center*

Wadi Al-Hitan (Egypt): nominated for inclusion on the World Heritage List

Dear Messrs./Madames

Mr. David Sheppard sent a letter dated January 10, 2005, to the Egyptian National Committee for UNESCO. This letter raised several questions growing out of discussions of the December 2004 IUCN World Heritage Panel concerning our Wadi Al-Hitan nomination. Here we attempt to clarify the two specific areas of uncertainty identified by the panel: (1) the relation of Wadi Hitan and Gebel Qatrani as separate sites in a possible serial nomination; and (2) plans and commitment of the Egyptian Environmental Affairs Agency [EEAA] and partners for the next five years.

First, concerning the question of functional relationship of the Wadi Al-Hitan nominated site and the adjacent area of Gebel Qatrani, these sites have similarities but also important differences. The two sites are similar in that both are well known for their fossil record, and both are in the desert northwest and north of Fayum oasis. However, there are also important differences:

- (1) Wadi Hitan is purely a paleontological site like World Heritage paleontological sites already established in Argentina, Australia, Canada, Germany, Kenya, Switzerland, and United Kingdom. Gebel Qatrani on the other hand is a mixed Natural/Cultural site including rich cultural elements in addition to its paleontological value. These include the oldest paved road in the world, ancient basalt quarries, multi-historical records of humans, natural resources, and land use through a long period of time (Prehistoric, Dynastic, Graeco-Roman, and present-day).
- (2) Wadi Hitan and Gebel Qatrani are different in terms of their geology, depositional environment, and vertebrate fossil record:
 - a. Wadi Hitan is well stratified and marine, and it includes many large articulated fossil whale skeletons resting in situ where they can be observed weathering from surrounding strata—the fossils are plentiful, obvious, and relatively complete. Hence they provide a satisfying stand-alone educational experience complementing the scientific importance of

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the Site. Some context aids interpretation of course, but anyone can see for him- or herself the fossil skeletons entombed in the strata where they were buried.

- b. By contrast, Gebel Qatrani is a poorly stratified, fluvial, and continental rather than marine, and most of the fossils here are small, rare, and generally fragmented and disarticulated. From the beginning of scientific study in the early 1900s, the fossils have been removed to museums as they were discovered. Hence the site, while well known scientifically, is much more difficult to imagine developing as satisfying educational experience going beyond what can be learned from museums and textbooks. Gebel Qatrani is an important site paleontologically, but a much more difficult one to develop into a meaningful World Heritage paleontological site.
- (3) Wadi Hitan is far ahead of Gebel Qatrani in terms of its planning, management, and infrastructure.
- a. Responsibility for management and operation of the Wadi Al-Hitan site is directly under the Wadi El Rayan Protected Area [WRPA] Management Unit supported by the Egyptian-Italian Environmental Cooperation Program [EIECP] and the technical assistance of IUCN. This will last until at least 2007. The current WRPA Management Plan was developed and endorsed by all stakeholders for the larger Wadi El Rayan Protected Area, which includes Wadi Hitan as a core zone. At Gebel Qatrani, on the other hand, responsibility for management is under a separate Qarun Protected Area, which is by comparison poorly funded, staffed, and equipped.
- b. Funds have been requested from the Egyptian National Commission for UNESCO to enable preparation of a management plan for Gebel Qatrani, but such a management plan, when completed, still will not ensure that resources are available for its implementation.

In conclusion, it does not seem advisable to delay consideration of Wadi Hitan as a World Heritage site now in the hope that Gebel Qatrani will be developed to the same level in the future. Such a delay risks dissipation of the momentum generated by a considerable national and international effort focused to date on Wadi Hitan. It seems to us to be a better strategy to move forward with Wadi Hitan now, and then link it to Gebel Qatrani at a later date when and if the latter site has been developed to a comparable stage.

Second, concerning the challenges that EEAA faces for implementing management of the nominated Wadi Al-Hitan site in the next five years, we would like to clarify the following:

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- (1) Extending the buffer zone of the nominated Site to the Bahariya highway and across the desert to the south to increase the scope for management of vehicular traffic offers some potential for greater control of vehicular traffic, but at a cost of proportionally increasing the area to be patrolled. It is envisioned that there will be a control gate on the north side of the Wadi Al-Hitan area, but this will be easier to maintain if it is relatively close to the other manned sites, and it seems impractical to establish and maintain a gate as far away as the Bahariya highway. On the south side of Wadi Al-Hitan there is no traffic and no need for a new gate. According to plans being implemented now, there will be a permanent outpost in Wadi Al-Hitan that will be staffed by local community guards, and these guards will monitor the Wadi Al-Hitan site.
- (2) Design and implementation of a management program for vehicular traffic, and provision of management and interpretation infrastructure within the nominated site is part of the management plan being developed at the moment as outlined in EIECP project document *Wadi el Rayan Protected Area* (2002; see Annex 1 here about activities regarding "The Wadi Hitan area of the WRPA is effectively managed as a World Heritage site").
- (3) A robust program of site monitoring related to the fossil interests and other values of the nominated Wadi Al-Hitan site is already being implemented (Annex II here: "Paleontology Monitoring Program").
- (4) Financial and human resources are in hand to secure the management of the Wadi Al-Hitan site for the medium-term. At the end of January 2005 the second phase of the Wadi Al-Rayan/Wadi Al-Hitan project of the EIECP was funded by grant from the Italian Government in the amount of \$1.111 million plus a debt-swap fund of \$457 thousand and an in-kind contribution from the Egyptian Government. These funds are in addition to the normal budget for Wadi Al-Rayan/Wadi Al-Hitan provided by EEAA (providing ca. \$100 thousand per year for salary, and operational and development costs). In terms of human resources, there are at present 37 people employed in Wadi Rayan, including the Director, eight Rangers/Environmental Affairs Researchers holding university degrees, 10 community guards recruited from the surrounding areas, and support staff. In the present project additional rangers and community guards will be recruited. There will be six local community guards with camels recruited for the Wadi Al-Hitan site in addition to the normal staff. It is worth mentioning here too that the project will receive technical assistance from IUCN (contract signed March 7, 2005, with UNDP as a partner agency with EIECP). There is also an official cooperation and twinning agreement signed on April 23, 2004, between Wadi El-Rayan Protected Area and the National Park of Gran Sasso and Monti della Laga in Italy, which promises a long-term training opportunity for Egyptian staff and other specific

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financial and technical assistance from Italy. There has been wide corporate support for development of Wadi Al-Hitan within Egypt and this will assuredly continue and expand.

- (5) Sustainable tourism programs to benefit the Wadi Al-Hitan site and local communities are being developed at the local, regional, and international levels:
- The principal program is outlined in EIECP project document *Wadi el Rayan Protected Area* (2002; see Annex III here about activities regarding "The Ecotourism Sector linked to the Protected Area is Developed and Diversified").
 - In addition, we have an Italian Cooperation-NGO project for \$2 million titled "Ecotourism for Sustainable Development in the Fayoum Oasis, Egypt" developed with the Fayoum Tourist Authority that started in January, 2005.
 - Another project has been approved by Italy but not yet started concerning a feasibility study "Tourism Development in Egypt: Promotion and Implementation of New Territorial Tourist Districts in Regional and Local Areas," which will focus in Fayoum. This will be implemented through the Tourist Development Authority of the Ministry of Tourism in Egypt.
 - Wadi Al-Hitan is featured in several EIECP publications including the widely distributed *Fayoum and Wadi El-Rayan* Egypt Pocket Guide authored by Alberto Silioti and published by American University of Press.
 - The archaeological site of Medinet Madi in western Fayoum is being developed by EIECP in parallel with Wadi Al-Rayan and Wadi Al-Hitan, and the two sites are expected to benefit each other as outlined in EIECP project document *Wadi el Rayan Protected Area* (2002; see Annex IV here about activities regarding "The Recreation and Educational Functions of Wadi Al-Rayan and Medinet Madi are Integrated").
 - A Ministry of Agriculture program of sustainable development funded by Italian debt-swap is focused on socioeconomic development within the Wadi Rayan protected area. This program includes tour guide training and promotion, development of handicraft production, and organic farming for sale to Wadi Rayan/Wadi Hitan visitors and others.
 - A three-way, four-year agreement has been implemented between EEAA, the Egyptian Geological Survey and Mining Authority, and the University of Michigan (U.S.A.) to further develop, study, and publicize the scientific resources of Wadi Al-Hitan. Excavation of a complete 18-meter long *Basilosaurus* whale skeleton is in progress that will enable functional interpretation of how the animal swam and lived. The skeleton will be molded and cast in the U.S. and Canada for exhibition in Cairo and elsewhere. The new excavation, ongoing scientific development of Wadi

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Al-Hitan, and anticipated exhibition of the first complete *Basilosaurus* skeletal mount in Egypt and elsewhere are expected to generate considerable publicity, contributing to visitation and sustainable tourism for the benefit of the Wadi Al-Hitan site and local communities.

We hope it is now clear from this summary that EEAA plans for Wadi Hitan are mature, and also that EEAA and its partners are fully committed to ongoing sustainable development of Wadi Hitan.

Sincerely

Dr. Moustafa Fouda
Director, Nature Conservation Sector

Cc: IUCN Headquarters

Annex I

EIECP Project Document *Wadi el Rayan Protected Area* (2002) Activities by Output

Output 6: Wadi Hitan Area of the WRPA is Effectively Managed as a World Heritage site

Activities

- 6.1 Support the NCS-led initiative for the designation of Wadi Hitan as a world heritage site (UNESCO) and develop a detailed site-specific conservation plan for the area.
- 6.2 Provide specialised training in the fields of geology and palaeontology to PAMU staff appointed for the development and conservation of the Wadi Hitan site and as curators of the open-air museum.
- 6.3 Initiate the recruitment and training of 6 community guards originating from villages in the vicinity of Wadi Hitan. Candidates should have long-term work experience under difficult desert conditions and demonstrated abilities in the handling of camels.
- 6.4 Establish a permanent outpost in a strategic location overlooking the Wadi Hitan site based on a simple design, which draws on the long-standing experience of the Wadi El Rayan Coptic monastery.
- 6.5 Ensure the procurement of the following items: (i) 2 off-road motorbikes (e.g. Honda 250cc, trial bikes) for patrolling purposes; (ii) N.6 camels for transport and logistics; (iii) a VHF base unit with relay station and 4 walkie-talkie units.
- 6.6 Facilitate visitor access to the Wadi Hitan site by demarcating a new track from the main gate and establishing an effective guiding / security service to be offered on request to visitors.
- 6.7 Establish a new ticketing system, which differentiates between nationals and foreigners and levies an additional fee for visiting the open-air museum in Wadi Hitan.
- 6.8 Design an open-air museum in the core area of the Wadi Hitan site (over a 1-2 km radius), featuring state of the art interpretation facilities and displays on the unique geology and palaeontology of the area. Vehicular access to the open-air museum will be restricted.

6.9 In collaboration with AAPG initiate a fund-raising initiative targeting the private sector (particularly the multinational petroleum companies) and other potential partners to finance the realisation of the open-air museum according to the highest international standards.

6.10 Establish and maintain a permanent camping site with basic visitor facilities. Camping may be allowed also away from allocated areas but a special permit will need to be arranged with the PAMU.

6.11 Facilitate the development of specialised ecotourism services by licensing private sector initiatives, according to the best practice guidelines developed by the project (see activity 3.1), in the following areas: (i) guided trekking tours; (ii) camel rides either in Wadi Hitan or along the ancient caravan trails approaching the Fayoum depression through Ufa and Kasr Qarun (iii) a Bedouin-style eco-lodge offering the "deep desert experience" (based on the preliminary proposal contained in the investment plan developed during the first phase of the WRPA project).

6.12 Develop a business plan for the Wadi Hitan site covering a period of 3-5 years. Detailed budgetary requirements will be defined in terms of investments and operating costs and potential sources of revenue quantified based on a system of fees and other income generating and fund raising activities including the leveraging of funds from government agencies, donor-sponsored projects and the private sector.

6.13 Design and implement a finely-targeted outreach programme to build the image of Wadi Hitan as a unique conservation area and highlighting its significance as a world heritage site (UNESCO). Effective tools based on the press, electronic and web-based media will be designed to disseminate information to a wide national and international audience.

6.14 Establish the legal framework for the creation of a permanent fund to support the long-term and sustainable management of the Wadi Hitan site. A stable institutional mechanism such as a Management Board will provide an umbrella for all key stakeholders and ensure the necessary conditions of pluralism, credibility and transparency, which are crucial prerequisites for the effective management of such a Conservation Fund.

Annex II

EEAA Wadi Rayan Protected Area *Operating Plan* (2003-2004)

Paleontology Monitoring Program

II.2. Paleontology Monitoring Program

Methodology

A. Photo Monitoring

Each fossil site has been mapped, photographed and numbered. The routine patrolling is executed in the fossil area twice per week (during the weekend, when normally the area is visited by the tourists), and once per month the condition of each fossil site is verified through the comparison with the photo. Once every three months the condition of each fossil site is checked and the broken parts of the skeletons are repaired.

The requirements for the photo monitoring, conducted once per month, are the following:

Personnel: 2 rangers, 1 community guard and 1 driver

Equipment: 4X4 car, digital camera, GPS, data sheets, pencil, compass, the file of the fossil photos.

B. Fossils Sites Description and Repairing

The procedure that is being used to repair the fossils is the following:

- Removing the sand from the fossils
- Looking for all the skeleton's components
- Cleaning the fossil constituents
- Mending the broken parts of the skeleton
- Brushing the fossil components with a hardener substance (polyvinyl acetate).
- Arranging the different parts of the skeleton in the right position and detecting the missing ones.

Personnel: 1 researcher (geologist), 1 researcher trained on fossil repair methodology, 2 community guards

Equipment: 1 palette, 2 brushes, polyvinyl acetate, glue Vinavil

Frequency: every three months and when needed

Annex III

EIECP Project Document *Wadi el Rayan Protected Area* (2002) Activities by Output

Output 3: Ecotourism Sector linked to the Protected Area is Developed and Diversified

Activities

3.1 Develop and publish best practice guidelines for the development and diversification of ecotourism facilities and services in the WRPA, based on the Ecotourism Investment Plan developed during the first phase of the project.

3.2 Design and conduct training programmes to sensitise tourism operators, potential investors and other concerned parties about desert conservation and environmentally sound, sustainable desert tourism.

3.3 In close co-ordination with Governorate authorities and the security forces, design and implement an improved visitor security system for the WRPA, while phasing out the present escort-based system, incompatible with the development of genuine ecotourism facilities and services.

3.4 Assist in the formulation and negotiation of new licenses according to best practice guidelines (see 3.1) and the investment plan developed during the first phase of the project, while engaging potential investors in contributing to visitor management and protection and the maintenance and improvement of visitor facilities.

3.5 Monitor the establishment of new ecotourism facilities ensuring full compliance with guidelines set out in the licenses and related FIAs.

3.6 Facilitate the involvement of the local communities through (i) technical and financial support to private sector initiatives, (ii) training for interpretation and guiding services and (iii) involving community members in the management and improvement of existing facilities and services.

3.7 In close collaboration with Tourism Development Authority (TDA), contribute to ongoing ecotourism initiatives in the Fayoum governorate, by examining the possibility of jointly supporting the establishment of an eco-centre in the periphery of the WRPA (e.g. Tunis), as a simple facility, run by a local NGO supported by Italian NGO-CISS, offering several ecotourism modules (e.g. crafts, rural life, cycling tours, etc.), which may be linked to ecotourism facilities and services available in the WRPA.

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Annex IV

EIFCP Project Document *Wadi el Rayan Protected Area* (2002) Activities by Output

Output 5: Recreation and Educational Functions of Wadi Al-Rayan and Medinet Madi are Integrated

Activities

5.1 In collaboration with the private sector, TDA and other key stakeholders (e.g. SCA and the Medinet Madi management team), design and implement a finely-targeted marketing strategy to promote the two sites as ecotourism destinations at local, national and international levels.

5.2 Demarcate and establish a suitably signposted track, physically linking the main visitor area of the WRPA with the Medinet Madi archaeological site.

5.3 Design and realise complementary exhibits and open air displays in the WRPA eco-centre and the *antiquarium* to be established by the Medinet Madi project, integrating information on the history, archaeology and biodiversity of the Fayoum region and the Western desert of Egypt.

5.4 Design and implement field-based environmental education activities and services targeting students and the general public, based on a holistic interpretation of the natural and cultural history of the region and highlighting the dynamic relationship between man and the natural environment.

5.5 Conduct customised training programmes and on the job training targeting rangers, guides etc. in order to improve interpretation and guiding skills supporting the effective operation of jointly designed visitor services.

5.6 Define an operational framework for the long-term collaboration between the management teams of the two sites by supporting the formal establishment and functioning of a coordinating committee.

5.7 Jointly initiate a process of bio-regional planning for the Wadi El Rayan - Medinet Madi areas based on formal consultations with local communities, Governorate authorities and other key stakeholders, and linked with the cultural heritage district.

Note. This output will be achieved by closely coordinating the activities with the project *Institutional support to SCA for environmental monitoring and management of cultural*

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ARAB STATES

WADI AL-HITAN (WHALE VALLEY)

EGYPT



WADI AL-HITAN (WHALE VALLEY) (EGYPT) ID N° 1186

1. DOCUMENTATION

- i) **Date nomination received by IUCN:** April 2004
- ii) **Dates on which any additional information was officially requested from and provided by the State Party:** IUCN requested supplementary information on the 11 August 2004, prior to the field mission, 4 October 2004, after the field mission, and 10 January 2005, after the IUCN WH Panel. State Party responses were received on 1 December 2004 and 29 March 2005 respectively.
- iii) **IUCN/WCMC Data Sheet:** 1 (the nomination which contains 30 references)
- iv) **Additional Documentation Consulted:** Wells, R.T. 1996. Earth's Geological History – a contextual framework for World Heritage fossil site nominations in **Global Theme Study of World Heritage Natural Sites**, IUCN, Switzerland, 43pp. Uhen, M.D. (2004) **Form, Function and Anatomy of *Dorudon atrox* (Mammalia, Cetacea): An archaeocete from the Middle to Late Eocene of Egypt**, University of Michigan, USA, 222pp. Matravers-Messana, G.H. (2002) **Wadi el-Rayan: Gateway to the Western Desert**, Wadi el Rayan Protection Project, Egypt, 99pp. Dolson, J., El-Barkooky, A., Wehr, F., Gingerich, P.D., Prochazka, N., and Shann, M. (2002) **The Eocene and Oligocene Palaeo-Ecology and Palaeo-Geography of Whale Valley and Fayoum Basins**, AAPG/EPEX/SEG/EGS/EAGE Field Trip No. 7. Rising Star Energy Publication Ltd, Egypt, 79pp. Gingerich, P.D. (1992) **Marine Mammals (Cetacea and Sirenia) from the Eocene of Gebel Mokattam and Fayum, Egypt: Stratigraphy, age and Paleoenvironments**, University of Michigan, USA, 84pp. Zimmer, C. (1998) **At the water's edge: macroevolution and the transformation of life** The Free Press, New York, USA, 290pp. Kamel, H et al. (2002) **Wadi El-Rayan Protected Area Management Plan**, EEAA, Egypt, 54pp. Storemyr, P (2003) **Widan el-Faras Ancient Quarry Landscape, North Faiyum Desert, Egypt: Site Description, historical Significance and Current Destruction**, Expert Centre for Conservation of Monuments and Sites, Switzerland, 22pp. Redfern, R. (2002) **Origins: The evolution of continents, oceans and life**, Weidenfeld and Nicholson, 360pp.
- v) **Consultations:** 7 external reviewers. The mission met with the Governor of Faiyum Province, officials of the Egyptian National Commission for UNESCO, officials and site management staff of the Egyptian Environmental Affairs Agency, representatives of the Egyptian National Geological Museum, and geologists from Cairo and Mansoura Universities.
- vi) **Field Visit:** Tim Badman. September 2004
- vii) **Date of IUCN approval of this report:** April 2005

2. SUMMARY OF NATURAL VALUES

Wadi Al-Hitan (Whale Valley) lies within the Faiyum¹ province, and forms part of the Wadi El-Rayan Protected Area (WRPA). It is located within the Western Desert of Egypt, 150 km south-southwest of Cairo and 80 km west of Faiyum City. WRPA is centred around a series of natural springs, and two brackish lakes created in the 1970s from excess agricultural water channelled from nearby Lake Qarun. The totally dry Wadi Al-Hitan is a distinct area within the WRPA, and lies c.40 km west of the lakes among an attractive and distinctive desert landscape of wind-eroded pillars of rock, surrounded by sand dunes, hills, cliffs and escarpment-bounded plateaux. The nominated property comprises a rectangular core area of c.20,015ha, (c. 12km x 16km square) defined by latitude/longitude co-ordinates, with a 5,885ha buffer zone.

The property is nominated for its fossil values, which are centred on the fossils of ancient whales from the earliest, and now extinct, suborder of whales, the Archaeoceti (or archaeocetes). These are the ancestors of the two modern suborders of cetaceans (Mysticeti and Odontoceti). The whale fossils of Wadi Al-Hitan represent one of the iconic stories of evolution: the emergence of the whales as modern ocean-going mammals from a previous life as land-based animals. The whales of Wadi Al-Hitan, in evolutionary terms are amongst the youngest archaeocetes, and are in the last stages of losing their hind limbs and have taken on the typical streamlined body form of modern whales, whilst retaining certain primitive aspects of skull and tooth structure. This represents a transition from living only in shallow coastal waters to being ocean-going animals, able to spread worldwide.

1. IUCN Adopts the recently announced official spelling of Faiyum, except where referring to alternative spelling used in older literature

The fossils are found within a horizontally-bedded rock succession of marine sandstones, shales, marls and limestones, often associated with evaporite minerals. The rocks are very extensively displayed in the field in natural exposures on the desert floor, and in a series of field exposures ranging from small cliffs to large escarpments. In addition to the fossil whales, the succession contains a range of other fossil values, and other geological evidence enabling a robust palaeogeographic and palaeoenvironmental reconstruction of the area through Eocene times to be made.

Over 40 million years ago the so-called Tethys Sea reached far south of the existing Mediterranean. This sea gradually retreated north depositing thick sediments of sandstone, limestone and shale, visible in three named rock formations which are visible in Wadi Al-Hitan. The oldest rocks are the Eocene Gehannam Formation, about 40-41 million years old, consisting of white marly limestone and gypseous clay and yielding many skeletons of whales, sirenians (sea-cows), shark teeth, turtles, and crocodilians. A middle layer, the Birket Qarun formation, of sandstone, clays and hard limestone, also yields whale skeletons. The youngest formation is the Qasr El-Sagha formation of late Eocene age, about 39 million years old. It is rich in marine invertebrate fauna, indicating a shallow marine environment. These formations were uplifted from the southwest, creating drainage systems, now buried beneath the sand, which emptied into the sea through mangrove-fringed estuaries and coastal lagoons when the coast was near what is now the Faiyum oasis, c. 37 million years ago.

The fossil beds of Wadi El-Hitan were first discovered during the winter of 1902-03. Large skulls and other remains of archaic fossil whales were first reported by H. J. L. Beadnell of the Geological Survey of Egypt. *Basilosaurus isis* and *Dorudon atrox* were named as new species by Charles Andrews of the Natural History Museum, London, UK in 1905. Other than two brief unpublished visits by the University of California, USA in 1947-48 and Yale University, USA in the late 1960s, the nominated property was not researched further until 1983 when it was visited by researchers from the University of Michigan, USA. Michigan carried out five further six-week expeditions in 1985, 1987, 1989, 1991 and 1993. Their research has been the main contribution to revealing the significance of Wadi Al-Hitan, and was responsible for the discovery in 1989 of the world's first evidence of an early whale displaying the remains of hind feet.

Three different species of Eocene whales have been identified with certainty at Wadi Al-Hitan. All are basilosaurids, the latest surviving group of archaeocete whales, and the group which are thought to have given rise to modern cetaceans. The largest was *Basilosaurus isis*, which was up to 21 meters long, with well developed five-fingered flippers on the forelimbs and with hind legs, feet, and toes, not known previously in any archaeocete. Their form was serpentine and they were carnivorous. Another species, *Dorudon atrox*, is also found with vestigial hind limb bones. It was a small whale with a more compact dolphin-like body, the presence of calving females of which may have attracted the larger predator whales. A third species, *Ancalocetus simonsi*, was

described in 1996. Besides whales, 19 other vertebrate species are known from the nominated property. They include three species of early sirenians (sea-cows), one partial skeleton of the primitive proboscidian *Moeritherium*, crocodiles, sharks, sawfish, rays, bony fishes, turtles (including a sea turtle), and sea snake. There is also a rich invertebrate fauna, including nummulites, molluscs including gastropods, bivalves and nautiloids, echinoids and crabs. Plant fossils include mangroves and sea-grasses. Given adequate protection, management and research, further discoveries of archaeocetes and other species, and of the biology and palaeoecology of early whales and the Eocene marine world are regarded as a certainty.

The whale fossils are present in an exceptional concentration, and are of a very high quality. Many whale and sirenian skeletons are very well-preserved: virtually complete, articulated specimens are found in-situ in their death positions, some with associated preservation of features such as stomach contents. In addition the many skeletons represent an ontogenetic series (i.e. a range of individuals from young to old) giving an added dimension to their study in terms of investigating life histories and development, and thus a deeper understanding of their evolution and ecology. The latest audited figures record a total of 379 whale fossils, of which 179 are catalogued, and a further 40 catalogued vertebrate fossils. 89 of the catalogued vertebrates are in the collection of the University of Michigan. 59 specimens, including the type specimens of the species first described from this site are in the collection of the Cairo Geological Museum, with the remainder of the catalogued species currently in the field. Earlier sirenian and cetacean material collected from the Faiyum is held in Cairo, London, Berlin and Stuttgart.

The nominated property adjoins an area with important fossil values; the rock succession exposed within Wadi Al-Hitan is overlain unconformably, outside the boundaries of the nominated property, by the Eocene – Oligocene Gebel Qatrani Formation. These rocks have been studied extensively at sites to the north of Lake Qarun, within the Qarun Protected Area, although they are also exposed over a wider area. Excavations in this formation have yielded internationally significant fossil remains of terrestrial mammals, including the fossil remains of eight primate lineages, including the earliest known hominoids (Redfern, 2002). The fauna also includes the unique twin-horned mammal *Arsinotherium*, as well as elephant ancestors. Gebel Qatrani is included on Egypt's current Tentative List as a potential mixed property. A request for international assistance from the World Heritage Fund to assist with the preparation of a management plan for Gebel Qatrani was submitted in early 2005. Furthermore Gebel Qatrani was identified by IUCN as a potential fossil World Heritage property in the IUCN contextual framework for fossil World Heritage (Wells, 1996), where it is described as: '*The most complete record of Palaeogene mammals for all Africa. The diverse fauna (40 genera, 75 species) which includes two hominoid genera is critical to understanding the evolution of many mammal groups on the continent, particularly hominids.*

3. COMPARISONS WITH OTHER AREAS

The original nomination document presents an incomplete comparative analysis. However, the State Party subsequently provided a comparative analysis prepared by a world expert on whale fossils, who has worked extensively on the nominated property and at other key sites world-wide. IUCN's comparative analysis has also benefited from the expert reviews of leading scientists with expertise in this area.

The primary claim of the nominated property for outstanding universal value is its demonstration of the early stages of whale evolution, and the evolution of the archaeocetes from land mammals to marine animals. Its claim to importance is based on it being the only known site in the world where large numbers of complete, high-quality archaeocete fossils can be seen in their original geological and geographical setting, and its 'iconic' status as the place where evidence of legs on whales was first discovered. These values are added to significantly by the additional geological context described above, and are drawn out in relation to IUCN's standard checklist for fossil site nominations in the Appendix to this report.

IUCN set out carefully in its contextual study (Wells, 1996) recommendations for the selection of fossil World Heritage properties. It stressed a number of key recommendations, including the central concept of the selection of properties that represent key events in the tree of life. It recommended the prioritisation of properties that represent community structures, but focussing on higher taxonomic levels, and vertebrates in particular, to maintain a manageable list of properties, and to focus on the most universally important properties. IUCN considers that the evolution of whales is a clearly defined aspect of the record of life that can be considered to fully meet these principles. It is an illustration of the process of evolution that is exceptionally vivid and accessible to the public, portraying a transition of land mammals returning to the sea, and gradually losing their legs in the process. Furthermore, it is a transition that is now well rooted in science and relates to an animal group that is both of modern conservation importance and widespread public appeal. IUCN considers it can justly be described as 'iconic'.

Other vivid illustrations of important fossil values that are represented on the World Heritage List include the diversity of the early explosion of life on Earth [the Burgess Shale within the Canadian Rocky Mountain Parks], the Age of the Fishes [Miguasha (Canada)], the Age of the Dinosaurs [Ischigualasto-Talampaya (Argentina), Monte San Giorgio (Switzerland), Dorset and East Devon Coast (UK), Dinosaur Provincial Park (Canada)], and the evolution of early man [Lake Turkana National Parks (Kenya)]. The rise of the mammals is a further example, and represents an important area of comparison in relation to the nominated property. In this case, terrestrial mammal evolution is represented on the World Heritage List by the exceptional fossil site of Messel Fossil Pit (Germany), which is considered the world's richest site for understanding the living environment of the Eocene, and the Australian Fossil Mammal Sites, whose values represent the evolution of the distinctive modern land mammal fauna of Australia

(from Miocene and younger sediments). Neither of these properties records marine values nor whale evolution. The World Heritage List also provides ample evidence of the outstanding universal value attached to cetacea and sirenia, as these species provide the basis for the selection of natural properties such as Peninsula Valdez (Argentina), Whale Sanctuary of El Vizcaino (Mexico) and Shark Bay (Australia). Relative to the values of other World Heritage properties, IUCN considers that the demonstration of whale evolution is justifiable as a sound claim to outstanding universal value in portraying the record of life.

There are thousands of fossil sites throughout the world that have yielded one or more whale specimens. A number of these are significant in relation to the illustration of the earliest stages of evolution of whales over 20 million years earlier than those at Wadi Al-Hitan. Important Eocene whale fossil sites are known in Egypt from Gebel Mokattam in Cairo, but are mostly lost to development. It is anticipated that much of the evidence from these sites could be replicated within the nominated property through further study. Older and more primitive archaeocete whales come primarily from India and Pakistan, from forested foothills of the Himalaya, from desert areas in Kutch, and from the desert in tribal parts of the Punjab, Balochistan and the North West Frontier Province. These sites illustrate earlier stages of the history of whale evolution, and demonstrate features that are different from and complementary to those of the nominated property. Many, however, are inaccessible, and none are even closely comparable to Wadi Al-Hitan in terms of the number and concentration of fossils.

A substantial number of partial skeletons of archaeocete whales, more or less contemporary with those of Wadi Al-Hitan, have been found on the Atlantic and Gulf coastal plain of eastern North America over the last 150 years. However, none of these skeletons is complete, and the sites where they are found are scattered and generally covered in vegetation with difficult access.

Fossil whales of the suborders Mysticeti and Odontoceti are known in abundance from Miocene and Pliocene sites such as 12-15 million year old Shark Tooth Hill, California, USA and the 5-6 million year old Cerro Blanco in the Pisco Formation, Peru. However, these whales are essentially modern and do not illustrate the evolutionary story in the same way as the values represented in the nominated property.

In discussing the comparative value of the nominated property, IUCN notes the important context for Wadi Al-Hitan provided by the adjacent interests of the Gebel Qatrani Formation within the Lake Qarun Protected Area. In the view of IUCN the values of the nominated property and the Gebel Qatrani Formation represent different aspects of an intimately related story. Although the comparative analysis for the nominated property must of necessity be based on its values alone, IUCN believes that there is significant evidence (including the IUCN contextual study) to suggest that Gebel Qatrani has important values which cannot be logically separated from the interests within Wadi Al-Hitan in relation to a claim for World Heritage status. The exposures in Lake Qarun have produced some whale fossils, but their values for demonstrating cetacean evolution are however greatly surpassed by the nominated property.

In summary the nominated property is the most significant site in the world to demonstrate the evolution of whales. This assessment is made in terms of the completeness, quality, concentration and accessibility of the fossils, and the abundant additional evidence enabling a robust construction of the palaeogeography and palaeoecology of the Eocene marine and coastal environment where they are found.

4. INTEGRITY

4.1 Boundaries

The boundaries of the nominated property are a rectangle defined by latitude and longitude coordinates, with a buffer zone based on a slightly larger and similarly defined rectangle. These boundaries have been selected to encompass the key features of interest, and a wider part of the WRPA. They are, therefore, sufficient to meet the conditions of integrity under the Convention, at least for administrative purposes. The boundaries are not optimal, however, for management purposes, in particular as they can only be traced in the field through use of a global positioning system. IUCN considers that topographic features visible in the landscape, specifically the tops of the escarpments within the protected area, would form a more operational boundary.

IUCN heard from scientists during the evaluation mission that the protected area within the property would be strengthened by the addition of a further area of outcrop to the west of the WRPA at Gebel Abiad. This area provides exposures of rock from the topmost Eocene rocks. IUCN considers that this area would add to the values of the nominated property in the future, but is not sufficiently critical to the core features of interest to be regarded as an essential addition to the nomination.

The buffer zone is also a rectangular area, running close to the proposed boundary of the nominated property, and like the nominated property lies entirely within the boundary of the WRPA. As proposed it appears to serve no functional purpose, and has no practical value in enhancing the protection of the nominated property over and above that provided by the property's boundary itself. During the evaluation mission the Egyptian parties identified that it was desirable that the buffer zone be extended westwards outside the existing protected area to the Bahariya Road, and southwards to provide a larger buffer area. As these areas are not currently within protected areas, such a proposal would require a ministerial declaration, which IUCN was advised was a relatively simple and quick process. IUCN considers that the extension of the buffer zone would be desirable, and in particular would strengthen the ability to manage access to the site from the Bahariya Road. However, in view of the extent of the defined boundary of the nominated property, the wider protection of the WRPA and the absence of substantial threats from the west and south of the property, IUCN does not consider that the absence of a formally declared buffer zone creates an immediate issue in relation to integrity.

4.2. Legal Status

The property has strong legal protection under Egyptian Law No. 102 of 1983 for Nature Protectorates. This provides strong and unequivocal legal protection for the property, forbidding actions that would lead to destruction or deterioration of the natural environment. The law commendably mentions geological features as specific elements receiving protection. WRPA was declared a protected area in 1989 according to Prime Ministerial Decree 943. Wadi Al-Hitan was added to WRPA in 1997 by Prime Minister's Decree 2954. The overall management goal of the protected area is the protection of natural resources, in accordance with the declaration decree.

4.3. Ownership

The nominated property is owned by the Egyptian State, and is managed by the Nature Conservation Sector of the Environmental Affairs Agency (EEAA).

4.4. Management

The nominated property and buffer zone are managed as part of a strict nature protection area within the WRPA. A management plan for the WRPA exists for the period 2002-2006, which was prepared through the EEAA, under the supervision of IUCN in 2002. Under the plan, the nominated property is identified as one of two Special Protection Zones, and the plan makes provision for strict protection of the fossil remains, and the development of well-controlled ecotourism. WRPA has also benefited from support under the Egyptian - Italian Environmental Co-operation Programme, providing for expenditure of c.6 million Egyptian pounds over the coming three years.

WRPA benefits from the services of a dedicated team of rangers, community guards, and other staff, with a total complement of 28 people. Some further enhancement of the staff team is envisaged. IUCN considers that support and training of what is still a relatively new staff team will be an essential part of the establishment of the management of the nominated property, and welcomes the attention to this aspect demonstrated by the EEAA, and the Egyptian-Italian Co-operation Programme.

The management and staffing arrangements are potentially sufficient to meet the needs of the nominated property. It is clear, however, that resources remain an issue, and that increased priority will need to be given in the short and medium term to the provision of adequate vehicles and equipment to the property's management team. The nominated property is also remote from the main staff base, and inhospitable, so the provision of on-site staffing requires careful consideration of logistical issues. The staff team is reliant to some extent on the provision of external assistance, and the development of adequate long-term funding to support the management of the property requires a strong central commitment by the State Party. IUCN is reassured that these matters are being accorded significant attention by the Egyptian authorities.

IUCN considers the operational aspects of a number of elements of the management plan still require further

consideration and detailed planning. Of particular importance will be the detail of how the plans for eco-tourism are developed, and how interpretation and educational opportunities are provided within the nominated property. The interests of the nominated property are currently presented and interpreted at the main visitor centre for the WRPA, situated adjacent to the lakes. In addition, knowledgeable ranger staff are available to assist visitors and there is an audio-visual theatre and video presentation. This provides a good introduction to the interests of the nominated property at the most accessible location for visitors, and there is scope to increase and develop this further. IUCN considers that the primary emphasis should be placed on experiencing the property with trained guides, as an alternative to the provision of signs and infrastructure, and notes the need for collaboration with private sector trekking companies who currently visit the property, and are expected to arrive in greater numbers in the future.

The monitoring arrangements for establishing and reporting on the condition of the fossil remains require further elaboration, in conjunction with a small scientific panel.

Beyond the nominated property, there is a range of challenging management issues within the WRPA. These do not impact on the nominated property, but are significant for its wider setting, and include the reclamation of desert land for agriculture, water management within the lakes, and the interaction with the village that lies within the protected area. Some activities appear to be carried out without adequate pre-planning and consultation in relation to the protected status and importance of the area. The management plan for the WRPA reports that there is weak collaboration between the different agencies, and IUCN considers that the integration of the activities of the different Egyptian ministries could be strengthened. Active involvement of the local community in the management of the WRPA could be strengthened, and there is an important opportunity to seek greater social and economic benefits for local communities through the presence and management of the protected area, and possible World Heritage status, particularly from sustainable tourism. It is important to note that a number of initiatives are underway to develop and implement sustainable tourism initiatives in the property.

4.5. Human Impact

The fossil remains at Wadi Al-Hitan are potentially vulnerable to visitor pressure through collecting and, in the longer term, to natural erosion by the wind if not conserved in museums or in the field. The whale fossils are large and relatively difficult to extract. Some of the obviously exposed skeletons, and features such as a worm bored tree-trunk, show the evidence of the removal of pieces as souvenirs. It is not feasible to completely prevent such removal without damaging the character of the property. Low level fencing and educational material appear to be effective in restricting damage to a low level, but require continued attention. Some natural erosion of the fossil remains is inevitable, but operates on a timescale that is not threatening to the integrity and value of the nominated property. Localised in-situ restoration and consolidation of some exposed

specimens through the application of polymers has been carried out under the supervision of the Egyptian Geological Museum. It is accepted however that there will be a gradual loss of some fossil material through natural exposure, but that such processes are both slow (so the impacts are gradual and can be mitigated by active management, research and responsible collection of fossils) and result in the maintenance of interest in the nominated property as new fossils are brought to light.

Palaeontological study is extractive in nature. The large size of the fossil skeletons and their remoteness means that the unauthorised removal of large specimens is unlikely, however regulated extraction, study and curation is an ongoing requirement. This issue is being tackled in an exemplary way in relation to the nominated property, through a tripartite memorandum of understanding between the University of Michigan, EEAA and the Egyptian Geological Survey and Mining Authority (EGSMA). This agreement is currently awaiting signature by EGSMA and sets out a well-developed research plan for the property over the period 2005-2008, which provides for regulated scientific exploration and specimen collection. It makes provision for curation of new discoveries within the Egyptian Geological Museum, research and study at Michigan, and the transfer of skills to Egyptian site staff through a training programme. There appears to be excellent and effective collaboration and support for site management from Egyptian geologists in both the national museum and universities. Such collaboration is leading to wider research on the geology of the area, helping to create a complete and robust picture of the palaeogeography and palaeoecology of the area.

The natural values of Wadi Al-Hitan as an unspoilt and beautiful desert landscape are fragile. The property is already heavily visited by visitors in 4-wheel drive vehicles, and there is noticeable evidence of vehicle tracks across the desert surface. Vehicular traffic is the greatest potential threat to both the physical character of Wadi Al-Hitan, and also the experience of visitors. Additional information provided by the State Party notes that design and implementation of a management programme for vehicular traffic, and provisions for visitor management and interpretation infrastructure is considered as part of the management plan being developed at present for the property. IUCN stresses the need to develop a holistic and sensitive approach to interpreting the property, which would ensure that its natural values are explained to visitors but would protect the remote and unspoilt character of the landscape and visitor experience.

5. ADDITIONAL COMMENTS

The relationship between Wadi Al-Hitan and the adjoining site of Gebel Qatrani is a key issue in relation to the consideration of this nomination by the World Heritage Committee. The Egyptian State Party currently conceives that the two properties of Wadi Al-Hitan and Gebel Qatrani are seen as self-contained. The reasons for this are firstly a view in relation to outstanding universal value, in that the distinctive elements of whale evolution that are only demonstrated at Wadi Al-Hitan,

and the fact that Gebel Qatrani is seen as potentially having mixed value – Eocene/Oligocene terrestrial fossil values that would be nominated under natural criterion (i), and the cultural values of the Widan Al-Faras basalt quarry landscape. Secondly in operational terms the State Party considers that Wadi Al-Hitan is administered separately, and benefits from a management capability that makes it 'ready' for nomination, whereas management measures for Gebel Qatrani are not sufficient at present to meet the conditions of integrity.

IUCN notes that:

- The fossils of Wadi Al-Hitan and Gebel Qatrani are found in rock formations that are geologically contiguous;
- The fossil values of both properties have the same core values – the evolution of mammals in the Eocene-Oligocene;
- The properties are essentially adjacent to each other, and the boundaries of the protected areas are almost contiguous;
- The two properties are managed by the same EEAA management team;
- The natural and cultural values of Gebel Qatrani are not intellectually related to each other, and the intention to nominate as a mixed property cannot provide a justification for viewing the interests separately; and
- The impact and benefits of World Heritage status for the Faiyum area would be enhanced by a wider area being nominated.

IUCN therefore considers that the fossil values of Gebel Qatrani cannot be separated from the values of Wadi Al-Hitan in two separate nominations. Whilst Wadi Al-Hitan provides a convincing demonstration of outstanding universal value in its own right, it is essential that a future nomination of the fossil values of Gebel Qatrani should be seen as an extension of the values of Wadi Al-Hitan, and not as a separate, stand-alone nomination.

IUCN recognises that an option for the Committee would be to defer the nomination of Wadi Al-Hitan pending a further integrated nomination of both properties. IUCN does not recommend this approach for the following reasons:

- Wadi Al-Hitan, on its own, demonstrates outstanding universal value and is able to meet the conditions of integrity. If Gebel Qatrani did not exist, the nominated property would be an acceptable nomination;
- Wadi Al-Hitan is a fragile property under current pressure, and World Heritage status provides impetus to ensure its protection; and
- With appropriate monitoring, the nomination of Wadi Al-Hitan provides the most effective starting point for developing a cohesive nomination for the wider fossil interests, in relation to the capacity of the State Party. The nomination recognises the extensive investment which the Egyptian State Party has made in the management of the WRPA, and its plans to develop similar capacity for the Lake Qarun PA.

On another issue, IUCN notes that sites elsewhere in the world, and in particular in Pakistan and India, display

different aspects of the earlier evolution of whales, and encourages the relevant States Parties to seek to link, as far as possible, research and promotion programmes in relation to these sites.

6. APPLICATION OF CRITERIA/STATEMENT OF SIGNIFICANCE

Wadi al-Hitan is nominated for inscription under natural criterion (i)

Criterion (i): Earth's history and geological features

Wadi Al-Hitan is the most important site in the world to demonstrate one of the iconic changes that make up the record of life on Earth: the evolution of the whales. It portrays vividly their form and mode of life during their transition from land animals to a marine existence. It exceeds the values of other comparable sites in terms of the number, concentration and quality of its fossils, and their accessibility and setting in an attractive and protected landscape. It accords with key principles of the IUCN study on fossil World Heritage Sites, and represents significant values that are currently absent from the World Heritage List. IUCN considers that the nominated property meets this criterion.

7. DRAFT DECISION

IUCN recommends that the Committee adopt the following draft decision:

The World Heritage Committee,

1. Having examined Document WHC-05/29.COM/8B
2. Inscribes Wadi Al-Hitan, Egypt, on the World Heritage List on the basis of natural criterion (i):

Criterion (i): *Wadi Al-Hitan is the most important site in the world to demonstrate one of the iconic changes that make up the record of life on Earth: the evolution of the whales. It portrays vividly their form and mode of life during their transition from land animals to a marine existence. It exceeds the values of other comparable sites in terms of the number, concentration and quality of its fossils, and their accessibility and setting in an attractive and protected landscape. It accords with key principles of the IUCN study on fossil World Heritage Sites, and represents significant values that are currently absent from the World Heritage List.*

3. Recommends the State Party to further develop the management plan for the property, which should consider:

(i) *Revising the boundary to use topographic features visible in the landscape, primarily the tops of the escarpments within the protected area, to ensure that they are clearly identifiable on the ground, and more useful for site management;*

(ii) *further explore the feasibility of extending the buffer zone of the property to the Bahariya Road,*

and across the desert to the south, in order to ensure effective management and control of vehicular traffic;

- (iii) carefully designing and implementing a management programme for vehicular traffic;*
 - (iv) provision of essential management infrastructure within the nominated property that minimises intrusion and damage to its natural values; and*
 - (v) make full use of the results and recommendations from programmes and studies that are underway in relation to the development of sustainable tourism, including visitors management and interpretation.*
4. Welcomes the support provided by the State Party of Italy for the management of this property and recommends the State Party of Egypt, in conjunction with Italy, identify measures to maintain and enhance this support in future to ensure the effective implementation of the management plan and protection of the values of the property in the long term.
5. Urges the State Party to consider any future nomination of the Gebel Qatrani Formation for natural fossil values as an extension of Wadi Al-Hitan.

APPENDIX 1: IUCN FOSSIL SITE EVALUATION CHECKLIST

Coverage of an extended time period

The rocks within the nominated property were deposited over a period of 3-4 million years covering the time period of the Middle to Late Eocene transition (40 – 37 Ma). The rocks containing the main whale remains are aged between 37-38 million years, and record gradual changes in conditions with a series of different stratigraphic levels preserving fossil remains. The feature of prime interest, the evolution of whales, took place through the Eocene period as a whole, with the earliest evidence from the early Eocene at c. 55 million years, and the presence of essentially modern forms at 33 million years ago. The fossils from the nominated property vividly illustrate the critical morphological changes that took place over this longer period, and particularly the gradual loss of hind legs as a fully marine mode of life was adopted. Beyond the nominated property, the stratigraphic section is exceptionally exposed and continuously extends northwards in the surrounding escarpments over a wider geological window including also the Oligocene and Lower Miocene Deposits as young as 15 Ma.

Richness of species diversity

The nominated property contains a diverse marine fauna, including 25 genera of more than 14 families, 10 orders and 4 classes of vertebrates. The fauna includes cartilaginous and bony fish, reptiles (including crocodiles, turtles and sea snake, and mammals (whales and sirenians). In addition there is a well developed invertebrate fauna and plant remains in the form of fossilised mangroves and sea-grass. The diversity is high in relation to the known diversity of Eocene whales, and is expected to be increased through further study, although in absolute numbers the vertebrate diversity is at the low end of the scale in relation to existing fossil WH properties. Taken with the adjacent area within the Gebel Qatrani Formation, the total number of vertebrates is greatly increased to over 90 species.

Uniquely representative of a geological time period

There are countless Eocene fossil sites world-wide, and thousands of sites that have produced whale fossils of some kind. The property is not uniquely representative of the Eocene marine environment, or of the iconic story of whale evolution during the Eocene. It is however considered to be the best site for illustrating whale evolution. Messel Fossil Pit World Heritage property is also of Eocene Age and preserves a fossil fauna that is, relatively speaking, much richer than the nominated property. It is however a terrestrial record, and provides no record of Eocene whales or other marine species.

Existence of other comparable sites

Amongst the many sites where remains of Eocene archaeocete whale fossils have been discovered, a number are also of international significance. These include sites that represent the earliest stages of evolution of whales over 20 million years earlier than Wadi Al-Hitan. Older and more primitive archaeocete

whales come primarily from India and Pakistan, from forested foothills of the Himalaya, from desert areas in Kutch, and from desert in tribal parts of the Punjab, Balochistan and the North West Frontier Province. A substantial number of partial skeletons of archaeocete whales more or less contemporary with those of Wadi Al-Hitan have been found on the Atlantic and Gulf coastal plain of eastern North America. None of these are even closely comparable to Wadi Al-Hitan in terms of the number and concentration of fossils, and in most cases access is very difficult. Other world fossil whales sites record essentially modern species.

Contribution to the understanding of life on earth

Whale evolution is an iconic story of the record of life on Earth. Whales evolved from land mammals, so in terms of a tree of life the property represents a vivid picture of mammals 'returning to the sea' from the land-based mode of life they had evolved. Wadi Al-Hitan has the best and most vivid fossil record that illustrates this change through the extinct group of archaeocete whales, and its value is added to greatly by its accessibility. Although not the earliest known whales, they represent a very important state in the evolution of this group of mammals. In evolutionary terms, they are in the last stages of losing their hind limbs and have taken on the typical streamlined body form of modern whales. This marks their transition from living only in shallow coastal waters, to being ocean-going mammals, with a world-wide distribution. The many skeletons provide an ontogenetic series with young and old individuals, giving additional dimensions to the study of their life history and a deeper understanding of their evolution. The extent of other fossil material mean it is possible to reconstruct the surrounding environmental and ecological conditions.

Prospects for ongoing discoveries

The nominated property has already produced the exceptional first discovery of direct evidence of vestigial feet on a fossil whale. However it still offers considerable scope for further study. Arrangements for a further phase of study are currently being put in place, and further discoveries are regarded as a virtual certainty. Beyond the vertebrate fossil remains, the property is particularly valuable in allowing study of an associated fossil fauna of invertebrates and plants, allowing a robust interpretation of Eocene marine environments, and the reconstruction of ecological interactions and past geography. Further study of the extensively exposed geology is likely to lead to further refinements and reinterpretations.

International level of interest

The nominated property is of established international interest, as the best and most complete record of Eocene whale evolution. This is evidenced by the level of international interest in the property over the last 20 years, and its recognition in the international media, including widely syndicated television programmes, and articles in popular magazines and books, as well as the scientific literature.

The nominated property is intimately linked, in a geological sense, with the adjacent exposures of the Gebel Qatrani Formation. These sites have produced an exceptionally rich, mainly terrestrial, fossil record including the earliest hominoids, and is of critical international importance in the development of knowledge of hominid evolution in Africa.

Associated features of natural value

The nominated property is a very attractive and distinctive desert landscape of conical hills, and various sculpted landforms, created in substantial part from wind erosion by sand, and demonstrating a range of interesting and attractive features. The cliffs of Gebel Gohannam provide a dramatic entrance to the property, and a landscape feature visible from far around. The nominated property is a key feature of the wider WRPA, which is centred on two artificially created lakes forming an important habitat, and a dramatic and attractive contrast to the surrounding desert landscape. The WRPA also includes an unusual area of natural springs, supporting indigenous vegetation and a range of species, including rarities such as the Dorcas Gazelle.

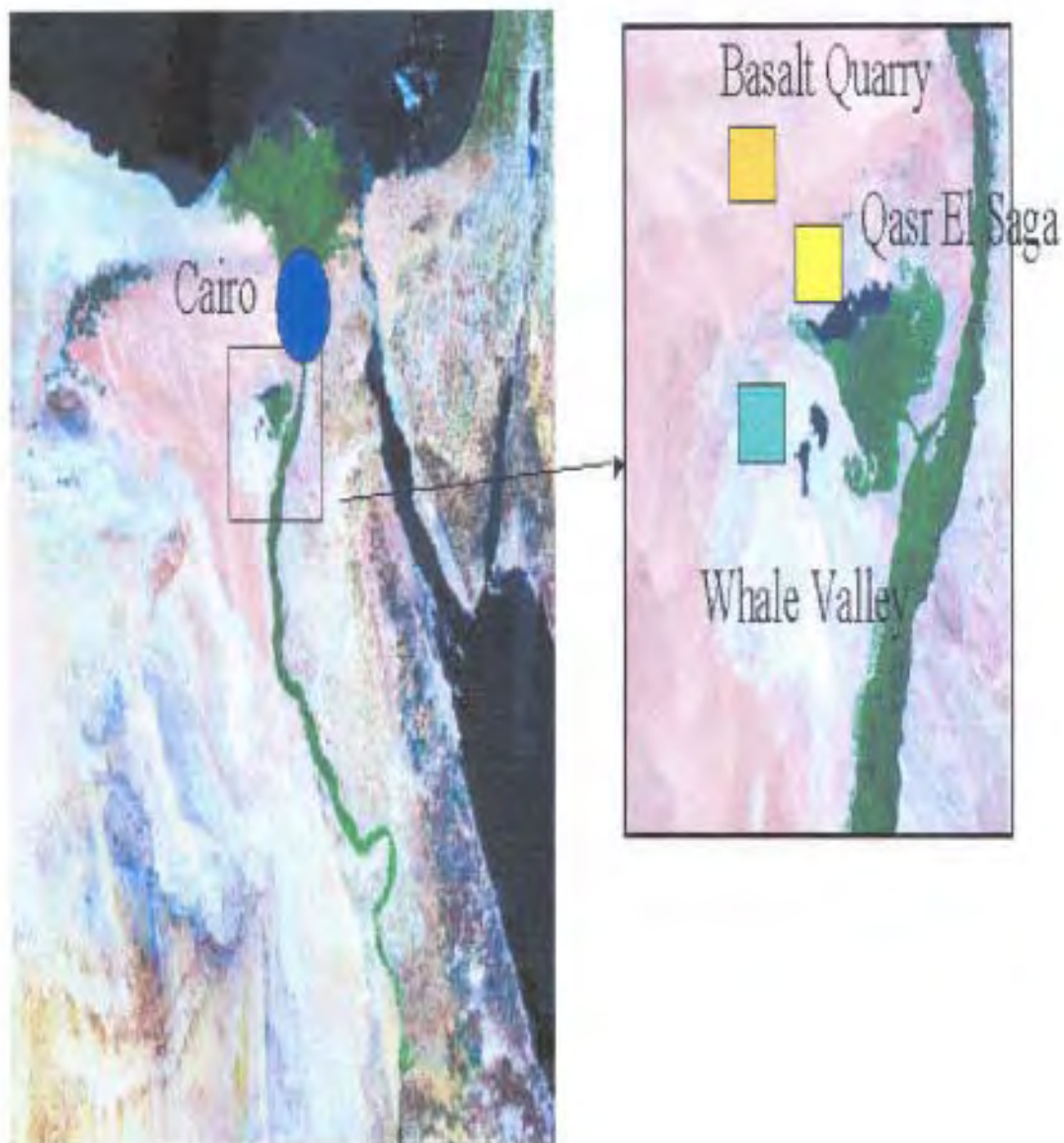
State of preservation of specimens

The state of preservation of the fossil specimens is excellent. The fossils are found in an exceptional concentration, with c.400 identified to date. Many specimens are near-complete specimens preserved in-situ in their death position, with a few to date having preserved features such as stomach contents.

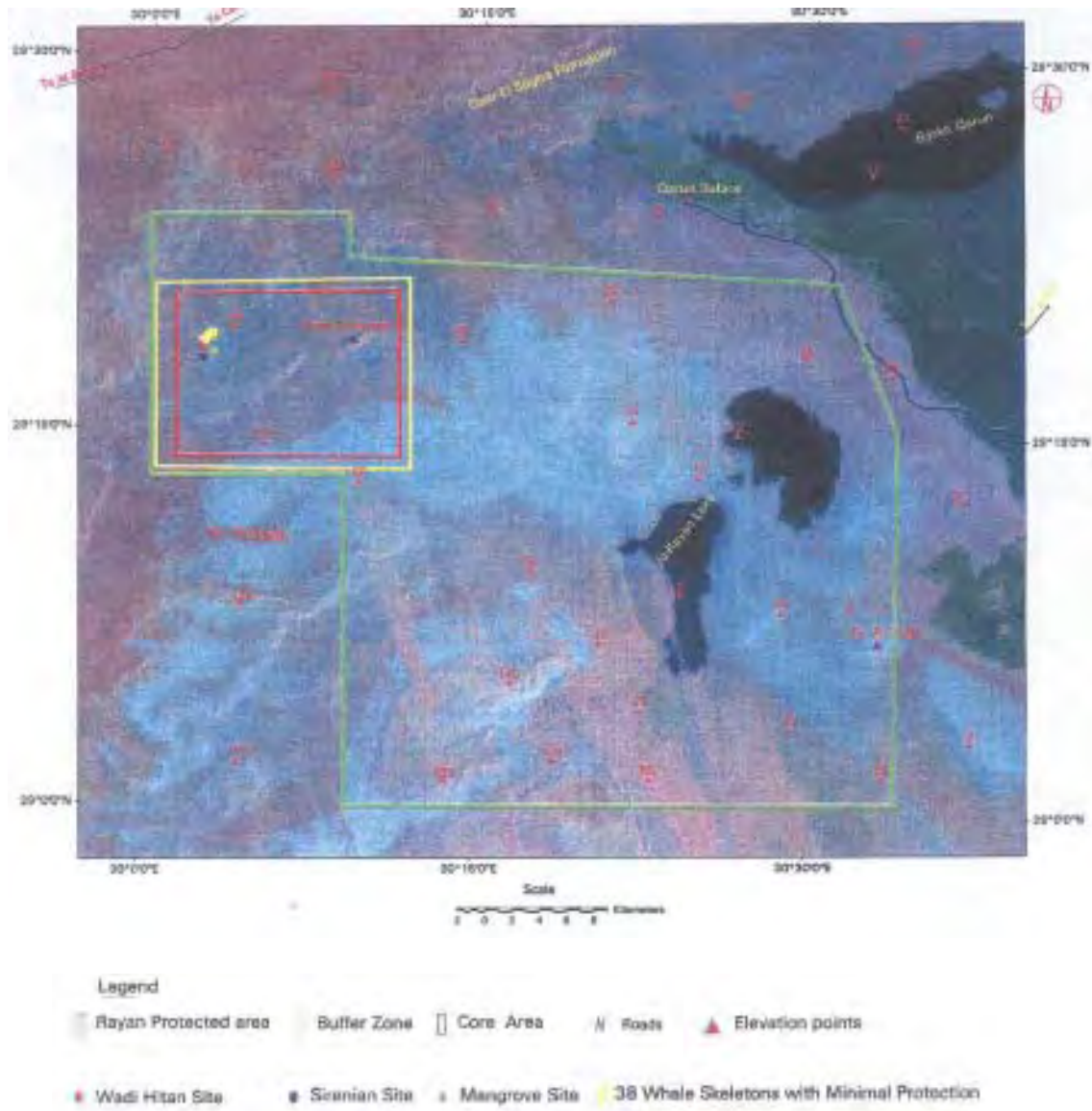
Curation, study and display of fossils

There are well-developed arrangements developed over the last 20 years through the collaboration between the Egyptian authorities and the University of Michigan. Fossils are curated in both Cairo and Michigan, and displayed in museum collections in both places. Fossils are also displayed in-situ within the nominated property, and one skeleton and representative fossil material are also on display at the main visitor centre of the WRPA.

Map 1: General Location of nominated property



Map 2: Boundaries of nominated property



ETATS ARABES

WADI AL-HITAN

(LA VALLÉE DES BALEINES)

EGYPTE



1. DOCUMENTATION

- i) Date de réception de la proposition par l'UICN :** avril 2004
- ii) Dates auxquelles des informations complémentaires ont été demandées officiellement puis fournies par l'État partie :** l'UICN a demandé des informations complémentaires le 11 août 2004, avant la mission d'inspection du bien, le 4 octobre 2004, après la mission et le 10 janvier 2005, après la réunion du Groupe d'experts du patrimoine mondial de l'UICN. Les réponses de l'État partie sont parvenues le 1^{er} décembre 2004 et le 29 mars 2005, respectivement.
- iii) Fiches techniques UICN/WCMC :** 1 référence (le document de la proposition contient 30 références)
- iv) Littérature consultée :** Wells, R.T. 1996. Earth's Geological History – a contextual framework for World Heritage fossil site nominations in **Global Theme Study of World Heritage Natural Sites**, IUCN, Switzerland, 43pp. Uhen, M.D. (2004) **Form, Function and Anatomy of *Dorudon atrox* (Mammalia, Cetacea): An archaeocete from the Middle to Late Eocene of Egypt**, University of Michigan, USA, 222pp. Matravers-Messana, G.H. (2002) **Wadi el-Rayan: Gateway to the Western Desert**, Wadi el Rayan Protection Project, Egypt, 99pp. Dolson, J., El-Barkooky, A., Wehr, F., Gingerich, P.D., Prochazka, N., and Shann, M. (2002) **The Eocene and Oligocene Palaeo-Ecology and Palaeo-Geography of Whale Valley and Fayoum Basins**, AAPG/EPEX/SEG/EGS/EAGE Field Trip No. 7. Rising Star Energy Publication Ltd, Egypt, 79pp. Gingerich, P.D. (1992) **Marine Mammals (Cetacea and Sirenia) from the Eocene of Gebel Mokattam and Fayoum, Egypt: Stratigraphy, age and Palaeoenvironments**, University of Michigan, USA, 84pp. Zimmer, C. (1998) **At the water's edge: macroevolution and the transformation of life** The Free Press, New York, USA, 290pp. Kamel, H et al. (2002) **Wadi El-Rayan Protected Area Management Plan**, ECAA, Egypt, 54pp. Storemyr, P (2003) **Widan el-Faras Ancient Quarry Landscape, North Faiyum Desert, Egypt: Site Description, historical Significance and Current Destruction**, Expert Centre for Conservation of Monuments and Sites, Switzerland, 22pp. Redfern, R. (2002) **Origins: The evolution of continents, oceans and life**, Weidenfeld and Nicholson, 360pp. Plusieurs autres documents de recherche et descriptions scientifiques publiés concernant le bien proposé et la formation du djebel Qatrani ou s'y référant. Les documents destinés aux visiteurs et les détails des dispositions d'aménagement ainsi que des programmes de coopération internationale. Des dossiers de proposition précédents, des évaluations, par l'UICN, de sites fossilifères proposés. Des analyses comparatives et des informations complémentaires soumises au Centre du patrimoine mondial par l'État partie après l'évaluation sur le terrain.
- v) Consultations :** 7 évaluateurs indépendants. La mission a rencontré le gouverneur de la province du Fayoum, les responsables de la Commission nationale égyptienne pour l'UNESCO, les responsables de l'Agence égyptienne pour les affaires environnementales, des représentants du Musée géologique égyptien et des géologues des universités du Caire et de Mansoura.
- vi) Visite du bien proposé :** Tim Badman. Septembre 2004
- vii) Date à laquelle l'UICN a approuvé le rapport :** avril 2005.

2. RÉSUMÉ DES CARACTÉRISTIQUES NATURELLES

Wadi Al-Hitan (la Vallée des baleines) se trouve dans la province du Fayoum et fait partie de l'Aire protégée Wadi El Rayan (APWR), située dans le désert occidental d'Égypte, à 150 km au sud-sud-ouest du Caire et à 80 km à l'ouest de la ville de Fayoum. L'APWR est centrée à la fois sur des sources naturelles et deux lacs saumâtres créés dans les années 1970 avec un excédent d'eau d'origine agricole canalisée depuis le lac Qarun voisin. Wadi Al-Hitan est totalement sec et constitue une partie distincte au sein de l'APWR. Il se trouve à environ 40 km à l'ouest des lacs, dans un paysage désertique particulier et plaisant de piliers rocheux érodés par le vent, entouré de dunes de sable, de collines, de falaises et de plateaux escarpés. Le bien proposé comprend une zone centrale rectangulaire

d'environ 20 015 ha (environ 12 km x 16 km) définie par des coordonnées de latitude/longitude et comportant une zone tampon de 5885 ha.

Le bien est proposé pour l'importance de ses fossiles, en particulier les fossiles d'anciennes baleines du très ancien sous-ordre des Archéocètes aujourd'hui éteint. Il s'agit des ancêtres des deux sous-ordres modernes de cétacés (Mysticètes et Odontocètes). Les fossiles de baleines de Wadi Al-Hitan représentent une étape caractéristique de l'évolution : l'émergence des baleines en tant que mammifères modernes vivant dans l'océan après avoir été des animaux terrestres. Les baleines de Wadi Al-Hitan, à l'échelle de l'évolution, sont parmi les plus jeunes Archéocètes ; elles se trouvent aux dernières étapes de perte de leurs membres postérieurs et ont déjà le corps typiquement

aérodynamique des baleines modernes tout en conservant certains aspects primitifs du crâne et de la structure de la dentition. Il s'agit d'une transition entre la vie dans des eaux côtières peu profondes et la vie d'animaux océaniques, capables de se répandre dans tous les océans.

On trouve les fossiles dans la séquence lithologique en couches horizontales de grès, schistes, marnes et calcaires marins, souvent associés à des minerais d'évaporite. Les roches sont extrêmement dispersées sur le terrain, en exposition naturelle sur le sol désertique et dans une série d'expositions de terrain qui vont de petites falaises à de grands escarpements. Outre les fossiles de baleines, la séquence contient une gamme d'autres fossiles intéressants et d'autres caractéristiques géologiques qui permettent une reconstruction paléogéographique et paléoenvironnementale solide de la région tout au long de l'Éocène.

Il y a plus de 40 millions d'années, la mer dite « mer de Tethys » s'étendait bien au sud des rives actuelles de la Méditerranée. Cette mer s'est progressivement retirée vers le nord en déposant d'épais sédiments de grès, de calcaires et de schistes, visibles dans trois formations rocheuses nommées que l'on trouve à Wadi Al-Hitan. Les roches les plus anciennes appartiennent à la formation Gehannam de l'Éocène (entre 40 et 41 millions d'années) et se composent de calcaires marneux blancs et d'argiles gypseuses et où l'on a découvert de nombreux squelettes de baleines, de siréniens (lamantins) de tortues et de crocodiliens, et des dents de requins. Une couche médiane, la formation de Birket Qarun, composée de grès, d'argiles et de calcaires durs recèle aussi des squelettes de baleines. La formation la plus jeune est celle de Qasr El-Sagha, de l'Éocène supérieur, il y a environ 39 millions d'années. Elle est riche en faune invertébrée marine, ce qui dénote un milieu marin peu profond. Ces formations ont été relevées depuis le sud-ouest, ce qui a créé des systèmes de drainage aujourd'hui enfouis sous le sable, qui se sont déversés dans la mer en passant par des estuaires frangés de mangroves et des lagunes côtières lorsque la côte était proche de ce qui est aujourd'hui l'oasis du Fayoum, il y a environ 37 millions d'années.

Les gisements fossilifères de Wadi Al-Hitan furent découverts durant l'hiver 1902-1903. C'est H. J. L. Beadnell de la Commission géologique d'Égypte qui signala pour la première fois de grands crânes et autres restes de baleines archaïques fossilisés. *Basilosaurus isis* et *Dorudon atrox* reçurent leur nom de nouvelles espèces de Charles Andrews du Muséum d'histoire naturelle de Londres, en 1905. Outre deux brèves visites non publiées de l'université de Californie, États-Unis, en 1947-1948 et de l'université de Yale, États-Unis, vers la fin des années 1960, le bien proposé ne fit pas l'objet d'autres recherches avant 1983 lorsque des chercheurs de l'université du Michigan, États-Unis, s'y rendirent. Le Michigan y conduisit cinq autres expéditions de six semaines en 1985, 1987, 1989, 1991 et 1993. Les travaux de recherche de l'université du Michigan sont la principale contribution ayant révélé l'importance de Wadi Al-Hitan, et c'est dans ce cadre que fut découverte, en 1989, la première preuve au monde d'une baleine

ancienne, présentant des vestiges de membres postérieurs.

Trois espèces différentes de baleines de l'Éocène ont été identifiées avec certitude à Wadi Al-Hitan. Toutes sont des Basilosauridés Le dernier groupe survivant des baleines Archéocètes est le groupe qui aurait donné naissance aux cétacés modernes. La plus grande espèce était *Basilosaurus isis* qui pouvait mesurer 21 mètres de long et avait des ailerons à cinq doigts bien développés comme membres supérieurs, ainsi que des jambes, pieds etorteils postérieurs inconnus jusqu'alors sur les Archéocètes. L'animal avait une forme serpentine et était carnivore. Une autre espèce, *Dorudon atrox*, présente également des os postérieurs vestiges. C'était une petite baleine au corps plus compact, proche de celui du dauphin, et la présence de femelles mettant bas pourrait avoir attiré les grandes baleines prédatrices. Une troisième espèce, *Ancalocetus simonsi*, fut décrite en 1996. Outre les baleines, on a décrit 19 autres espèces de vertébrés dans le bien proposé, notamment trois espèces de siréniens primitifs (lamantins), un squelette partiel du proboscide primitif *Moeritherium*, des crocodiles, des requins, des poissons-scies, des raies, des poissons osseux, des tortues (y compris une tortue de mer) et un serpent de mer. Il y a aussi une faune invertébrée riche, y compris des nummulitidae, des mollusques et notamment des gastéropodes, des bivalves et des nautiloidea, des échinides et des crabes. Parmi les plantes fossilisées, il y a des espèces de mangroves et d'herbes marines. À condition que le bien reçoive une protection adéquate et fasse l'objet de mesures de gestion et de travaux de recherche, il est considéré comme certain qu'il y aura d'autres découvertes d'Archéocètes et autres espèces, et que l'on obtiendra de nouvelles connaissances en matière de biologie et de paléocologie des premières baleines et du milieu marin de l'Éocène.

La concentration de fossiles de baleines est exceptionnelle et les fossiles sont de très haute qualité. De nombreux squelettes de baleines et de siréniens sont très bien préservés : des spécimens pratiquement complets et articulés sont découverts *in situ* dans la position dans laquelle ils ont trouvé la mort, certains présentant des caractéristiques associées telles que le contenu de l'estomac bien préservé. En outre, les nombreux squelettes représentent une série ontogénétique (c'est-à-dire une gamme d'individus allant des jeunes aux vieux), ce qui apporte une dimension supplémentaire à leur étude du point de vue de la recherche sur la biologie et le développement et permet donc une compréhension plus profonde de leur évolution et de leur écologie. Les derniers chiffres vérifiés font état d'un total de 379 baleines fossiles dont 179 sont cataloguées, ainsi que de 40 fossiles vertébrés catalogués. Parmi les vertébrés catalogués, 89 se trouvent dans la collection de l'université du Michigan. 59 spécimens, y compris les spécimens types des espèces décrites à l'origine dans le bien se trouvent dans la collection du Musée géologique du Caire, et le reste des espèces cataloguées est actuellement sur le terrain. Le matériel de siréniens et de cétacés prélevé à l'origine dans le Fayoum se trouve au Caire, à Londres, à Berlin et à Stuttgart.

Le bien proposé jouxte une zone qui présente des caractéristiques fossilifères importantes. La séquence lithologique exposée à Wadi Al-Hitan est recouverte en discordance, à l'extérieur des limites du bien proposé, par la formation Éocène-Oligocène du djebel Qatrani. Ces roches ont été étudiées de manière approfondie dans les sites qui se trouvent au nord du lac Qarun, dans l'Aire protégée du Qarun, mais ils sont aussi exposés sur une plus vaste région. Dans cette formation, les excavations ont donné des vestiges fossilifères de mammifères terrestres d'importance internationale, en particulier les vestiges fossilifères de huit lignées de primates, y compris les tout premiers hominoïdes connus (Redfern, 2002). La faune comprend aussi le mammifère à deux cornes *Arsinotherium*, ainsi que les ancêtres de l'éléphant. Le djebel Qatrani est inscrit sur la Liste de référence de l'Égypte comme bien mixte potentiel. Une demande d'aide internationale auprès du Fonds du patrimoine mondial en vue de préparer un plan de gestion pour le djebel Qatrani, a été soumise au début de 2005. En outre, le djebel Qatrani a été identifié par l'UICN comme un bien fossilifère potentiel du patrimoine mondial dans l'étude contextuelle de l'UICN pour les biens fossilifères du patrimoine mondial (Wells, 1996), et où il est décrit comme suit : « ... le registre le plus complet de mammifères paléogènes pour toute l'Afrique. La faune diverse (40 genres, 75 espèces) qui comprend deux genres hominoïdes a une importance fondamentale pour la compréhension de l'évolution de nombreux groupes de mammifères du continent, en particulier les hominidés. »

3. COMPARAISON AVEC D'AUTRES SITES

Le dossier de proposition d'origine contient une analyse comparative incomplète. L'État partie a cependant commandé une analyse comparative à un expert mondial des fossiles de cétacés de l'université du Michigan, qui a beaucoup travaillé sur le bien proposé ainsi que sur d'autres sites clés à l'échelle mondiale. L'analyse comparative de l'UICN a également bénéficié d'une revue d'experts scientifiques renommés pour leurs compétences dans ce domaine.

La valeur universelle exceptionnelle du bien proposé est principalement justifiée par le fait que l'on y trouve les premières étapes de l'évolution des baleines et de l'évolution des Archéocètes, mammifères terrestres devenus des animaux marins. L'importance du bien est justifiée par le fait qu'il s'agit du seul site connu au monde où l'on peut observer un grand nombre de fossiles d'Archéocètes complets, de haute qualité, dans leur milieu géologique et géographique d'origine et tient aussi à sa valeur d'icône puisque l'on y a découvert la preuve que les baleines avaient des pattes. Ces caractéristiques sont beaucoup renforcées par le contexte géologique additionnel décrit plus haut et sont décrites par rapport à la liste de référence normalisée de l'UICN pour les biens fossilifères proposés qui se trouve en annexe au présent rapport.

Dans son étude contextuelle (Wells, 1996), l'UICN énonce des recommandations sur la sélection de biens fossilifères du patrimoine mondial. Elle souligne en particulier le concept fondamental du choix de biens qui

représentent des événements clés dans l'arbre de la vie. L'étude recommande de donner la priorité à des biens qui représentent des structures communautaires, mais en mettant l'accent sur les plus hauts niveaux taxonomiques et les vertébrés en particulier, afin de maintenir une liste gérable de biens et de se concentrer sur les biens d'importance universelle. L'UICN considère que l'évolution des baleines est un aspect clairement défini du registre biologique pouvant être considéré comme satisfaisant intégralement à ces principes. Il s'agit d'une illustration exceptionnellement vivante et accessible à un large public du processus d'évolution, présentant une transition pour des mammifères terrestres qui retournent à la mer et qui, ce faisant, perdent progressivement leurs membres. En outre, c'est une transition qui est aujourd'hui scientifiquement fondée et qui a trait à un groupe animal à la fois important pour la conservation moderne et attrayant pour le grand public. L'UICN considère que le terme « icône » se justifie pleinement.

Parmi les autres illustrations vivantes d'importantes valeurs fossilifères représentées sur la Liste du patrimoine mondial, il y a la diversité de la toute première explosion de la vie sur terre [les schistes de Burgess dans les Parcs des Montagnes rocheuses canadiennes], l'Âge des poissons [Miguasha (Canada)], l'Âge des dinosaures [Ischigualasto-Talampaya (Argentine)], Monte San Giorgio (Suisse), Dorset et Côte Est du Devon (Royaume-Uni), Parc provincial Dinosaur (Canada)], et l'évolution des premiers hommes [Parcs nationaux du lac Turkana (Kenya)]. L'avènement des mammifères est un autre exemple, comparable avec le bien proposé. Dans ce cas, l'évolution des mammifères terrestres est représentée sur la Liste du patrimoine mondial par le site fossilifère exceptionnel de Messel (Allemagne), considéré comme le site le plus riche du monde pour la compréhension du milieu vivant de l'Éocène et les sites fossilifères de mammifères d'Australie dont les valeurs représentent l'évolution d'une faune de mammifères terrestres moderne et distincte (du Miocène jusqu'à des sédiments plus jeunes). Aucun de ces biens ne contient d'élément marin ni ne concerne l'évolution des baleines. La Liste du patrimoine mondial fournit aussi de nombreuses illustrations de la valeur universelle exceptionnelle attachée aux cétacés et aux siréniens car ces espèces sont à la base du choix de biens naturels tels que la péninsule Valdez (Argentine), le Sanctuaire de baleines d'El Vizcaíno (Mexique) et Shark Bay (Australie). Du point de vue des valeurs d'autres biens du patrimoine mondial, l'UICN considère que la démonstration de l'évolution des baleines justifie la valeur universelle exceptionnelle du point de vue de la description de l'évolution de la vie.

Il y a des milliers de gisements fossilifères dans le monde qui ont donné un spécimen de baleine au moins. Plusieurs sont importants car ils illustrent les premières étapes de l'évolution des baleines sur 20 millions d'années et sont plus anciens que Wadi Al-Hitan. On connaît, en Égypte, d'importants sites fossilifères de baleines de l'Éocène dans le djebel Mokattam, au Caire, mais ils sont essentiellement ensevelis sous l'urbanisation. On estime que la poursuite des études pourrait permettre de trouver, dans le bien proposé, bon nombre de vestiges recelés par ces sites. C'est en Inde

et au Pakistan dans les contreforts boisés de l'Himalaya, dans le désert du Kutch et dans le désert des zones tribales du Punjab, du Balouchistan et de la province de la Frontière du Nord-Ouest que l'on a trouvé des baleines Archéocètes plus anciennes et plus primitives. Ces sites illustrent des étapes plus anciennes de l'histoire de l'évolution des baleines et présentent des caractéristiques différentes et complémentaires à celles du bien proposé. Beaucoup, cependant, sont inaccessibles et aucun ne se compare, même de loin, à Wadi Al-Hitan du point de vue du nombre et de la concentration des fossiles.

Un nombre important de squelettes partiels de baleines Archéocètes, plus ou moins contemporains de ceux de Wadi Al-Hitan, ont été découverts dans la plaine côtière du golfe du Mexique et la Région atlantique de l'est de l'Amérique du Nord depuis 150 ans. Toutefois, aucun des squelettes n'est complet et les sites où on les trouve sont dispersés, généralement couverts de végétation et d'un accès difficile.

On possède en abondance des fossiles de baleines des sous-ordres Mysticète et Odontocète dans des sites du Miocène et du Pliocène tels que Shark Tooth Hill, en Californie, vieux de 12 à 15 millions d'années et le Cerro Blanco de la formation de Pisco, au Pérou, vieux de 5 à 6 millions d'années. Toutefois, ces baleines sont essentiellement modernes et n'illustrent pas l'histoire de l'évolution de la même manière que le bien proposé.

Dans sa discussion des valeurs comparatives du bien proposé, l'UICN fait remarquer le contexte important que le voisinage de la formation du djebel Qatrani, dans l'Aire protégée du lac Qarun, procure à Wadi Al-Hitan. De l'avis de l'UICN, les valeurs du bien proposé et la formation du djebel Qatrani représentent différents aspects d'une histoire intimement liée. Bien que l'analyse comparative du bien proposé ne s'appuie, obligatoirement, que sur les valeurs propres au site, l'UICN estime qu'il existe suffisamment de raisons importantes (y compris l'étude contextuelle de l'UICN) de suggérer que le djebel Qatrani a d'importantes caractéristiques qui ne peuvent logiquement être séparées de celles de Wadi Al-Hitan dans la proposition d'inscription sur la Liste du patrimoine mondial. Les zones exposées du lac Qarun ont produit quelques fossiles de baleines, mais leur valeur démonstrative de l'évolution des cétacés est largement surpassée par celle du bien proposé.

En résumé, le bien proposé est le site le plus important du monde pour illustrer l'évolution des baleines. Cette évaluation s'appuie sur la nature complète des fossiles, leur qualité, leur concentration et leur accessibilité, ainsi que sur les abondantes preuves supplémentaires qui permettent une construction solide de la paléogéographie et de la paléoécologie du milieu marin et côtier de l'Éocène dans la zone où on les trouve.

4. INTÉGRITÉ

4.1 Limites

Les limites du bien proposé dessinent un rectangle défini par les coordonnées de latitude et de longitude,

avec une zone tampon qui correspond à un rectangle légèrement plus grand et défini de la même manière. Ces limites ont été choisies afin de contenir les principales caractéristiques intéressantes, ainsi qu'une partie plus large de l'APWR. Elles suffisent donc pour satisfaire aux conditions d'intégrité définies par la Convention, du moins pour les besoins administratifs. Elles ne sont cependant pas optimales pour les besoins de la gestion, notamment parce qu'elles ne peuvent être tracées sur le terrain qu'avec un système de positionnement mondial (GPS). L'UICN considère que les caractéristiques topographiques visibles dans le paysage, et plus précisément, le sommet des escarpements de l'aire protégée seraient de meilleures limites opérationnelles.

Durant la mission d'évaluation, des experts scientifiques ont déclaré à l'UICN que l'aire protégée à l'intérieur du bien serait renforcée par l'ajout d'une zone supplémentaire d'affleurements à l'ouest de l'APWR, au djebel Abiad. Cette zone contient des expositions de roches de l'Éocène supérieur. L'UICN estime que cette zone pourrait compléter, à l'avenir, les valeurs du bien proposé, mais que son importance n'est pas suffisamment vitale pour les centres d'intérêt principaux pour qu'elle soit considérée comme un ajout essentiel à la proposition.

La zone tampon est aussi une zone rectangulaire qui suit les limites prévues pour le bien proposé et qui est, comme celui-ci, intégrée entièrement dans les limites de l'APWR. Telle qu'elle est, elle semble ne servir aucun but fonctionnel et n'a pas de valeur pratique du point de vue du renforcement de la protection du bien proposé au-delà de ce que les limites du bien elles-mêmes assurent. Durant la mission d'évaluation, les parties égyptiennes ont déclaré souhaitable que la zone tampon soit étendue vers l'ouest, en dehors de l'aire protégée existante, jusqu'à la route de Bahariya et vers le sud afin de fournir une zone tampon plus vaste. Ces zones n'étant pas actuellement dans des aires protégées, cette proposition nécessiterait une déclaration ministérielle qui, selon ce que l'UICN a pu comprendre, serait un processus relativement simple et rapide. L'UICN considère que l'agrandissement de la zone tampon serait souhaitable, et en particulier qu'il renforcerait les capacités de gérer l'accès au site depuis la route de Bahariya. Toutefois, vu l'étendue des limites définies pour le bien proposé, la protection plus large de l'APWR et l'absence de menaces importantes à l'ouest et au sud du bien, l'UICN ne considère pas que l'absence d'une zone tampon officiellement déclarée crée un problème d'intégrité immédiat.

4.2 Statut juridique

Le bien dispose d'une protection juridique forte au titre de la Loi égyptienne No 102 de 1983 sur les protectorats naturels. Celle-ci fournit une protection juridique forte et sans équivoque pour le bien, empêchant des actions qui pourraient conduire à la destruction ou à la détérioration du milieu naturel. La loi a le mérite de mentionner ouvertement les caractéristiques géologiques comme des éléments spécifiques qui reçoivent une protection. L'APWR est devenue aire protégée en 1989, en vertu du décret 943 du Premier Ministre. Wadi Al-Hitan a été adjoint à l'APWR en 1997

par décret No 2954 du Premier Ministre. Le but global de la gestion de l'aire protégée est la protection des ressources naturelles, conformément au décret de proclamation.

4.3 Régime de propriété

Le bien proposé appartient à l'État égyptien et il est géré par le secteur Conservation de la nature de l'Agence pour les affaires environnementales (EEAA).

4.4 Gestion

Le bien proposé et la zone tampon sont gérés dans le cadre d'une aire naturelle intégralement protégée, au sein de l'APWR. Il y a un plan d'aménagement pour l'APWR pour la période 2002-2006 qui a été préparé, en 2002, par l'EEAA, sous la supervision de l'UICN. Dans ce plan, le bien proposé est identifié comme une des deux zones spécialement protégées et il est prévu d'accorder une protection intégrale aux vestiges fossilifères, ainsi que de réglementer l'écotourisme. L'APWR a également bénéficié de l'appui du Programme de coopération environnementale italo-égyptien qui couvrira les dépenses à hauteur d'environ 6 millions de livres égyptiennes dans les trois prochaines années.

L'APWR bénéficie des services d'une équipe dévouée de gardiens, de gardes communautaires et autres employés, c'est-à-dire, en tout, 28 personnes. Il est prévu de renforcer encore le personnel. L'UICN considère que l'appui et la formation de ce qui est encore une équipe relativement nouvelle seront essentiels pour la mise en place de la gestion du bien proposé et se félicite de l'attention portée à cet aspect par l'EEAA et par le Programme de coopération italo-égyptien.

Les dispositions relatives à la gestion et au personnel semblent suffisantes pour satisfaire les besoins du bien proposé, mais il est clair que les ressources restent un problème et qu'il faudra donner de plus en plus la priorité, à court et à moyen terme, à l'acquisition de véhicules et d'équipements adéquats pour l'équipe chargée de gérer le bien. Le bien proposé est éloigné de la principale base du personnel et inhospitalier, de sorte que pourvoir le site en personnel exige de tenir dûment compte des questions de logistique. L'équipe dépend, dans une certaine mesure, de la fourniture d'une assistance extérieure et l'apport d'un financement solide et adéquat à long terme, pour soutenir la gestion du bien, nécessite un engagement ferme de l'État partie. L'UICN a reçu l'assurance que les autorités égyptiennes accordent une attention suffisante à ces questions.

L'UICN considère que les aspects opérationnels de plusieurs éléments du plan d'aménagement doivent encore faire l'objet d'un examen approfondi et d'une planification précise. Les détails d'élaboration des plans d'écotourisme sont particulièrement importants, ainsi que la manière dont les possibilités d'interprétation et d'éducation sont dispensées dans le bien proposé. Les centres d'intérêt du bien proposé sont actuellement présentés et interprétés au centre d'accueil principal des visiteurs pour l'APWR, qui se trouve près des lacs. Le centre d'accueil des visiteurs présente, à l'extérieur, un squelette de baleine et un important fragment de squelette est mis à disposition pour examen, à l'intérieur,

ainsi que des exemples d'autres fossiles provenant du bien proposé; on y trouve aussi des expositions et une reconstitution peinte du milieu de l'époque. Il y a des gardes compétents pour aider les visiteurs, ainsi qu'une salle audiovisuelle et une présentation de vidéos qui donnent une bonne introduction sur les centres d'intérêt du bien proposé, dans un lieu très accessible pour les visiteurs; les possibilités d'amélioration et de développement sont importantes. L'UICN considère que l'accent doit être placé, en premier lieu, sur l'expérience, avec des guides formés, plutôt que sur la mise en place de panneaux et d'infrastructures et ajoute qu'il importe d'établir une collaboration solide avec les entreprises de randonnée du secteur privé qui organisent actuellement des visites dans le bien et qui devraient amener beaucoup plus de visiteurs à l'avenir.

Les dispositions de suivi et d'établissement des rapports sur l'état des fossiles nécessitent d'être affinées, en collaboration avec un petit groupe scientifique.

Au-delà du bien proposé, il y a un certain nombre de problèmes de gestion épineux concernant l'APWR. Ils n'ont pas d'incidence sur le bien proposé mais sont importants pour le paysage en général et comprennent la transformation des terres désertiques pour l'agriculture, la gestion de l'eau dans les lacs et l'interaction avec le village qui se trouve dans l'aire protégée. Certaines activités semblent être menées sans planification préalable adéquate et sans consultation relative au statut de protection et à l'importance de la zone. Le plan de gestion de l'APWR indique que la collaboration n'est pas très étroite entre les différentes agences et l'UICN considère que l'intégration des activités de différents ministères pourrait être renforcée. La participation active de la communauté locale à la gestion de l'APWR pourrait être renforcée et il est possible de chercher à obtenir des avantages économiques et sociaux plus importants pour les communautés locales grâce à la présence et à la gestion de l'aire protégée et, éventuellement, du statut de patrimoine mondial, en particulier dans le cadre d'activités d'écotourisme. Il importe de noter que plusieurs initiatives sont en cours pour concevoir et appliquer des activités de tourisme durable dans le bien.

4.5 Impact anthropique

Les vestiges fossilifères de Wadi Al-Hitan pourraient être vulnérables aux pressions exercées par les visiteurs – par exemple le ramassage – et, à long terme, à l'érosion naturelle s'ils ne sont pas conservés dans des musées ou sur place. Les fossiles de baleines sont de taille importante et relativement difficiles à extraire. Certains des squelettes exposés et des caractéristiques telles qu'un tronc d'arbre troué par les vers présentent des traces de prélèvement de morceaux comme souvenirs. Il est impossible d'empêcher totalement cela sans porter préjudice au caractère du bien. Des clôtures basses et du matériel pédagogique semblent être des moyens efficaces de limiter les dommages, mais nécessitent une attention permanente. Il est inévitable qu'il y ait une certaine érosion naturelle des fossiles, mais cela se produit à une échelle de temps qui ne menace pas l'intégrité et la valeur du bien proposé. Des travaux de restauration et

de consolidation *in situ* localisés de certains spécimens exposés, par l'application de polymères ont été conduits sous la supervision du Musée géologique égyptien. Il est clair, cependant, qu'il y aura une perte progressive de matériel fossilifère en raison de l'exposition naturelle, mais ce processus est à la fois lent (de sorte que les impacts sont progressifs et peuvent être atténués par une gestion active, la recherche et un ramassage responsable de fossiles) et entraîne le maintien de l'intérêt du bien proposé à mesure que de nouveaux fossiles sont mis au jour.

L'étude paléontologique est extractive par nature. En raison de la grande taille des squelettes fossilisés et de leur éloignement, il est peu probable qu'un prélèvement non autorisé de grands spécimens puisse avoir lieu; en revanche, une extraction, une étude et une conservation réglementées sont une exigence permanente. Cette question est abordée de manière exemplaire pour le site proposé grâce à un memorandum d'accord tripartite entre l'université du Michigan, l'EEAA et la Commission géologique et Administration des mines d'Égypte (CGAME). Cet accord n'attend plus que la signature de la CGAME et comprend un plan de recherche bien préparé pour le bien, pour la période 2005-2008, qui prévoit une exploration scientifique et une collecte de spécimens réglementées. Il prévoit aussi la conservation des nouvelles découvertes au Musée géologique égyptien, la recherche et l'étude au Michigan et le transfert des compétences au personnel du site égyptien dans le cadre d'un programme de formation. La coopération et l'appui que les géologues égyptiens du Musée et les universités apportent au site semblent excellents et efficaces. Cette collaboration permet une recherche plus vaste sur la géologie de la région, contribuant à créer une image complète et solide de la paléogéographie et de la paléoécologie de la région.

Les caractéristiques naturelles de Wadi Al-Hitan, paysage désertique superbe et vierge, sont fragiles. Déjà, des véhicules 4x4 y pénètrent et l'on peut y voir des traces de véhicules à la surface du désert. Le trafic motorisé est la plus grande menace potentielle à la fois pour les caractéristiques physiques de Wadi Al-Hitan et pour l'expérience des visiteurs. Dans les informations complémentaires fournies par l'État partie, il est indiqué que la conception et l'application d'un programme de gestion pour réglementer et gérer l'accès des véhicules dans le bien, ainsi que les dispositions relatives à la gestion des visiteurs et aux infrastructures d'interprétation sont considérées comme parties intégrantes du plan d'aménagement en train d'être préparé pour le bien. L'UICN souligne qu'il faut adopter une approche globale et sensible de l'interprétation du bien, pour s'assurer que les valeurs naturelles soient expliquées aux visiteurs tout en protégeant le caractère isolé et intact du paysage et l'expérience des visiteurs.

5. AUTRES COMMENTAIRES

Les relations entre Wadi Al-Hitan et le site voisin du djebel Qatrani sont un problème clé dans le contexte de l'examen de cette proposition par le Comité du patrimoine mondial. L'État partie Égypte conçoit actuellement que les deux biens de Wadi Al-Hitan et

djebel Qatrani sont des propositions distinctes. Cela s'explique par le fait que les éléments particuliers de l'évolution des baleines ne sont présents qu'à Wadi Al-Hitan, que le djebel Qatrani est considéré comme ayant une importance mixte potentielle – valeurs fossilifères terrestres Éocène/Oligocène qui pourraient être proposées au titre du critère naturel (i), et que le paysage de carrières de basalte de Widan Al-Faras présente des valeurs culturelles. Deuxièmement, du point de vue opérationnel, l'État partie considère que Wadi Al-Hitan est administré séparément et bénéficie d'une capacité de gestion qui explique qu'il est « prêt » pour la proposition, tandis que les mesures de gestion du djebel Qatrani ne sont pas suffisantes pour l'instant pour remplir les conditions d'intégrité.

L'UICN note que :

- les fossiles de Wadi Al-Hitan et djebel Qatrani se trouvent dans des formations rocheuses qui sont géologiquement contiguës ;
- les valeurs fossilifères des deux biens ont le même intérêt fondamental – l'évolution de mammifères à l'Éocène-Oligocène ;
- les biens sont essentiellement limitrophes et les limites des aires protégées sont pratiquement contiguës ;
- les deux biens sont gérés par la même équipe de gestion EEAA ;
- les valeurs naturelles et culturelles du djebel Qatrani ne sont pas intellectuellement reliées les unes aux autres et l'idée de proposer ce site comme un bien mixte ne justifie pas de considérer les intérêts séparément;
- les incidences et les avantages du statut de patrimoine mondial pour la région du Fayoum seraient renforcés si une zone plus vaste faisait l'objet de la proposition.

En conséquence, l'UICN considère que les valeurs fossilifères du djebel Qatrani ne peuvent être séparées des valeurs de Wadi Al-Hitan en deux propositions distinctes. Wadi Al-Hitan fournit une démonstration convaincante de valeurs universelles exceptionnelles en soi, mais il est essentiel qu'une proposition future des valeurs fossilifères du djebel Qatrani soit considérée comme une extension des valeurs de Wadi Al-Hitan et non comme une proposition en soi.

L'UICN reconnaît que le Comité pourrait choisir de différer la proposition de Wadi Al-Hitan en attendant une proposition intégrée des deux sites, mais ne recommande pas cette approche pour les raisons suivantes :

- Wadi Al-Hitan en soi démontre des valeurs universelles exceptionnelles et peut remplir les conditions d'intégrité. Si le djebel Qatrani n'existait pas, le bien proposé serait acceptable ;
- Wadi Al-Hitan est un bien fragile qui subit actuellement des pressions et le statut de bien du patrimoine mondial serait une incitation à garantir sa protection ;
- avec le suivi approprié, la proposition de Wadi Al-Hitan fournit le point de départ le plus efficace pour l'élaboration d'une proposition cohérente pour les intérêts fossilifères plus généraux, compte tenu de

la capacité de l'État partie. La proposition reconnaît l'investissement important que l'État partie Égypte a consenti pour la gestion de l'APWR, ainsi que ses plans prévoyant de mettre en place une capacité semblable pour l'Aire protégée du lac Qarun.

Par ailleurs, l'UICN note que des sites, ailleurs dans le monde, et en particulier au Pakistan et en Inde, présentent différents aspects de l'évolution plus ancienne des baleines et encouragent les États parties pertinents à s'efforcer de relier les travaux de recherche et les programmes de promotion concernant ces sites.

6. APPLICATION DES CRITÈRES DU PATRIMOINE MONDIAL/IMPORTANCE

Wadi al-Hitan est proposé au titre du critère naturel (i).

Critère (i) : histoire de la terre et processus géologiques

Wadi Al-Hitan est le site le plus important du monde démontrant un des changements majeurs qui s'inscrit dans l'histoire de la vie sur Terre : l'évolution des baleines. Leur forme et leur mode de vie durant leur transition entre l'état d'animaux terrestres et l'existence marine est décrit de manière vivante. Le site a des valeurs qui dépassent celles de sites comparables du point de vue du nombre, de la concentration et de la qualité de ses fossiles, ainsi que de leur accessibilité et de leur emplacement dans un beau paysage protégé. Il concorde avec les principes clés de l'étude de l'UICN sur les sites fossilifères du patrimoine mondial et représente des valeurs importantes actuellement absentes de la Liste du patrimoine mondial. L'UICN considère que le bien proposé remplit ce critère.

7. PROJET DE DÉCISION

L'UICN recommande au Comité du patrimoine mondial d'adopter le projet de décision suivant :

Le Comité du patrimoine mondial,

1. *Ayant examiné le Document WHC-05/29.COM/8B*
2. *Inscrit Wadi Al-Hitan, Égypte, sur la Liste du patrimoine mondial, sur la base du critère naturel (i) :*

Critère (i) : Wadi Al-Hitan est le site le plus important du monde démontrant un des changements majeurs qui s'inscrit dans l'histoire de la vie sur Terre : l'évolution des baleines. Leur forme et leur mode de vie durant leur transition entre l'état d'animaux terrestres et l'existence marine est décrit de manière vivante. Le site a des valeurs qui dépassent celles de sites comparables du point de vue du nombre, de la concentration et de la qualité de ses fossiles, ainsi que de leur accessibilité et de leur emplacement dans un beau paysage protégé. Il concorde avec les principes clés de l'étude de l'UICN sur les sites fossilifères du patrimoine

mondial et représente des valeurs importantes actuellement absentes sur la Liste du patrimoine mondial.

3. *Recommande à l'État partie de consolider le plan d'aménagement du bien pour :*
 - i) *réviser les limites du bien pour tenir compte des caractéristiques topographiques visibles, en particulier les sommets des escarpements de l'aire protégée pour faire en sorte qu'elles soient clairement identifiables sur le terrain et plus utiles à la gestion du site ;*
 - ii) *étudier la possibilité d'étendre la zone tampon du bien jusqu'à la route de Bahariya et à travers le désert en direction du sud, afin d'augmenter la possibilité de gérer le trafic motorisé ;*
 - iii) *concevoir avec soin et appliquer un programme de gestion du trafic motorisé ;*
 - iv) *fournir une infrastructure de gestion essentielle dans le bien proposé afin d'atténuer le plus possible les intrusions et les dommages causés aux valeurs naturelles ; et*
 - v) *utiliser pleinement les résultats et recommandations de programmes et études en cours concernant le développement d'un tourisme durable, y compris pour la gestion des visiteurs et l'interprétation.*
4. *Se félicite de l'appui apporté par l'État partie Italie à la gestion de ce bien et recommande à l'État partie Égypte, conjointement avec l'Italie, de déterminer les mesures nécessaires pour maintenir et renforcer cet appui à l'avenir dans le but de garantir l'application efficace du Plan de gestion et la protection des valeurs du bien, à long terme.*
5. *Prie instamment l'État partie d'envisager de proposer la formation du djebel Qatrani pour ses valeurs fossilifères naturelles en tant qu'extension de Wadi Al-Hitan.*

ANNEXE 1 : LISTE DE RÉFÉRENCE DE L'UICN POUR L'ÉVALUATION DES SITES FOSSILIFÈRES

Couverture d'une longue période de temps géologique

Les roches du bien proposé ont été déposées sur une période de 3 à 4 millions d'années couvrant l'époque de transition entre l'Éocène moyen et l'Éocène supérieur (40 – 37 millions d'années). Les roches qui contiennent les principaux vestiges de baleines datent de 37 – 38 millions d'années et présentent des modifications progressives dans les conditions avec une série de différents niveaux stratigraphiques préservant les vestiges fossiles. La caractéristique la plus intéressante, l'évolution des baleines, a eu lieu tout au long de l'Éocène avec les premières traces au début de l'Éocène vers 55 millions d'années, et la présence de formes essentiellement modernes vers 33 millions d'années. Les fossiles du bien proposé illustrent de manière éclatante les changements morphologiques d'importance critique qui ont eu lieu tout au long de cette longue période, et en particulier, la perte progressive des membres postérieurs à mesure qu'un mode de vie marin intégral était adopté. Au-delà du bien proposé, la section stratigraphique est exceptionnellement exposée et s'étend de manière continue en direction du nord dans les escarpements environnants sur une vaste fenêtre géologique comprenant également les dépôts de l'Oligocène et du Miocène inférieur, dont les plus récents ont 15 millions d'années.

Riche diversité des espèces

Le bien proposé contient une faune marine diverse, y compris 25 genres de plus de 14 familles, 10 ordres et 4 classes de vertébrés. La faune comprend des poissons cartilagineux et osseux, des reptiles (y compris des crocodiles, des tortues et des serpents de mer) et des mammifères (baleines et siréniens). En outre, on trouve une faune d'invertébrés bien développée et des vestiges de plantes sous forme de mangroves et d'herbes marines fossilisées. La diversité est élevée par rapport à la diversité connue des baleines de l'Éocène et devrait augmenter à mesure que les études progressent, bien qu'en nombre absolu, la diversité de vertébrés se trouve à l'extrémité la plus basse de l'échelle comparé à des biens fossilifères du patrimoine mondial existants. Si l'on inclut la zone contiguë de la formation du djebel Qatrani, le nombre total de vertébrés passe à plus de 90 espèces.

Représentativité unique d'une période géologique

Il y a, de par le monde, un nombre incalculable de sites fossilifères de l'Éocène et des milliers de sites ont produit des fossiles de baleines d'une sorte ou d'une autre. Le bien ne représente pas de manière unique le milieu marin de l'Éocène ni l'histoire à valeur d'icône de l'évolution des baleines durant l'Éocène. Il est cependant considéré comme le meilleur site illustrant l'évolution des baleines. Le Bien du patrimoine mondial du site fossilifère de Messel date aussi de l'époque de l'Éocène et préserve une faune fossilisée qui est, en termes relatifs, beaucoup plus riche que celle du bien proposé. Il s'agit cependant de fossiles terrestres qui n'offrent aucun registre de baleines ou d'autres espèces marines de l'Éocène.

Existence de sites comparables

Parmi les nombreux sites où l'on a découvert des vestiges de fossiles de baleines Archéocètes de l'Éocène, plusieurs sont aussi d'importance internationale. Cela comprend des sites qui représentent les étapes les plus anciennes de l'évolution des baleines, qui ont plus de 20 millions d'années d'ancienneté par rapport à Wadi Al-Hitan. Des baleines Archéocètes plus anciennes et plus primitives se trouvent essentiellement en Inde et au Pakistan, dans les contreforts boisés de l'Himalaya, les zones désertiques du Kutch et dans les zones tribales désertiques du Punjab, du Balouchistan et de la province de la Frontière du Nord-Ouest. Un nombre important de squelettes partiels de baleines Archéocètes plus ou moins contemporaines de celles de Wadi Al-Hitan ont été trouvés dans la plaine côtière du golfe du Mexique et la Région atlantique de l'est de l'Amérique du Nord. Aucun d'entre eux n'est comparable à Wadi Al-Hitan du point de vue du nombre et de la concentration des fossiles et, dans la plupart des cas, leur accès est très difficile. Les autres sites fossilifères de baleines, ailleurs dans le monde, contiennent essentiellement des espèces modernes.

Contribution à la compréhension de l'évolution de la vie sur Terre

L'évolution des baleines raconte une partie de l'histoire à valeur d'icône de la vie sur Terre. Les baleines qui étaient des mammifères terrestres ont évolué et, dans l'arbre de la vie, le site représente une illustration vivante de mammifères « retournant à la mer » après avoir eu un mode de vie terrestre. Wadi Al-Hitan présente l'ensemble de fossiles le meilleur et le plus vivant illustrant ce changement à travers le groupe aujourd'hui éteint des baleines Archéocètes et sa valeur est fortement augmentée par son accessibilité. Bien qu'il ne s'agisse pas des plus anciennes baleines connues, elles représentent un état très important de l'évolution de ce groupe de mammifères. Du point de vue de l'évolution, elles en sont aux dernières étapes de la perte de leurs membres postérieurs et ont adopté le corps aérodynamique typique des baleines modernes. Cela illustre leur transition entre une vie dans les eaux côtières peu profondes et une vie de mammifères océaniques largement distribués à l'échelle planétaire. Les nombreux squelettes constituent une série ontogénétique contenant des individus jeunes et vieux, ce qui apporte une dimension supplémentaire à l'étude de leur biologie et aide à mieux comprendre leur évolution. Vu l'étendue des autres matériaux fossiles, il est possible de reconstruire le milieu environnant et les conditions écologiques.

Possibilités de découvertes futures

Le bien proposé a déjà livré la première découverte exceptionnelle de preuve directe de pieds vestiges sur une baleine fossilisée. Toutefois, il offre encore de vastes possibilités d'étude. Les dispositions pour une nouvelle phase d'étude sont en train d'être mises en place et l'on considère quasi certain qu'il y aura de nouvelles découvertes. Au-delà des restes fossiles vertébrés, le bien est particulièrement intéressant car il permet l'étude d'une faune fossile d'invertébrés et de

plantes fossiles associées et, partant, la possibilité d'une interprétation solide des milieux marins de l'Éocène et de reconstruction des interactions écologiques et de la géographie ancienne. D'autres études des caractéristiques géologiques largement exposées conduiront probablement à affiner les conclusions et à des réinterprétations.

Intérêt au plan international

Il est clair que le bien proposé présente un intérêt international car il s'agit du registre le meilleur et le plus complet de l'évolution des baleines de l'Éocène. Cette affirmation est corroborée par le niveau d'intérêt international suscité par le bien depuis 20 ans et sa reconnaissance dans la presse internationale, au moyen notamment de programmes de télévision largement diffusés et d'articles dans des magazines et des ouvrages populaires, ainsi que dans la littérature scientifique.

Le bien proposé est intimement lié, au sens géologique, aux expositions contiguës de la formation du djebel Qatrani. Ces sites ont produit des vestiges fossilisés exceptionnellement riches, principalement terrestres, qui comprennent les tout premiers hominoïdes et sont d'importance internationale critique pour le développement des connaissances sur l'évolution des hominidés en Afrique.

Caractéristiques associées de valeur naturelle

Le bien proposé présente un paysage désertique très beau et très particulier composé de collines coniques et de différents reliefs sculptés, créés en grande partie par l'érosion éolienne et l'abrasion par le sable et présentant toute une gamme de caractéristiques intéressantes et belles. Les collines du djebel Gohannam forment une entrée spectaculaire sur le bien et une caractéristique paysagère que l'on voit de loin. Le bien proposé est un élément clé de l'Aire protégée de Wadi El-Rayan centrée sur deux lacs artificiels qui forment un habitat important et un contraste magnifique et spectaculaire sur le paysage désertique environnant. L'APWR comprend également une zone inhabituelle de sources naturelles entretenant une végétation indigène et une gamme d'espèces, notamment des espèces rares comme la gazelle Dorcas.

État de préservation des spécimens

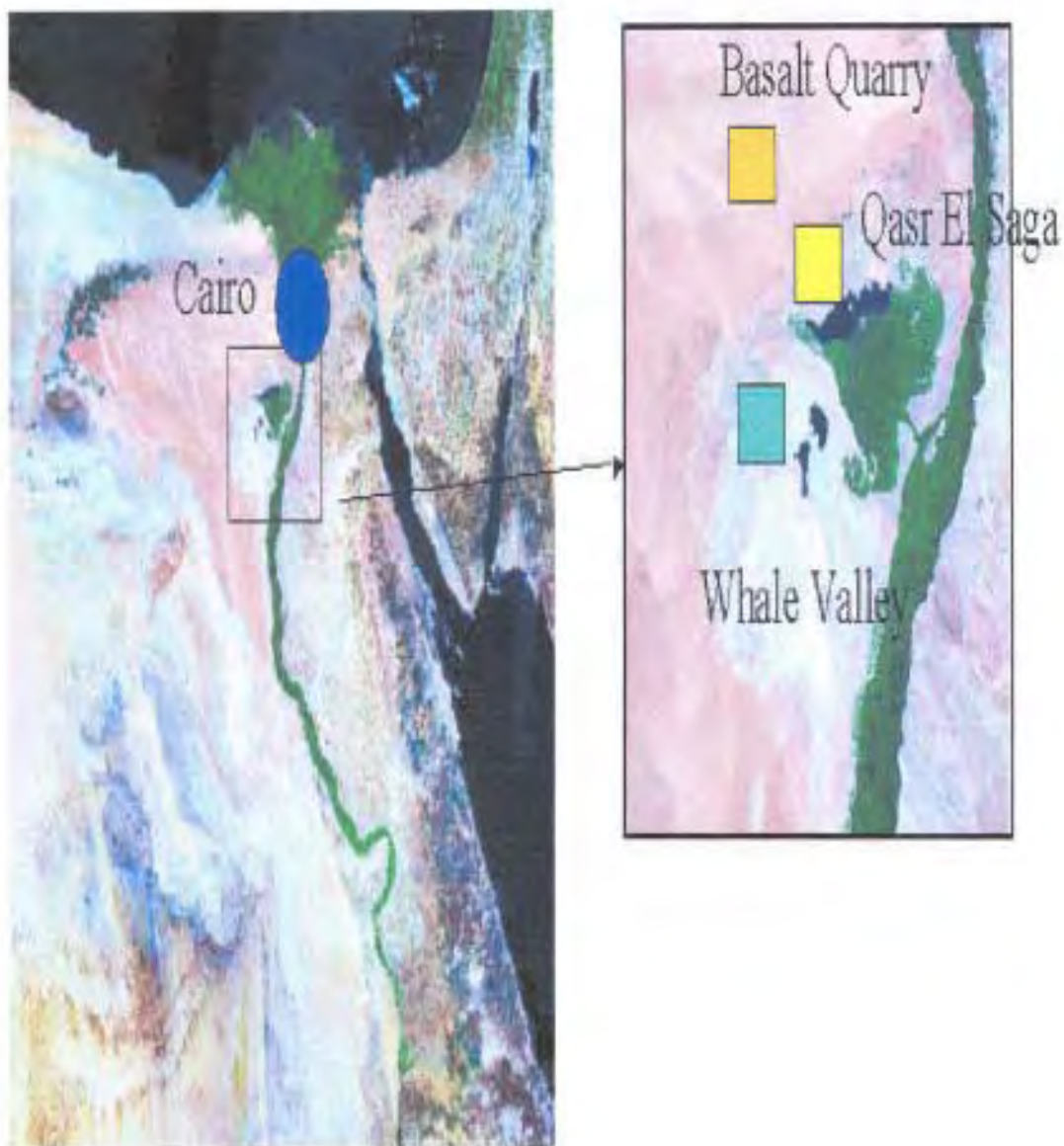
L'état de préservation des spécimens fossilisés est excellent. On trouve les fossiles en concentration exceptionnelle et environ 400 ont été identifiés à ce jour. Beaucoup sont des spécimens quasi complets préservés *in situ* dans la position dans laquelle ils sont morts et quelques-uns ont été découverts à ce jour qui présentaient des caractéristiques telles que le contenu de l'estomac.

Conservation, étude et exposition du site et des fossiles

Les dispositions prises depuis 20 ans sont solides grâce à la collaboration entre les autorités égyptiennes et l'université du Michigan. Les fossiles sont conservés à la fois au Caire et au Michigan et présentés dans les

collections de musées, dans ces deux endroits. Il y a aussi des fossiles présentés *in situ* dans le bien proposé et un squelette ainsi que du matériel fossilisé représentatif sont également exposés dans le principal centre d'accueil des visiteurs de l'Aire protégée de Wadhi El-Rayan.

Carte 1: Localisation du bien proposé



Carte 2: Limites du bien proposé

