



## World Heritage Sites

### Protected Areas and World Heritage



## WADI AL- HITAN (WHALE VALLEY) EGYPT

*Wadi Al-Hitan in Egypt's Western Desert is the only place in the world where the skeletons of families of archaic whales can be seen in their original geological and geographic setting of the shallow nutrient-rich bay of a sea of some 40 million years ago. The fossils and sediments of different periods and levels reveal many millions of years of life and are valuable indications of the palaeoecologic conditions, of Eocene vertebrate and invertebrate life and the evolution of these ancestors of modern whales. Remarkably, two species still had small hind limbs, feet and toes. The quality, abundance, concentration and state of preservation of these fossils is unequalled.*

### COUNTRY

Egypt

### NAME

Wadi Al-Hitan (Whale Valley)

### NATURAL WORLD HERITAGE SITE

2005: Inscribed on the World Heritage list under Natural Criterion viii.

### IUCN MANAGEMENT CATEGORY

Ia Strict Nature Reserve

### BIOGEOGRAPHICAL PROVINCE

Sahara (2.18.7)

### GEOGRAPHICAL LOCATION

In the Western Desert 150 km southwest of Cairo and 80 km west of Faiyum in the Wadi el-Rayan Protected Area. Located between 29° 15' 13" to 29° 23' 56"N by 30° 00' 41" to 30° 10' 06 E.

### DATES AND HISTORY OF ESTABLISHMENT

1905: Fossil whales first discovered on the site; named *Basilosaurus*;

1970s: Wadi el-Rayan lakes and wetland created by agricultural drainage from Faiyum;

1980s: Geologists began to study the whale fossils, naming the area Whale Valley (Wadi Al-Hitan);

1989: Wadi el-Rayan Protected Area (WRPA) (175,900 ha) declared by Prime-ministerial Decree 943 under Law 102 of 1983 on Natural Protectorates;

1997: Wadi Al-Hitan included as a Special Protected Area within the Wadi el-Rayan Protected Area by Prime-ministerial Decree 2954.

### LAND TENURE

State. Managed by the Nature Conservation Sector of the Egyptian Environmental Affairs Agency.

## AREA

20,015 ha, with a 5,885 ha desert buffer zone which is undesignated. The Reserve is entirely within the Wadi El-Rayan Protected Area, no other part of which is nominated.

## ALTITUDE

70m to 210m (Gebel Gehannam).

## PHYSICAL FEATURES

The area is in the arid western desert on the westernmost edge of the great depression of Faiyum-Wadi Rayan west of the Nile. The deepest contours of the nearby Wadi el-Rayan are now occupied by two brackish lakes created in the 1970s from excess agricultural water channelled from nearby Lake Qarun in the Faiyum oasis which has enriched the previously meagre wildlife of the area. The totally dry sand-covered Wadi Al-Hitan 40 km west exhibits wind-eroded pillars of rock surrounded by sand dunes, cliffs and remnant hills of a low shale and limestone plateau.

**Geological History:** For eons the Tethys Sea reached far south of the existing Mediterranean. It gradually retreated north depositing thick layers of sediments which became sandstone, limestone and shale, seen at Wadi Al-Hitan. Three Eocene formations are visible. The oldest is the Gehannam Formation (ca 40-41 million years old) consisting of white marly limestone and gypseous shale and yielding many skeletons of archaic whales (archaeocetes), sirenians (sea cows), shark teeth, turtles, and crocodylians. The middle unit, Birket Qarun Formation, consists of sandstone, clays and hard limestone, which 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 palaeo-drainage systems, now buried beneath the sand, which emptied to the sea through mangrove-fringed estuaries and lagoons when the coast was near present Faiyum some 37 million years ago.

In Wadi Al-Hitan in an area over 10 kilometres long there has been found an unusually large concentration of over 400 fossil skeletons of archaic whales and other vertebrates, extensively displayed on the desert floor and in cliffs. A few are exposed but most are shallowly buried in sediments, from which erosion slowly releases them. It is expected that further skeletons will be excavated. The site provides evidences of millions of years of coastal marine life. The presence of many baby skeletons suggests that the place was a shallow and nutrient-rich embayment frequented for calving. Since the fossils of different periods lie at different levels they are valuable indicators of palaeogeologic and palaeoecologic conditions, Eocene life, and the evolution of marine mammals.

## CLIMATE

The climate is typically Saharan, hot and dry in summer and mild with scanty rain in winter. At nearby Wadi el-Rayan the annual average precipitation is 10.1 mm, 40% falling in December. The average ambient relative humidity is 51%. The mean winter temperature is 13.7°C with an absolute minimum of -1.2°C; the mean summer temperature is 28.5°C with an absolute maximum of 48.4°C; the average diurnal range is 15.6°C. The direction of the wind for most of the year is from the north, varying from northwest to northeast. The Wadi is subject to both erosion and deposition which buries or exposes the skeletons.

## VEGETATION

**Modern:** The present site is extremely barren and there is very little vegetation. *Tamarix nilotica* is the most prominent shrub, accompanied by the halophytes *Salsola imbricata* spp. *gaetula*, *Zygophyllum coccineum* and *Cornulaca monacantha*.

**Ancient:** Fossil remains of sea grasses and mangroves with clearly exposed vertical pneumatophores were first noticed in the 1920s. Nearby, a worm-bored log was found of a species resembling the mangrove palm *Nypa fruticans*, a plant of southeast Asia, which suggests that the Eocene climate in the area was humid and warm

## FAUNA

Modern: The present day fauna is very sparse; mammals found in the Wadi el-Rayan Protected Area which might occasionally occur are north African jackal *Canis aureus lupaster*, red fox *Vulpes aegyptiaca*, Rüppell's fox *V. rueppeli*, fennec fox *Vulpes zerda*, Egyptian mongoose *Herpestes ichneumon*, African wildcat *Felis sylvestris lybica*, and dorcas gazelle *Gazella dorcas* (VU). 19 reptiles and 36 breeding birds are recorded for the WRPA, mostly attracted by the lakes. Wadi Al-Hitan is not separately noted but the desert species hoopoe lark *Alaemon alaudipes*, probably occurs

Ancient: The nominated site contains a diverse Eocene marine fauna including 25 genera of more than 14 families and 4 classes of vertebrates. They are not the oldest whale fossils but cover a vital evolutionary period of some 4 million years when these mammals evolved from land to sea-going animals. The fossils which range from young to old individuals in a great concentration of specimens, are so well preserved that even some stomach contents are intact. The neighboring Gebel Qatrani is also an exceptionally rich fossil site.

The skeletons of four species of Eocene whales have been uncovered in the highest concentration of such remains in the world: 379 fossil whales (179 catalogued) and 40 catalogued vertebrates. Three of the whales are Basilosaurids, the latest surviving group of archaeocete whales which are the earliest, now extinct, sub-order of whales, ancestors of the modern Mysticeti and Odontoceti whale families. Their fossils reveal the evolution of whales from land and shore-based to ocean-going mammals. Though they retained certain primitive aspects their form was already streamlined. The largest was *Basilosaurus isis*, which was up to 21 meters long, with well developed five-fingered flippers on the forelimbs and the quite unexpected presence of hind legs, feet, and toes, not known previously in any archaeocete; a vestigial use may have been as claspers during aquatic mating. Their form was serpentine and they were carnivorous. The dense aggregation of infant skeletons was probably because the area, being shallow and nutrient-rich, was a calving ground and nursery.

Another species is *Dorudon atrox*, also found with vestigial hind limb bones, a small whale with a more compact dolphin-like body. The presence of calving females of this species may have attracted the larger predator whales. Other whales found are *Saghacetus osiris* and *Anclacetus simonsi*. Nineteen other species of invertebrates are known: three species of early sirenian (sea cow), one partial skeleton of the primitive proboscidian *Moeritherium*, early mammals, sharks, crocodiles, three kinds of sawfish, rays, cartilaginous and bony fishes, several kinds of turtles, including a sea turtle and a sea snake. There is a rich invertebrate fauna with thousands of remains, large and small, which, with the remains of plants, permit reconstruction of the ecology and habitat of the animals.

## CULTURAL HERITAGE

Wadi Al-Hitan itself was probably always rather abandoned in historical times. However, the ancient Lake Moeris in the nearby Faiyum depression was large and the climate 8,500-4,000 years ago was wetter, so the abundant wildlife and surrounding fertile soils, attracted continuous human habitation to the Faiyum area from Neolithic times to the present. It was also a major crossroad used for many centuries by travellers between the Nile Valley and the oases of the Western Desert. Remains of human settlements from the early Egyptian, Greek and Roman eras are found there.

## LOCAL HUMAN POPULATION

No-one lives on the site, but Wadi el-Rayan 40 km away has a few thousand settled and temporary farmers and fishermen.

## VISITORS AND VISITOR FACILITIES

From 1997 on, Wadi el-Rayan became a popular excursion area for Cairenes, and in 2003 a well equipped Visitors' Centre with an audio-visual theatre and fossil museum was sited on the western lakeshore. Brochures, a video and a website have been produced for the site which is visited by some 150,000 people a year. However at first only about 1,000 visitors a year drove on to Wadi Al-Hitan as the 4WD track is unpaved, crosses treacherous sands and the site itself is extremely desert. Sustainable tourism is being developed and by 2008, 12,000 visitors were arriving each year (UNESCO,

2010). Because the area has had to be protected, the management plan for the Wadi el-Rayan Protected Area is applied to Wadi Al-Hitan restricting visitors to prearranged guided tours along a prescribed trail either on foot or by camel.

## **SCIENTIFIC RESEARCH AND FACILITIES**

The first fossil whale was found in the Faiyum oasis by Schweinfurth in 1879. An exhibition of fossils from Faiyum in the new Egyptian Geological Museum in 1899 caught worldwide attention. Large fossil skeletons were first found in Wadi Al-Hitan in the winter of 1902-3 and named *Zeuglodon* by Beadnell of the Geological Survey of Egypt. This find was followed by Andrews of the Natural History Museum, London who in 1905 renamed it *Basilosaurus isis* on the assumption that it was a dinosaur, and named a second find *Dorudon atrox*. Two brief unpublished visits by the University of California and Yale University followed in mid century. But between 1985 and 1993 P. Gingerich from the University of Michigan discovered hundreds of fossils, among them, in 1989, the last whales found with functioning feet, 10 million years after their evolution from terrestrial to marine existence. A dense aggregation of skeletons was found including many infant skeletons.

Field work was to resume in 2005 and the discovery recently made to the north of the adjacent similar property is under the same management as Wadi Al-Hitan. As such, there is a strong case for the property to be extended to include it. This is an off-site occurrence of the Eocene-Oligocene Gebel Qatrani formation north of Lake Qarun within the Lake Qarun Protected Area which has revealed the fossils of ancestral elephants, a two-horned mammal *Arsinotherium*, and eight primate lineages, including two genera of the earliest known hominoids (Redfern, 2002). It has been called 'the most complete record of palaeogene mammals for all Africa' (Wells, 1996) and has the world's highest concentration of the fossilised skeletons of archaic whales. They are evidence of many millions of years of coastal life in the shallow nutrient-rich bay of an early sea. The fossils of different periods and levels are valuable clues to its past geologic and geomorphic processes, its Eocene vertebrate and invertebrate life and the evolution of modern cetaceans 40 million years ago.

Specimens from Wadi Al-Hitan are currently displayed in several institutions: 56 specimens, including the type specimens, are preserved in the Cairo Geological Museum; others are held in London, Berlin, Stuttgart and the University of Michigan where there is a complete *Dorudon atrox* skeletal mount on exhibit. A research plan for the property during 2005-2008 has been developed in a Memorandum of Understanding between EEAA, the University of Michigan, the Egyptian Geological and Mining Surveys. This provides for regulated scientific exploration and specimen collection, curation by the Egyptian Geological Museum and the University of Michigan and training of Egyptian staff.

## **CONSERVATION VALUE**

Wadi Al-Hitan is of international value as it represents an unequalled record of Middle to Late Eocene life and geological evolution. It is the only place in the world where the skeletons of families of archaic whales can be seen in their original geological and geographic setting of the shallow nutrient-rich bay of an early sea of some 40 million years ago. No other place in the world yields archaic whale fossils of such quality in such abundance, concentration and good preservation. Many of the sirenians and cetaceans are preserved as virtually complete articulated skeletons which, uniquely, preserve reduced hind limbs, making them intermediate between earlier land mammals and later modern whales. The nominated area contains most of the key interrelated elements in their natural relationships, which provide a robust foundation for reconstructing the mosaic of paleoenvironments and palaeogeography of a southern coastal realm of the Late Eocene Tethyan Ocean, enabling interpretation of how animals then lived and how they were related to each other. The fossils are of iconic value for the study of evolutionary transition and render the site vitally important to palaeontologists.

## **CONSERVATION MANAGEMENT**

The nominated property is managed as a Special Protection Zone within the Wadi el-Rayan Protected Area (WRPA). The 2002-2006 Management Plan for the WRPA was applied to Wadi Al-Hitan, restricting visitors to the site to guided tours along a marked trail and proscribing many activities. These include the destruction of geological formations, discharging pollutants, hunting and littering. The Wadi Al-Hitan site is patrolled daily to catch illegal visitors and twice a week a team monitors the condition of the fossils,

photographing them and when necessary repairing damage. To ward off 4WD intruders, staff from neighboring tribes are to be trained as guards and tourist guides, and local people will participate in the area's management. Motorcycle patrols and camel supply transport are proposed. A field outpost is to be sited in excavated caves for protection from the extreme conditions. An open-air museum, two camping sites, camel tours and a bedouin-style ecolodge supplied by private ecotourist companies are all projected, and a sustainable source of funds will be sought.

## MANAGEMENT CONSTRAINTS

The exposed skeletons are fragile and vulnerable which makes it imperative that it should not be disturbed. They are exposed to wind erosion and burying by wind-carried sand, although fresh fossils are also exposed by the same process. They are more at danger from collectors who steal bones and fossil wood as souvenirs and saleable curiosities, As tourism increases visitors will require constant surveillance and monitoring: damage was done in 2007 by 4WDs being driven over the skeletons by privileged foreigners. The wild landscape is scarred by 4WD tracks which are kept to a minimum. A long-term threat to the Wadi El-Rayan area is the drying up of the artificial lakes by evaporation.

## COMPARISON WITH SIMILAR SITES

**Fossil whale sites:** Whales evolved from land mammals during early Eocene times, which started some 55 million years ago. By the end of the Eocene 33 million years ago modern toothed and baleen whales existed in virtually their modern form. Thus Wadi Al-Hitan, with its Archaeoceti or archaic whales at 40-37 million years before the present, presents vital evidence of the transition from land mammals to modern ocean-going whales. The intermediacy of the archaeocete whales of Wadi Al-Hitan is corroborated by skeletal features like the retention of well-formed hind limbs, feet and toes in *Basilosaurus* and in *Dorudon*. Wadi Al-Hitan is the only place in the world where numerous archaeocete skeletons can be seen in place in their original geological and geographic setting. In addition the off-site occurrence in the Gebel Qatrani formation north of the property has been called 'the most complete record of palaeogene mammals for all Africa' (Wells, 1996). The site has the world's highest concentration of the fossilised skeletons of archaic whales, evidence of many millions of years of coastal life in the shallow nutrient-rich bay of an early sea. The fossils of different periods and levels are valuable clues to its past geologic and geomorphic processes, its Eocene vertebrate and invertebrate life and the evolution of modern cetaceans 40 million years ago.

Older and more primitive archaeocete whale fossils come primarily from India and Pakistan from forested foothills of the Himalaya, from desert areas in Kutch, and from desert in tribal parts of Punjab, the Northwest Frontier and Balochistan provinces that are inaccessible to most people. Important older whale sites near Gebel Mokattam in Cairo are now covered by the developing city. 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 past 150 years, but none of these skeletons are complete and the sites where they were found are scattered, covered by vegetation, and generally inaccessible.

Fossil whales of the suborders Mysticeti and Odontoceti are known in abundance from Miocene and Pliocene sites like the 12-15 million-year-old Shark-Tooth Hill in the Temblor Formation of California (Brand, 2004) and the 5-6 million-year-old Cerro Blanco in the Pisco Formation of Peru (Buena Vista Museum, 2001) the whales from these sites are essentially modern.

**Other palaeontological sites with World Heritage designation:** Wadi Al-Hitan with its excellent preservation and abundance of coastal to marine fossil record and sedimentary facies provides an outstanding window on Eocene life evolution and palaeogeography comparable and complementary to the Messel Pit Fossil Site in Germany with its dominantly terrestrial record. In the wealth of its deposits, Wadi Al-Hitan is most similar to the Triassic Ischigualasto/ Talampaya Natural Parks site in Argentina, Monte San Giorgio in Switzerland, the Cretaceous Dinosaur Provincial Park in Canada and the Oligo-Miocene fossils of the Australian Fossil Mammal sites. There are very rich deposits of the Burgess shale in the Canadian Rocky Mountain Parks and Miguasha National Park in Canada, but these are Palaeozoic; also in the Jurassic Dorset and East Devon Coast of the U.K. and the Quaternary deposits of Lake Turkana National Parks in Kenya. The concentration of fossils at Wadi Al-Hitan, and public

interest in the site nationally and internationally, are comparable to each of the sites already on the World Heritage List.

## STAFF

The present staff of 28 rangers and guards is part of the Wadi el-Rayan force. Only one palaeontologist-ranger is at present solely working in Wadi Al-Hitan. In time 6 guards working in shifts plus two environmental researchers will staff the outpost.

## BUDGET

The Italian-Egyptian Environment Program, supported by technical assistance from the IUCN, funded the WRPA from 1998-2001 and during Phase II (2004-2008) is committed to fund development at Wadi Al-Hitan with E£6 million (US\$518,000). Future funding is expected from government grants, entry fees, donations, and eventually from a Conservation Fund but money is needed both to supply vehicles, electricity and water now, and over the long term. The projected total expenses for the whole WRPA are given but sums for Wadi Al-Hitan are not stated separately (UNESCO,2010).

## LOCAL ADDRESS

Nature Conservation Sector, Egyptian Environmental Affairs Agency; State Ministry for Environmental Affairs, 30, Misr-Helwan Agricultural Road, Maadi, Cairo.

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The principal source for the above information was the original nomination for World Heritage status.

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