

The Cheetah, *Acinonyx jubatus* (Schreber, 1776) in Egypt (Felidae, Acinonychinae)

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Summary. – Field survey of known and potential cheetah habitats in the northern sector of the Egyptian Western Desert was carried out to collect data on the present distribution and status of that animal in Egypt. Data were also gathered on the ecological characteristics of present cheetah habitats and the status of known and potential cheetah prey species in the area. Impacts of human activities on the cheetah, and on its preys and habitats were also investigated.

The results show that the cheetah has disappeared from most of its former range in the northern part of the Egyptian Western Desert. Its entire population has been reduced to what appears to be few individuals confined to a highly inaccessible area in the northern and western parts of the Qattara Depression. These individuals appear to be essentially nomadic, roaming over a vast area of the desert in search of prey.

Habitats presently occupied by the cheetah in Egypt include uninhabited oasis depressions within the Qattara Depression. Large groves of *Acacia raddiana* west and southwest of these habitats appear to be regularly visited by cheetahs. The survey also showed that gazelles, which constitute an important cheetah prey item, have been largely exterminated throughout the study area as a result of uncontrolled illegal hunting, with the exception of a small population which still survives in the western part of the Qattara Depression. Cape hare and several rodent species are numerous throughout present cheetah habitats, and may constitute the main cheetah prey in that area.

We compare morphological characters of cheetahs of the Egyptian Western Desert to those of cheetahs from different parts of the world range of *A. jubatus*. Stringent conservation measures are needed to save this rare and possibly unique population of the cheetah.

Résumé. – L'exploration des habitats connus et potentiels du guépard et l'étude de leurs caractéristiques écologiques ont été entreprises dans le secteur nord du désert occidental de l'Égypte, pour y collecter des données sur sa répartition actuelle et son statut ainsi que sur le statut des espèces proies connues ou potentielles, et aussi sur l'impact des activités humaines. Les résultats montrent que le guépard a disparu de la plus grande partie de son aire de répartition dans cette région : sa population a été réduite à quelques individus confinés dans une zone très peu accessible dans le nord et l'ouest de la dépression de Qattara. Ces individus, essentiellement nomades, occupent des oasis inhabitées où ils visitent régulièrement de grands bosquets d'*Acacia*

raddiana. Les gazelles ont été exterminées à l'exception d'une petite population qui survit dans la partie occidentale de cette dépression. Des lièvres et des rongeurs y sont probablement les proies du guépard. Les caractères morphologiques du guépard du désert occidental d'Égypte sont comparés à ceux des autres guépards. Pour sauver cette population unique, proche de l'extinction, des mesures de conservation rigoureuses, seraient nécessaires.

KEYS WORDS : *Acinonyx*, Cheetah, Egypt, distribution, status.

INTRODUCTION

The cheetah of North Africa is one of the rarest and least known of the large mammals of this vast region of Africa. During the second half of this century, population of this once characteristic Saharan predator was reduced to small, highly fragmented populations, which appear to be on the very brink of extinction (Hufnagl 1972; Osborn and Helmy 1980; Eaton 1982).

The decline of the cheetah, however, is not only limited to its North African population. During this century the cheetah has become extinct in India, Iraq, Syria, Jordan, Sinai, and most of the Arabian Peninsula (Harrison 1968; Osborn and Helmy 1980; Gasperatti *et al.* 1985; Harrison and Bates 1991), and has suffered great reduction in numbers and geographical range in sub-Saharan Africa (Myers 1975; Eaton 1982; Frame 1984; Kraus and Marker-Kraus 1991). Caro (1994) asserts that the cheetah has only a moderate chance of surviving in the wild through the next century.

The cheetah appears to have been well known to the Ancient Egyptians. Several illustrations of the cheetah appear in hunting and other scenes decorating walls of temples and tombs of ancient Egypt (Osborn and Osbornová 1998). In recent times, the cheetah was described as common in vast areas in the Egyptian Western Desert and in northern Sinai earlier during the twentieth century (Flower 1932; Murray 1935; Hardy 1949; Russell 1951; El Negumi 1952). More recent reports of cheetahs in remote areas in the Western Desert continued to appear in the literature (Hoogstraal; Hoogstraal *et al.* 1966-67; Murray 1967). Osborn and Helmy (1980) reviewed previous records of the cheetah in Egypt and added several of their own. The persistence of an extant population of the cheetah in the Egyptian Western Desert into the eighties and nineties of this century was reported by Saleh (1993), who also commented on the precarious status of that population.

The subspecific status of the Egyptian cheetah is not clear. Pocock (1939) and Ellerman and Morrison-Scott (1951) assign the cheetah of northeast Africa to the subspecies *venaticus*, which has a geographical range extending from eastern North Africa to India. Examining material obtained from northeast of Wadi El Natrun, Western Desert, Egypt, however, Hoogstraal *et al.* (1966-67) concluded that more material is needed to decide on the subspecies of the cheetah occurring in Egypt. Osborn and Helmy (1980) gave a general description of the species, offering no comparison of Egyptian material to cheetah subspecies and populations from other parts of its range.

In this report, we present the results of field surveys of known and potential cheetah habitats in Egypt, which we undertook during years 1994 to 1997. These results provide a relatively comprehensive view of the present and past geographical distribution of this species in Egypt, its current status, and its basic ecology.

METHODS

We surveyed the historic cheetah range in the northern sector of the Egyptian Western Desert systematically to determine whether the cheetah survives there today, based on sightings of the animal itself or its tracks. Cheetah tracks were identified by reference to a set of plaster molds of cheetah tracks made by one of us (I. H.) from an adult animal killed by a shepherd in 1967, near Wadi El Natrun, Egyptian Western Desert (Hoogstraal *et al.* 1966-67). These tracks were also compared with the significantly larger tracks of the Sub-Saharan cheetah.

Inquiries about the cheetah were also made with local residents of the study area, particularly individuals who frequent remote desert areas where cheetahs may still survive. Bedouin camel herders and desert guides who range widely throughout the desert were a particularly useful source of information.

The presence of cheetahs in an area was confirmed by the actual sighting of an animal by the survey team. Cheetah sighting by other individuals was accepted only after proper confirmation. Confirmation of these sightings was based upon assessing the person's ability to identify the animal in a picture showing several other cats and larger carnivores. Behavior of the animal, as described by the observer, sometimes helped to reveal the identity of the species seen. When a sighting appeared to be authentic, we visited the observation locality to verify the presence of the cheetah. It should be noted, however, that the great majority of the cheetah sightings reported to us turned out to be of other animals such as the striped hyena *Hyaena hyaena*, Egyptian golden jackal *Canis aureus lupaster*, and jungle cat *Felis chaus*.

Material examined for morphological studies includes the skull and bones of one animal killed in Loh El Mahafiz, the Egyptian Western Desert and now deposited at the Al Azhar University Zoological Collection (AUZC 13.45). It also includes the skins of two animals (AUZC 13.47), presumably killed south of El Alamain, Western Desert. The skins were brought raw to Al Azhar University in 1993 by a Bedouin who claimed to have obtained them from another person who had just shot them in that area. The authenticity of the origin of these skins, however, could not be sufficiently ascertained. Color photographs and description notes taken by one of us (I. H.) of the skin of one animal killed at Qur El Hilab, northeast of El Maghra Oasis, Western Desert of Egypt were also used.

Data on the basic ecological setting of the study area, including geomorphology, climatic factors, vegetation cover, animal life, potential cheetah prey species, and human activities were collected. A more detailed investigation of the ecology of habitats currently occupied by cheetahs was carried out. At these habitats, topography and surface features, vegetation type, composition and local distribution of plant species, and composition and local distribution of fauna were studied using standard methodology. Small mammals, including rodents and smaller carnivores, were sampled using folding Sherman and Tomahawk live traps. Captured animals were identified and subsequently released at the points of their capture. Larger mammals, their tracks, or other indirect evidence of their presence were observed in the field. Several mammals were readily observed at night in the car headlights, such as Cape hare (*Lepus capensis*), Egyptian golden jackal, striped hyena, and wild cat (*Felis silvestris*). Reptiles were captured by hand after following their tracks, or dug out of their burrows. Observation of the avifauna of the sites was also made.

Data presented in this report represent the results of six survey expeditions carried out during the years 1996-1997. These surveys covered the entire study area. In addi-

tion, data are also included from two other expeditions, launched in 1994 and 1995, which surveyed habitats in the Qattara Depression.

RESULTS

The Study Area

Geography and Geomorphology

The study area covers the northern sector of the Egyptian Western Desert, extending from the western margins of the Nile Valley and Delta, westward to the Libyan border, and from the Mediterranean coast southward to latitude $28^{\circ} 30' N$ (Figure 1). The area covers about 150,000 km², and encompasses all Egyptian localities where cheetahs were reported in the past, as well as numerous other potential cheetah habitats.

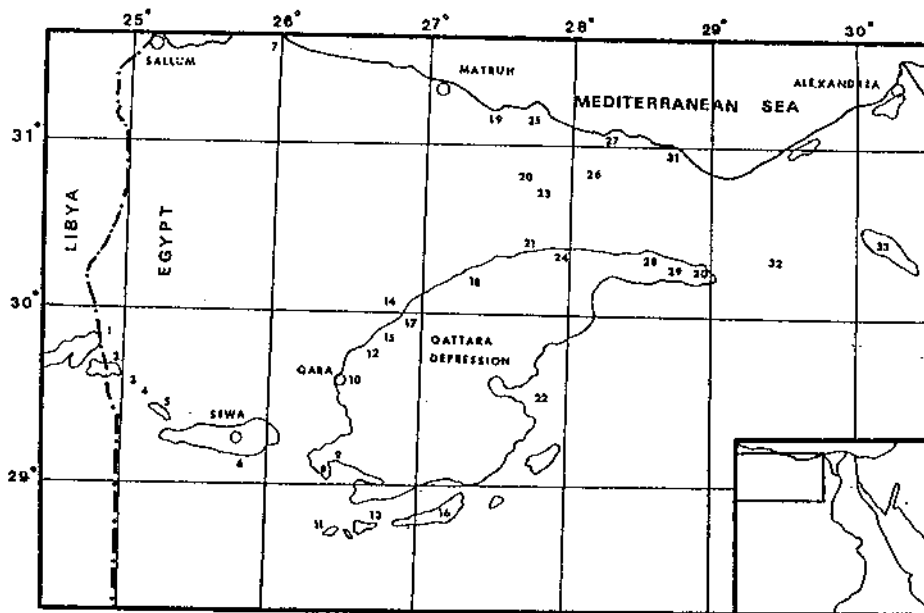


Fig. 1. — Location map of the study area: (1) El Malfa; (2) Geigab; (3) Hatiyat El Megharba; (4) Hatiyat Shayata; (5) Hatiyat Umm El Ghozlan; (6) El Zietun; (7) Sidi Barrani; (8) Minqar Tabaghbagh; (9) Umm Kitabain; (10) Gabal and Hatiyat El Qara; (11) El Bahrain; (12) Talh El Fawakhir; (13) Nuwemisa; (14) Talh El Eskandar; (15) Ein El Ghazzalat; (16) Sitra Oasis; (17) Hatiyat Abdel Nabi; (18) Ein El Qattara; (19) Garawla; (20) Loh El Mahafiz; (21) Minqar Abu Tartor; (22) Talh Badr El Din; (23) Wadi El Hamim; (24) Minqar Abu Marzuq; (25) Ras El Hikma; (26) Khasm El Qaood; (27) El Dabaha; (28) Abu Duweise; (29) Hatiyat El Lobboq; (30) El Maghra; (31) El Allamain; (32) Qur El Hilab; (33) Wadi El Natrun.

The area is a flat, northward sloping, limestone plateau, interrupted by a number of closed depressions. The rocky surface of the plateau is covered in places with a thin layer of sand and broken limestone debris. The Qattara Depression, which lies in the middle of the study area, is the largest depression in the area. About 19,500 km² of the Qattara lies below sea level and its lowest point is at -134 meters. Several smaller depressions lie south and southwest of the Qattara Depression, including Sitra, Nuwe-misa, El Bahrain, Siwa, El Malfa, Geigab, and others. Ground water rises close to the ground surface in these depressions, forming springs, salt lakes of various sizes, and extensive areas of wet mixture of sand, silt, and salt, locally called *sabkha*.

Climate

Climate of the study area varies from arid in the Mediterranean coastal belt characterized by a maritime influence on temperature ranges, to the hyper-arid, almost rainless inland desert with extreme daily and seasonal ranges of temperature (Ayyad and Ghabour 1986; Egyptian Meteorological Authority 1996). Figure 2 summarizes the climatic profile of the study area, based on data from Mersa Matruh (on the Mediterranean coast), Wadi El Natrun (95 km south of the coast), and Siwa Oasis (265 km south of the coast).

August is the hottest month of the year, while January is the coldest. Mean temperature and daily temperature range generally increase going southward away from the Mediterranean coast. Extremely high and low temperatures are often recorded in inland areas. In Siwa, temperatures as high as 49.6° C and as low as -4.5° C have been recorded. Precipitation is generally low and mostly consists of winter rain. Annual rainfall at the coast varies between 110 and 190 mm, progressively decreasing inland to reach 53.7 mm in Wadi El Natrun, about 20 mm at the northern rim of the Qattara Depression, and 9.9 mm at Siwa Oasis. In coastal areas humidity is moderate, rising slightly during summer. Humidity decreases inland, and is lowest during spring months. Surface wind blows from a north-northwesterly direction at the coast with a deviation to a north-northeasterly direction farther inland.

Vegetation

In the Mediterranean coastal belt, local rainfall is sufficient to support a relatively diverse, more or less continuous, desert vegetation cover of perennial and ephemeral species (Tadros 1953). This coastal belt extends inland for only 30 to 50 km. Along the southern fringes of the coastal belt, where rainfall drops drastically, vegetation breaks down into a discontinuous cover confined to sand sheets and shallow sandy basins. This patchy plant cover represents the transition between continuous coastal desert vegetation and the interior barren desert. South of the Mediterranean littoral belt, rainfall becomes so low and unpredictable that perennial plant life based on local precipitation is not possible. Plant life in this largely barren desert becomes restricted to deeper depressions where ground water is sufficiently close to the surface to support perennial desert vegetation (Saleh *et al.* 1988).

In the inland desert south of the Mediterranean coastal belt, groves of acacia trees represent the only permanent vegetation cover outside the oasis depressions. These isolated groves of *Acacia raddiana* grow in shallow, sandy depressions in otherwise mostly barren, gravel-veneered desert. These acacia groves vary considerably in the composition, richness, and density of their understory vegetation (Saleh 1993). A combination of local runoff water from adjacent areas following rare rain showers, and the deep sub-surface water, allow the survival of this type of vegetation.

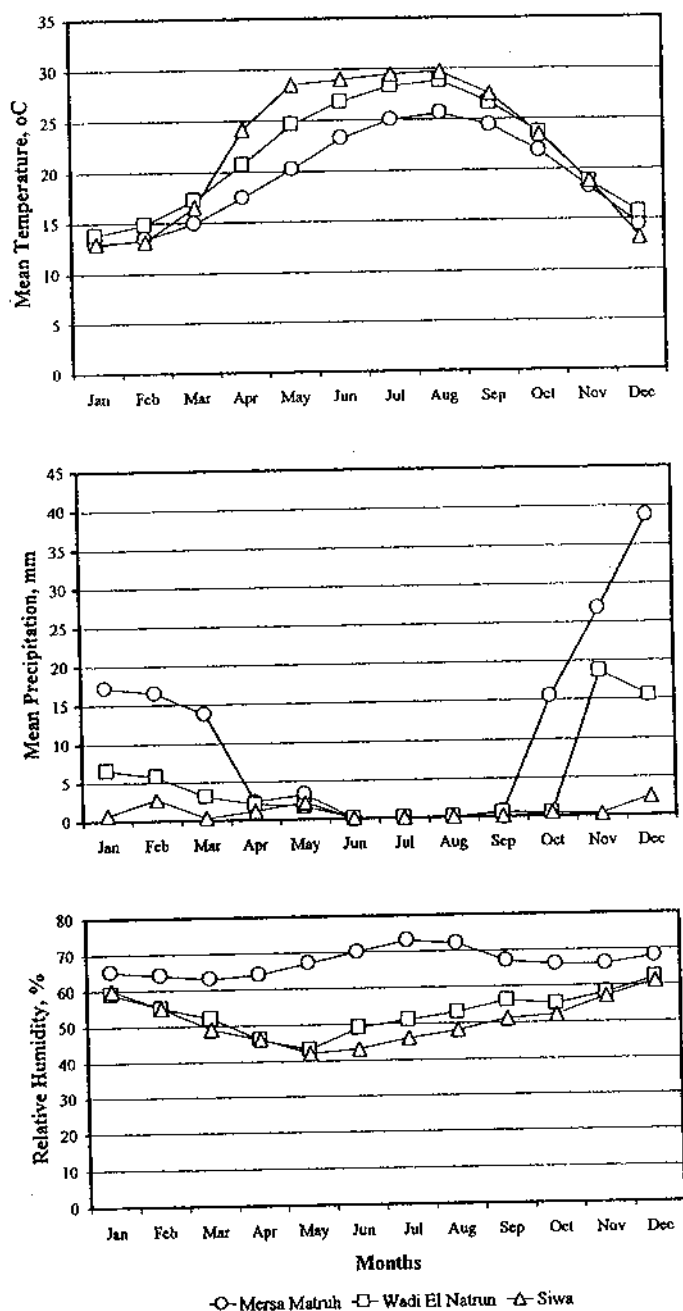


Fig. 2. - Climatic profile of the study area, based on data from Mersa Matruh (on the Mediterranean coast), Wadi El Natrun (95 km south of the coast), and Siwa Oasis (265 km south of the coast).

Morphology of the North Africa Cheetah

Examination of the skull and bones of the animal killed by a Bedouin at Loh El Mahafiz, Egyptian Western Desert, in 1990 which we retrieved during this survey showed that the animal was a young adult with teeth hardly worn and sutures fully fused. Table 1 shows a comparison of the measurements of that skull (AUZC 13.45), and two other Egyptian specimens from Wadi El Natrun (Hoogstraal *et al.* 1966-67) and from northeast of El Malfa (Hufnagl 1972), two from Libya (Hufnagl 1972), one from Iraq (Harrison and Bates 1991), and the means of specimens from South and East Africa (Hoogstraal *et al.* 1966-67). The table shows that cranial measurements of Egyptian and Libyan cheetahs are comparable. It is also clear that the skulls of these North African animals are strikingly smaller than those of cheetahs from Iraq, South Africa, and East Africa.

The skin of one animal killed at Qur El Hilab, northeast of El Maghra Oasis, Western Desert of Egypt, is slightly lighter in color than that of sub-Saharan cheetahs. Similarly, the skins of the two cheetahs, which are said to have been killed south of El Alamain, Western Desert were only slightly lighter in color than those of most of the sub-Saharan cheetah skins kept at the Zoological Museum in Giza, and several live South African cheetahs kept at the Giza Zoo in Cairo.

TABLE 1. - Cranial measurements of a cheetah *Acinonyx jubatus* killed at Loh El Mahafiz, Western Desert, Egypt in 1992, compared with those of an Egyptian specimens from Wadi El Natrun (Hoogstraal *et al.* 1966-67), an Egyptian specimen from northeast of El Malfa (Hufnagl 1972); two specimens from Libya (Hufnagl 1972), one from Iraq (Harrison and Bates 1992) and the means of specimens from South and East Africa (Hoogstraal *et al.* 1966-67).

| Measurements | Egypt | | | Libya | | Iraq | South Africa | East Africa |
|--------------------------|----------------|----------------|----------|-----------|----------|----------|--------------|-------------|
| | Loh El Mahafiz | Wadi El Natrun | El Malfa | N-Central | NW | | | |
| Greatest length | 143.5 mm | 142 mm | - | - | - | 172.0 mm | 180.8 mm | 183.8 mm |
| Condylbasal length | 130.1 mm | 126 mm | - | 133.8 mm | 135.0 mm | 156.3 mm | 162.3 mm | 163.6 mm |
| Basilar length | 121.4 mm | 117 mm | - | - | - | - | 143 mm | - |
| Zygomatic breadth | 104.0 mm | - | 100.6 mm | 102.3 mm | 103.3 mm | 114.1 mm | 123.5 mm | 128.2 mm |
| Interorbital breadth | 35.0 mm | - | - | - | - | 40.3 mm | 38.3 mm | 41.2 mm |
| Intertemporal breadth | 53.4 mm | 53.1 mm | - | - | - | - | 69.8 mm | - |
| Braincase width | 62.1 mm | - | - | - | - | 67.3 mm | 69.8 mm | - |
| Canine to molar distance | 44.1 mm | 46.8 mm | 47.8 mm | 47.3 mm | 46.0 mm | 53.2 mm | 53.5 mm | - |
| Mandible length | 101.8 mm | 101.6 mm | 104.2 mm | 100.8 mm | 104.3 mm | 119.6 mm | 119.0 mm | 126.8 mm |
| Mandibular tooth row | 54.0 mm | 51.5 mm | - | - | - | 59.1 mm | 60.0 mm | - |

Distribution

Cheetah distribution records up to the 1980s are shown in Figure 3. These include records from published reports (Flower 1932; Murray 1935; Omer-Cooper 1947; Hardy 1949; Russell 1951; Hoogstraal 1964; Murray 1967; Hoogstraal *et al.* 1966-67; Osborn and Helmy 1980), as well as those obtained during this survey for the same time period. Localities and dates of these records are as follows:

Alexandria, 66 km west of, 1909 (tracks); El Maghra, 8 km north of, 1910 (one shot); Giza Pyramids, 166 km west of, late 1920's (tracks); Qattara Depression cliffs, late 1920's (few pairs reported); Sallum, 1927 (three cubs collected); El Maghra and

surrounding area, 1930's (verbal reports); Sallum, 1934 (one shot); Sallum, 1934 (two verbal reports); Sallum, 1937 (one skin); El Malfa, 75 km north of, 1955 (one shot by an oil company employee); Sitra Oasis, 1964 (one seen); Sidi Barrani, 1964 (one shot); Talh El Fawakhir, 1965 (one seen); Hatiyat El Lobboq, 15 km east of El Maghra, 1967 (tracks); East of Cairo-Alexandria Desert Highway, km 125, 1967 (one shot); Mersa Matruh, a few kms south of, 1970 (one shot); Qur El Hilab, 45 km ENE of El Maghra, 1974 (an adult female and two cubs shot by a Bedouin hunter); Sitra Oasis, 1975 (six individuals counted); El Zeitun, Siwa Oasis, 1975 (seven individuals counted); Khashm El Qaood, 1976 (three seen, one killed by a hunter); El Maghra, north of, early 1980's (one killed by a shepherd); El Dabaha, 30 km south of, 1985 (one seen feeding on a gazelle it had just killed); Wadi El Hamim, south of Ras El Hikma, 1988 (one killed by a hunter).

Records of the 1990s, including those made or verified by the survey team, are shown in Figure 3 and are summarized as follows:

Loh El Mahafiz, 50 km south of Garawla, 1990 (two killed and three more seen by a Bedouin, bones and one skull were retrieved by us); Sitra Oasis, 1991, 1992 (several tracks seen); Minqar Tabaghbagh, 1993 (tracks); Umm Kitabain, 1993 (tracks); Gabal El Qara, 1994 (tracks); Hatiyat El Qara, 1994 (tracks); Talh El Eskandar acacia groves, 1994 (several tracks); Qur El Ghazzalat, 1994 (tracks of one following a gazelle); Ras El Qattara escarpment, 1994, 1996 (tracks); Minqar Abu Tartor, 1994 (tracks); Minqar Abu Marzuq, 1994 (tracks); Ein El Qattara, 1996 (tracks of several animals); Ein El Ghazzalat, 1996 (tracks); Talh El Eskandar acacia groves, 1996 (tracks); Talh El Fawakhir acacia groves, 1996 (tracks); Minqar Abu Marzuk, north of 1996 (one animal seen and chased by Bedouin); midway between Abu

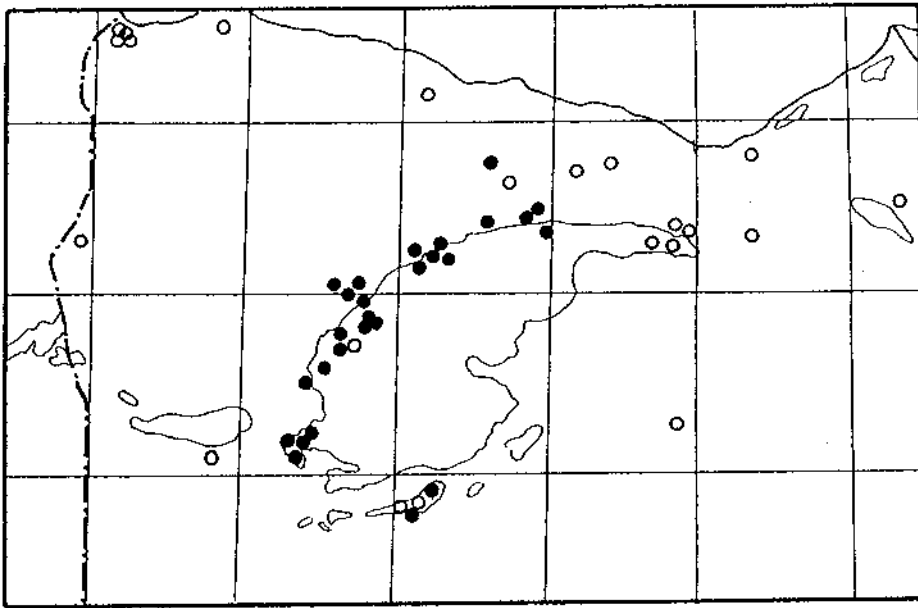


Fig. 3. - Distribution records of the cheetah in the Egyptian Western Desert up to 1989 (circles) and from 1990 to present (dots).

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Duweise and Ein El Qattara, 1997 (two animals seen on several occasions); Ein El Ghazzalat, 1997 (two animals seen); Umm Kitabain, 4 km northeast of, 1997 (tracks); Minqar Tabaghbagh, 1997 (tracks); Ein El Qattara, 1997 (tracks); Ras El Qattara Escarpment, 1997 (tracks); Talh El Fawakhir acacia groves, 1997 (tracks).

The above records show that the cheetah formerly occurred in the Mediterranean coastal belt, as well as in most of the oasis depressions and acacia groves in the northern part of the Egyptian Western Desert. During this decade, the cheetah has essentially disappeared from the Mediterranean coastal desert belt, the Siwa oasis area, and the entire eastern part of its former range.

The largest number of recent cheetah records occurred in areas in the northern, western, and northwestern part of the Qattara Depression, including the highly isolated, wild oases of Ein El Qattara and Ein El Ghazzalat, and numerous acacia groves both inside and outside the depression. A study of tracks made in wet sand in Ein El Qattara oasis shows that a small number of individual cheetahs frequent the area. In one case, fresh tracks of an adult and a younger animal travelling together were seen at several localities within the oasis and outside it. During three different visits to the area, cheetah tracks were found climbing up and down the escarpment above the oasis, and travelling north and northwest on the plateau, presumably in search of prey in other vegetated areas outside the depression. In 1994, fresh cheetah tracks were found close to the northern rim of the Qattara Depression at Minqar Abu Tartor and Minqar Abu Marzuq, 50 and 55 km northeast of Ras El Qattara, respectively. In 1996 a cheetah was seen and chased by Bedouins in the same area. The area is midway between the Ein El Qattara Oasis in the depression, and several vegetated basins to the north, northeast, and northwest of it. The very large group of acacia groves of Talh El Eskandar and Talh El Fawakhir, which are scattered over an area of about 350 km² and include more than 130 groves; is located southwest of that area. In the recent past, large herds of gazelles (*Gazella dorcas* and *G. leptoceros*) were found in these groves. Local Bedouin claim that in the seventies and early eighties cheetahs were always found in these groves. We found fresh cheetah tracks in these groves in 1994, 1996, and 1997.

In the deeper, southwestern part of the Qattara Depression, a vast area of about 900 km² of virtually inaccessible wetlands and soft sand supports the largest gazelle population in the entire depression (Saleh 1993). The area, which includes the wild oases of Hatiyat Tabaghbagh and Hatiyat Umm Kitabain, is a mosaic of lakes, salt marshes, desert scrub, wild palm groves, and *Desmostachya bipinnata* grassland. Although the difficult terrain did not allow a sufficiently thorough survey of the area, we found cheetah tracks around the northern and eastern fringes of this area. According to Bedouin who occasionally visit the area to retrieve free-ranging camels, cheetahs still frequent this area. Bedouin also claim that cheetahs travel between this area and other Qattara Depression habitats in search for prey.

Several pristine oasis depressions located northwest of Siwa Oasis, near the Libyan borders, were also surveyed in 1997. These include the oases of Umm El Ghozlan, El Megharba, Shayata, Geigab (Qeiqab), Ein Umm Zaghra, El Malfa, and several smaller vegetated depressions. These seldom-visited habitats have some of the largest populations of dorcas and slender-horned gazelles (*Gazella dorcas* and *G. leptoceros*) in the entire Egyptian Western Desert. No evidence of the presence of cheetah in this area was found during this survey. Hufnagl (1972) reported several cheetah records from eastern Libya not far from the Egyptian border. He mentioned an adult female cheetah taken in 1955 by an oil company employee at 30° 30' N and 25° E (Hufnagl 1972), which is just inside the Egyptian boundaries northeast of El Malfa.

Ecology

Habitat

Cheetah records obtained in the last decade refer to the northern, northwestern, and southwestern regions of the Qattara Depression as the most important cheetah areas in Egypt. The region encompasses several habitat patches of different sizes and structures, scattered throughout a vast area of barren desert. Cheetahs living in this region appear to travel regularly among these habitat patches. The following is a description of major habitat patches in that region :

Ein El Qattara Oasis : Ein El Qattara is an uninhabited oasis located immediately below the northern rim of the Qattara Depression. The depression escarpment is made of deeply eroded limestone, and drops almost vertically more than 200 m to the depression floor, about 50 m below sea level. The oasis covers an area of a steeply sloping ground extending from the foot of the escarpment down to the depression floor. A series of brackish-water springs are found in the upper part of the oasis, which occupies a wadi-like hollow just west of the Ras El Qattara headland. The water from some of these springs feeds a small runnel, which sinks into the ground in the lower part of the oasis. The upper part of the oasis consists of rocky, horizontal terraces covered with sand and clay deposits, strewn with boulders and broken limestone debris. The lower, flatter part of the oasis is covered with a very extensive wet *sabkha*, which covers many square kilometers of the depression floor.

The vegetated part of the oasis covers about 25 km². Rushes of *Juncus rigidus* grow in locally dense stands close to the flowing brackish/saline water of springs. Luxuriant cover of *J. rigidus* and *Phragmites australis* is also found in and around the water pool of the lower part of the oasis, where the soil is covered with patches of salt crust. *Nitraria retusa*, *Tamarix mannifera*, *Phoenix dactylifera*, *Inula crithmoides*, *Cressa cretica*, and *Arthrocnemum glaucum* grow in isolated clumps in saline but drier spots. In the wadi-like landscape of the upper part of the oasis, and in slightly elevated areas of the lower part where a thin layer of colian sand accumulates, a sparse and scattered growth of *Zygophyllum album* is found, and typically with a small number of associates, including *Anabasis articulata*, *Phoenix dactylifera*, and *Nitraria retusa*.

Land mammals of the oasis consists of ten species, including the cheetah. The Cape hare and the rodents *Gerbillus gerbillus*, *Meriones libycus* and *Jaculus jaculus* are restricted to sandy areas, particularly around *Nitraria retusa* and *Tamarix mannifera* vegetation. The other two rodents, *Gerbillus campestris* and *Acomys cahirinus helmyi*, are found more often in rocky areas or under palm trees. Among carnivora, the Egyptian golden jackal and the sand fox *Vulpes rueppelli* appear to be very numerous ; their tracks are found throughout the oasis. Very few gazelle tracks were found in the area. Reptiles and birds are very poorly represented (Saleh 1993, 1996).

The oasis is one of the most pristine areas in the Qattara Depression. It is very difficult to reach because of the impassable wet *sabkha*, which surrounds the area. Direct human influence on the oasis is negligible. However, hunting at more accessible adjacent areas has reduced the gazelle population in the region, including the oasis, to what appears to be a small fraction of its original size.

Ein El Ghazzalat Oasis : This is a man-made oasis, about 10 km² in area, located at 29°55' N, 27°36' E in a gently rolling, barren area of the Qattara Depression floor. The oasis was formed in the early 1960's when an exploratory oil well, drilled and capped a decade earlier, began to produce brackish water at high artesian pressure when the cap failed. This water accumulated in a series of interconnected lakes. These lakes

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are now surrounded by swampy and salt-marsh habitats that support a dense and vigorous growth of vegetation, which has extended to cover a large area around the lakes. This new habitat has attracted a variety of animals including gazelles and cheetahs.

Salt marshes support the most abundant element of the vegetation in this oasis. This vegetation is dominated by *Phragmites australis*, which grows within the water pools and in the permanently wet areas around them. The floristic composition of this vegetation is very poor. In favorable spots, *Phragmites australis* forms pure stands often with complete coverage. The presence of one or more of its four associates appears to be related to local edaphic characteristics. *Juncus rigidus* grows in locally dense patches close to flowing spring water. *Tamarix mannifera* grows in slightly elevated areas surrounding the pools, along with a few individuals of *Nitraria retusa* and *Arthrocnemum glaucum*. A lawn of *Cyperus laevigatus* covers almost completely the area immediately surrounding the spring, where a continuous water spray from the breached wellhead covers the ground. In the outer zone around the fringes of the salt marshes, where thick deposits of drifted sand occur, a community dominated by *Zygo-phyllum album* flourishes. Common associates of this community include *Anabasis articulata*, *Phoenix dactylifera*, and *Nitraria retusa*.

Land mammals of the area consist of ten species, including the cheetah. Gazelles are apparently not very numerous in the area, although they appear to visit the oasis, possibly to drink. Cape hare is very numerous, as are rodents and small carnivores. Grey heron *Ardea cinerea* and several species of waterfowl are abundant in the lake and salt marshes. Reptiles are represented by only seven species of small lizards and one snake.

The West Qattara Acacia Groves : Numerous groves of *Acacia raddiana* are scattered in shallow, local depressions close to the western rim of the Qattara Depression. A few others are located within the western part of the depression itself. In the past, these acacia groves supported large populations of gazelles, and were reported to be typical habitats of cheetah in that area (Osborn and Helmy 1980).

Two groups of these acacia groves, located southwest of Ein El Qattara, appear to be among the present cheetah habitats. The Talh El Eskandar group (30°03' N and 26°45' E) is the larger, covering about 200 km² and consisting of about 80 individual groves. The second is the Talh El Fawakhir group (29°45' N and 26°38' E) which consists of about 50 individual groves scattered over an area of about 150 km².

Acacia groves of these groups vary considerably in the composition, richness, and density of their understory vegetation. While groves with no vegetation other than *Acacia raddiana* are common, most of the west Qattara groves support a rich understory of perennial vegetation. Plants associated with these groves include *Francoeuria crispa*, *Astragalus trigonus*, *Coryza linifolia*, *Hyoscyamus muticus*, *Stipagrostis plumosa*, *Fagonia arabica*, *Monsonia nivea*, *Capparis deserti*, *Zygo-phyllum coccineum*, and *Anastatia hierochuntica*.

Eight mammalian species were recorded from the West Qattara groves. Large colonies of the silky jird *Meriones crassus*, which is characteristic of this habitat, were observed in most of these groves. Six reptiles have been recorded from these groves, which also support a large population of the hare.

Acacia groves form a special habitat of key importance to the two species of gazelles inhabiting this part of the Egyptian Western Desert. Both dorcas (*Gazella dorcas*) and slender-horned (*G. leptoceros leptoceros*) gazelles disperse over a vast area of the northern part of the Western Desert during winter, when they do not need to drink, feeding on leaves, flowers, and fruits of acacia trees in these groves. At the present time, only a small number of gazelles visit these groves.

Prey species

Bedouin of the northern part of the Egyptian Western Desert claim that cheetahs are only found where gazelles are found. A Bedouin camel herder, who killed three cheetahs at Qur El Hilab, northeast of El Maghra, in 1974, reported that those cheetahs had just killed an adult female dorcas gazelle before he tracked them down and shot them. He remarked that, judging from the tracks, the cheetah had chased the gazelle for 200 to 300 meters before it captured it. A shepherd told us that, in 1985, about 30 km south of Dabaha on the Mediterranean coast, he observed a cheetah chasing and killing a male dorcas gazelle. A Bedouin who killed two cheetahs at Loh El Mahafiz in 1990 pointed out to us a cave near the top of a low cliff where he claims to have seen three more cheetahs two hours after he killed the other two. The cave is about 200 meters from the site where we recovered the bones of the cheetahs he had killed. He thought that the cheetahs were using the cliff as a vantage point, resting and feeding in the shady cave. We examined the cave, which was mostly sanded in, and uncovered large quantities of bones of gazelles and hares. It is interesting to note, however, that bones of rodents (possibly *Meriones sp.* and *Jaculus jaculus*) were found among the bones of one of the dead cheetahs we excavated, which lay in an articulated configuration, presumably having been buried in sand a short time after it was killed. This discovery supports the inference that these rodents were in the stomach of the cheetah before it was killed.

One of us (I.H.) observed a cheetah stalking and successfully capturing a gray heron *Ardea cinerea* in the salt marshes around Lake Sitra in 1975.

Claims of cheetahs killing young camels, adult donkeys, sheep, and goats are rife among Bedouin of the northern part of the Western Desert. A cheetah stalking sheep was shot by a shepherd east of Wadi El Natrun in 1967 (Hoogstraal *et al.* 1966-67). The man who killed two cheetahs at Loh El Mahafiz in 1990 claims that one of the cheetahs he killed was actually stalking his donkey. Several persons have related to us stories of cheetahs killing newborn camels. According to these accounts, a cheetah may follow a pregnant she-camel when it leaves its herd to give birth. The newborn camel is quickly snatched by the cheetah.

Cheetah droppings collected by one of us (M.S.) in 1991 in Sitra Oasis contained large quantities of hair of Egyptian golden jackal and Cape hare (Saleh 1993). No gazelles were found in Sitra at that time, but cheetah tracks were abundant in the area, which had unusually large populations of jackals and hare.

Throughout this survey, cheetahs or their tracks were often observed at areas, which supported extremely low gazelle population densities, or even no gazelles at all. All these localities, however, have large populations of the Cape hare and several rodent species. It may be assumed, therefore, that cheetahs inhabiting these areas subsist primarily on these small prey species.

Table 2 shows potential cheetah prey species and their estimated abundance in three current cheetah habitats in the northern sector of the Western Desert of Egypt.

DISCUSSION

Examination of the cheetah skull obtained by us from Loh El Mahafiz, Western Desert, and comparing it with the descriptions of two other cheetah skulls from Egypt (Hoogstraal 1966-67; Hufnagl 1972) and two from Libya (Hufnagl 1972) show their

TABLE 1

| Prey Species |
|------------------|
| Cape hare |
| Rodent |
| Egyptian gazelle |
| Sand fox |
| Fennec |
| Scimitar |
| Aladd |
| Blubal |
| Slender |
| Dorcas |
| Barba |

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TABLE 2. - Estimated abundance of potential cheetah prey species in three current cheetah habitats in the northern sector of the Western Desert of Egypt.

| Prey Species | Abundance | | |
|--|----------------|------------------|-------------------------------|
| | Ein El Qattara | Ein El Ghazzalat | The west Qattara acacia grove |
| Cape hare <i>Lepus capensis</i> | Very common | Very common | Very common |
| Rodents | Very common | Very common | Very common |
| Egyptian jackal <i>Canis aureus lupaster</i> | Common | Common | Common |
| Sand fox <i>Vulpes reppelli</i> | Common | Common | Uncommon |
| Fennec fox <i>Vulpes zerda</i> | Rare | Rare | Absent |
| Scimitar-horned oryx <i>Oryx dammah</i> | Extinct | Extinct | Extinct |
| Addax <i>Addax nasomaculatus</i> | Extinct | Extinct | Extinct |
| Bubal hartebeest <i>Alcelaphus buselaphus</i> | Extinct | Extinct | Extinct |
| Slender-horned gazelle <i>Gazella leptoceros</i> | Very rare | Very rare | Very rare |
| Dorcas gazelle <i>Gazella dorcas</i> | Very rare | Rare | Very rare |
| Barbary sheep <i>Ammotragus lervia</i> | Extinct | Extinct | Extinct |

close size similarity. These skulls are strikingly smaller than those of the sub-Saharan (Hoogstraal 1966-67) and Asiatic (Harrison and Bates 1991) cheetahs. This observation agrees with the report of Dragesco-Joffé (1993) that Saharan cheetahs are considerably smaller than sub-Saharan animals. Harrison and Bates (1991), however, suggest that the Asiatic subspecies *A. j. venaticus* appears to be doubtfully distinct from *A. j. jubatus* of South Africa.

Dragesco-Joffé (1993) reported that Saharan cheetahs are considerably lighter in color than sub-Saharan cheetahs, with muted tail rings and tear line. The skin of one cheetah killed in Qur El Hifab, Western Desert, is only slightly lighter in color than that of sub-Saharan cheetahs (Osborn and Helmy 1980).

The results of the field survey reported here provide the latest assessment of the current status of the cheetah in Egypt. These data show that the cheetah was widely distributed throughout the northern part of the Egyptian Western Desert up to the 1970's. During the following decade, which witnessed the sweeping development of the coastal land, coupled with a most extensive and uncontrolled hunting in the area (Saleh 1987), the cheetah seems to have disappeared from most of the Mediterranean coastal belt and the more accessible inland habitats of El Maghra and Siwa Oases. By the early 1990's, the cheetah had disappeared from all its former habitats outside the highly inaccessible Qattara Depression, but seems to continue to range out of the depression into the nearby south Qattara oasis and acacia groves southwest of the depression. It is almost certain that the remaining population is extremely small and highly vulnerable, both because of its small size and the almost total extinction of gazelles, which may be an important, possibly the most important, prey species.

At the present time, the cheetah of the Egyptian Western Desert inhabits isolated habitat patches in an extremely arid area. Vegetated oasis depressions and groves of *Acacia raddiana* are the typical habitat patches. These habitat patches form isolated vegetation islands in a vast barren desert. The low productivity of these habitats and the relatively small size of the habitat patches appear to compel the cheetah to move continuously among these patches to find adequate food. It is likely that the home range of an individual cheetah, therefore, covers a huge area, with the animal travelling long distances between habitat patches. Tracks of one cheetah, which we followed in

the Talh El Eskandar area in 1994, covered a distance of more than 20 km in one day and passed through 17 individual acacia groves. McLaughlin (1970) estimated the home range of one cheetah family group at 82 km² and another at 76 km² in the Nairobi National Park, where ungulate prey is abundant. He also remarked on the high mobility of most cheetahs, even in areas with abundant prey. In Niger, however, Dragasco-Joffé (1993) reported that desert cheetahs are fairly sedentary, remaining in the same area as long as game is available.

Smaller antelopes, particularly gazelles, are generally considered the main cheetah prey species in sub-Saharan Africa (Piennar 1969; Schaller 1972; Eaton 1982; Caro 1994; Nowell and Jackson 1996). Eaton (1982) reported that prey species cover a range of sizes from 2.3 to 272 kg (hares and newborn warthogs to adult wildebeest and zebra). In the Serengeti, Thomson's gazelle *Gazella thomsoni* is the prey most frequently killed by cheetahs, followed by the Cape hare (Caro 1994). However, killing success rate for the hare was 88%, the highest for all prey species, while that for Thomson's gazelle was only 27%. In Turkmenistan, the Asiatic cheetah is reported to primarily take goitered gazelles, *Gazella subgutturosa*. The disappearance of the cheetah from this area is strongly correlated with the decline of this gazelle (Heptner and Slidskii 1972 in Nowell and Jackson 1996). In Iran, cheetahs living outside protected areas where gazelles are lacking are reported to prey on hares (Nowell and Jackson 1996). Caro (1994) noted, however, that food habits and prey size of cheetahs differ among study locations, reflecting differences in available prey species and their abundance.

Dragasco-Joffé (1993) reported that dorcas gazelle is the favorite prey of the desert cheetah in Niger. A variety of other animals, such as dama gazelle *Gazella dama*, barbary sheep *Ammotragus lervia*, bustards *Chlamydotis sp.*, ostriches *Struthio camelus*, Cape hare *Lepus capensis*, domestic goats, baby camels, jackals *Canis aureus*, desert hedgehogs *Paraechinus sp.*, and even young striped hynas are also reported to be taken (Dragasco-Joffé 1993).

In Egypt, little information is available on the feeding habits of the cheetah. Hares and gazelles are often assumed to be the cheetah's main prey (Russell 1951; Murray 1967; Osborn and Helmy 1980). Osborn and Helmy (1980) suggest that rodents and birds are also taken. Our results suggest that gazelles, although an important prey item for the cheetah, are unlikely to represent the main prey. Smaller mammals, such as the Cape hare, rodents, and possibly foxes and jackals are likely to constitute the bulk of the cheetah's diet, particularly in the low-productivity inland-desert habitats. In the Serengeti, where cheetah predominantly hunts Thomson's gazelle, Schaller (1972) suggests that a female cheetah with cubs kills at a rate of approximately one gazelle per day, averaging 341 kills per year. McLaughlin (1970) found that a solitary cheetah makes a kill every two to three days, averaging 150 Thomson's gazelle per year. Schaller (1968) estimated the average weight of food killed by an adult cheetah as about 10 kg/day, with only about 4 kg actually eaten by the animal per day. Assuming that the Egyptian cheetah weighs only two thirds of the East African cheetah, the average rate of kill of the Egyptian animal may be roughly about 7 kg/day to allow a daily food consumption of about 3 kg. This means that a single cheetah would require a total of 2555 kg of kill/year. A cheetah can obtain this by killing 170 dorcas or slender-horned gazelles of about 15 kg average body weight, or 1419 hares of 1.8 kg average body weight per year. The normally low population density of gazelles in low-productivity desert habitats implies that maintenance of enough gazelles to sustain a single cheetah will require a vast area of the desert, probably hundreds of square kilometers. A cheetah feeding primarily on gazelles will, therefore, require an enormous home range,

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which may not be energetically feasible. A smaller home range can be sufficient if the cheetah feeds on a wider range of other sympatric prey species, including smaller mammals such as hares and rodents and even smaller carnivores.

Illegal hunting of the cheetah appears to be a major cause of its decline, particularly in areas with larger human populations in the Mediterranean coastal strip and around Siwa Oasis. The widespread decimation of gazelle populations (Saleh 1987, 1993), a major prey species for the cheetah, as a result of illegal hunting appears to have contributed more to the observed cheetah decline throughout the rest of the uninhabited part of its range.

It is certain that the present cheetah population in Egypt is extremely small. It appears that the surviving cheetahs are pushed into marginal habitats in inaccessible areas as a result of the extermination of gazelles in the more favorable habitats of the Mediterranean coastal desert and the larger oasis depressions south and southwest of the Qattara Depression. If present trends continue, it is unlikely that the few cheetahs remaining in the present habitats in the Qattara Depression can survive for long.

The precarious status of the desert cheetah in Egypt certainly calls for immediate and most drastic conservation measures to assure its continuing survival in the wild. The establishment of a rigorously managed cheetah - gazelle sanctuary in the western region of the Qattara Depression is needed. A public awareness campaign targeting local Bedouins, along with their active participation in the management and protection of the sanctuary and its wildlife should form an integral component of any conservation plan.

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