Green AA. 1986. Status of large mammals of northern Saudi Arabia. Mammalia 50(4):483-94.

Keywords: 5SA/Acinonyx jubatus/antelope/Caracal caracal/cheetah/distribution/extinction/Felis silvestris/hyena/mammal/Middle East/oryx/status/ungulate/wild cat

Abstract: The cheetah is extinct in the Arabian Peninsula. The last observations or presence indices date from 1935 (on the north side of Jebel Tubayq) and from 1949 (Kuwait). It has probably disappeared from Saudi Arabia about 1950. The major causes of disappearance or decrease of the desert fauna are over hunting and habitat loss, related to fire arms and motor vehicles.

Le guépard est éteint dans la péninsule arabe. Les dernières observations ou indices de présence datent de 1935 (côté nord de Jebel Tubayq) et de 1949 (Koweït). Il a probablement disparu d'Arabie Saoudite vers 1950. Les causes principales de disparition ou de réduction de la faune du désert sont la chasse à outrance et la perte de l'habitat, liés à l'apparition des armes à feu et des véhicules motorisés.

Status of large mammals of northern Saudi Arabia

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Summary. — Until the mid-nineteenth century, large mammals were quite abundant in the desert of northern Saudi Arabia. Numbers began to decline at that point. Some mammals were already extinct in the Arabian peninsula by 1950 ; the situation today is critical for most large mammals in the Al Jawf region of northern Saudi Arabia. The Government took a step toward reversing this trend in 1982. With the assistance of the FAO, a trust fund project was begun to creat a « Range and Animal Development Research Centre ». Wildlife management was one of the disciplines in this predominantly agricultural project. The author participated in the project during Jan. 1983-Jan. 1984, doing a reconnaissance of wildlife and habitat in the Al Jawf region and making recommendations for the establishment of a pilot reserve.

Résumé. — Les grands mammifères ont été abondants dans le désert du nord de l'Arabie Saoudite jusque vers la moitié du XIX^{e} siècle, période à partir de laquelle leur nombre n'a cessé de décliner. Certains mammifères se sont éteints vers 1950 et la situation de la plupart des grands mammifères est aujourd'hui très critique dans la région de Al-Jouf dans le nord du pays. Le gouvernement a entrepris quelques actions en 1982 pour enrayer cette tendance, en créant un « Centre de recherche sur l'animal et l'habitat » avec l'assistance de la F.A.O. L'aménagement de la faune sauvage faisait partie des sujets d'étude de cette institution à prédominance agricole. L'auteur a participé à ce projet de janvier 1983 à janvier 1984, période durant laquelle il fit des inventaires sur la faune et son habitat dans la région de Al-Jouf, suivis de recommandations pour la création d'une aire protégée pilote.

INTRODUCTION

The desert wildlife in the Al Jawf region of northern Saudi Arabia has been decimated during the past century. Some species (carnivores) were probably never very common. Some are now extinct in the Kingdom (cheetah (1), Arabian oryx), or are locally extinct (mountain gazelle, dorcas gazelle). Several others are reduced to remnant populations in isolated areas (Persian gazelle, Nubian ibex, wolf). Two factors are primarily responsible for this situation : over-hunting

(1) See section below, « Status of large mammals » for scientific names of mammals mentioned.

and loss of habitat. They go hand in hand. The decline began in the last century with the arrival of modern firearms capable of shooting accurately over long distances. The process accelerated in mid-twentieth century when motor vehicles became common in the area. Whereas an antelope could once have escaped from a man on a horse or camel, this is no longer the case with a motor vehicle. Even if not shot, the animal may later die from exhaustion following a long chase.

The motor vehicle also bears a major responsibility for loss of habitat. A century ago there were areas where the Bedu seldom ventured with their livestock because of lack of water. Or perhaps they came in winter for short periods, when their animals' water requirements were minimal. They moved their herds of camels and sheep more or less continually, following the rains. (A consequence of continual movement was that the range did not become overgrazed). Today in the Al Jawf region, 40 % of the Saudis are herdsmen. Flocks of sheep are trucked to likely spots in the desert, and camels are driven there on foot. Semi-permenant camps are established, and water is brought in by tank truck from up to 250 km away. (Overgrazing of rangeland is a consequence of this behaviour). All of the rangeland is being used by the Bedu in the Al Jawf region, and there is no longer any haven for the large mammals. Whereas gazelles can co-exist with domestic livestock in some regions of the world, such is not the case here where every herdsman is also an avid hunter.

STUDY AREA

The study area covers about 80.000 km² in the provinces of Al Jawf, Northern Frontier and Qarayyat in northern Saudi Arabia. A detailed description of the habitat and of the avifauna has been given by Green (1984).

Average annual rainfall in the Al Jawf region varies from 40 mm in the west to 60 mm in the east and north, with about 50 mm at Sakakah, capital of Al Jawf Province. There is great annual variation. Rains are expected in winter or spring when humid, north-westerly winds blow down from the Mediterranean. The south-easterly summer winds are very dry. Winter temperatures drop below freezing at night. Summer daytime highs reach 40° C. Vegetation is sparse and consists mainly of perennial shrubs and grasses, legumes and herbs. The main Human endeavor is raising camels, sheep and goats. Farming is becoming more important in the oases of the Al Jubah sandstone depression and in Wadi as Sirhan (map in Fig. 1). Due to over-grazing, gathering of saltbush roots for fuel, and to droughts, the grazing potential of most districts has deteriorated sharply in recent years.

The different geographical regions of the study area are shown in the map in Figure 1. The FAO project is based in Sakakah, a city of about 40,000 people in an ancient oasis in the Al Jubah sandstone depression. This depression is roughly triangular in shape, extending 40 km north, southeast and southwest from Sakakah. The depression is about 200 m lower than the surrounding desert it is warmer in the basin in both winter and summer. With ground water close to the surface, many new farms are being started here. The natural vegetation is severely overgrazed. At the west end of the depression is the town of Al

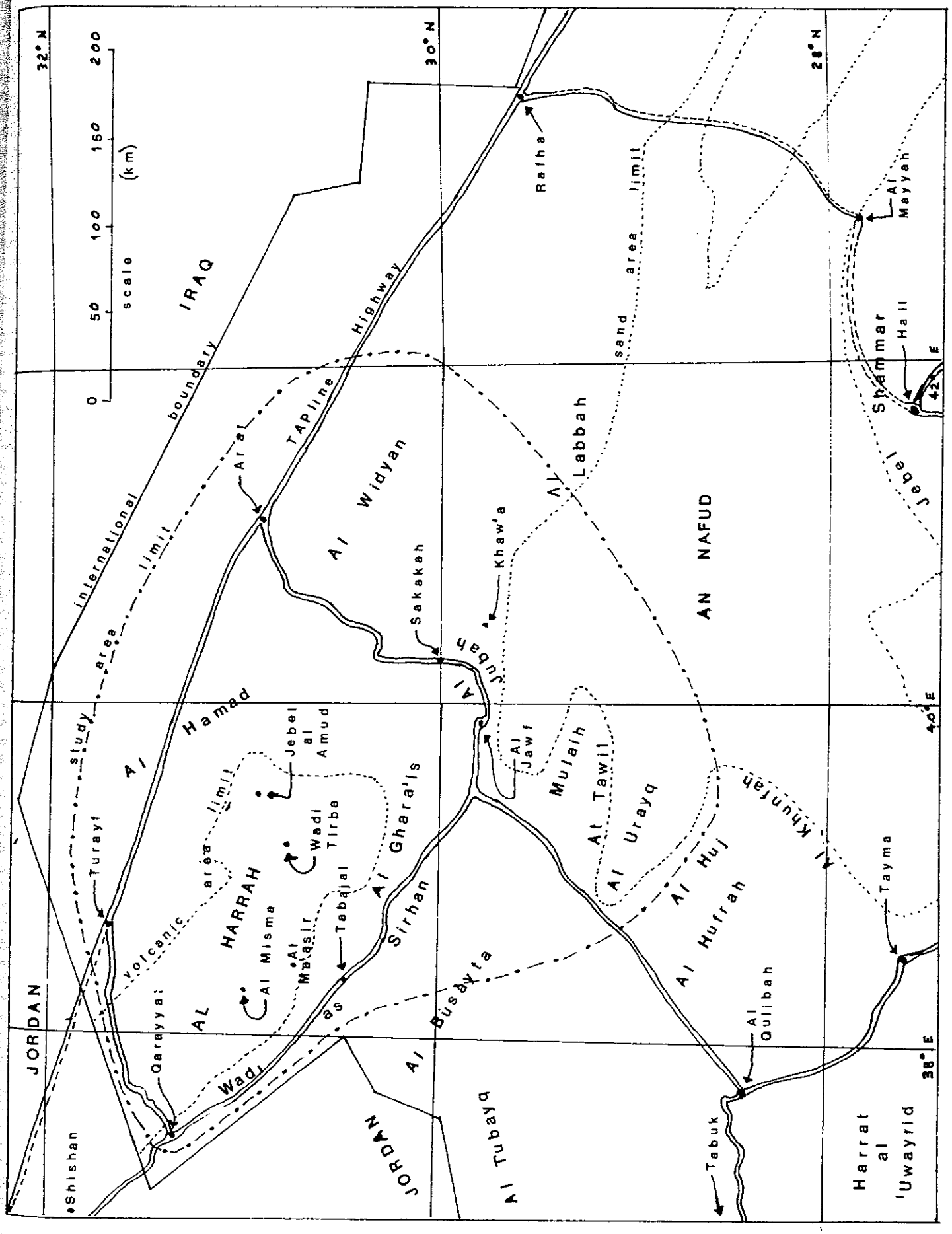

Fig. 1. — Map of Al Jawf region of northern Saudi Arabia showing principal regions, towns, highways and other points mentioned in the text. Dashed-dotted line indicates limit of 80,000 km² study area. Dotted lines indicate limits of volcanic area of Al Harrah and of sandy area of An Nafud.

Jawf (formerly Dumat al Jandal). Artesian water supplies a shallow lake and marsh of importance to migrant and winter visiting aquatic birds (Green 1984). The ruins of the 1600 year old castle, Qasr al Marid, tower from the heights west of the lake.

Most regions surrounding Al Jubah have bedrocks of limestone. To the northwest is the high plateau of Al Hamad, stretching northward into Iraq. The wide, silty wadis are productive, but heavily overgrazed. To the east is Al Widyan, a land of limestone gulches, buttes and badlands. Al Labbah is a small area on the southern edge of Al Widyan, adjacent to the An Nafud sand desert. The wadis of Al Labbah are deeper, wider and have better soils and more luxuriant vegetation than one finds to the north. Northwest of Al Jawf town are the rolling limestone hills of Al Ghara'is. Farther west are the bleak, barren plains of Al Busayta. Large mammals are extremely rare in all of these regions.

The greatest abundance and variety of birds and mammals occur in the northwest of the study area in Al Harrah. This region, covering 15,000 km² in Saudi Arabia, extends northward across Jordan and into Syria, covering about 45,000 km² altogether. Al Harrah is composed of basalt stoney plains, gravelly plains and old volcanoes. Although much of the region is barren, the silty and sandy wadis are very productive. There is permenant water at the springs of Al Ma'asir, at a spring in the Al Misma range, and perhaps elsewhere. Escape cover exists in rocky gorges.

Wadi as Sirhan lies in a valley southwest of Al Harrah. There is very good vegetative cover in the saline, sandy soils of the valley, but the region is too heavily used for domestic livestock grazing and farming to be of future interest for wildlife management.

The An Nafud sand desert lies in the south of the study area. Only a portion of this 65,000 km² area was investigated. Most of the Great Nafud is an undulating sand sheet with longitudinal dunes parallel to the prevailing winds. Beyond the study area to the east are sand mountains rising 50 to 300 metres. Within the study area in the northwest is an area of urug dunes known as Al 'Urayq. These dunes are long, parallel, sharp-crested sand ridges separated by broad sand valleys and deep pits — a treacherous area for driving motor vehicles. An Nafud has a good vegetative cover.

At the northwest edge of An Nafud is the sandstone massif of At Tawil. The mountain area covers about 1 200 km², but the At Tawil sandstone area includes the barren plain of Mulaih to the north and the sandstone plateau to the west. Where sand has drifted onto mountain slopes or into mountain valleys or left remnant dunes in the eastern portion of Mulaih, there is fairly good vegetative cover. Elsewhere it is generally very sparse.

STATUS OF LARGE MAMMALS

Members of the orders Chiroptera and Rodentia are found in the Al Jawf region. These and other small mammals are not considered here. One species from the order Lagomorpha is represented in the study area.

Cape hare, *Lepus capensis* Linnaeus.

Widespread and common. Seen frequently on every desert excursion. It is probable that two subspecies occur in the study area, but this remains to be confirmed by collection. *L. c. arabicus* Ehrenberg is the common, small, greyish-brown race of northwestern Saudi Arabia (Harrison 1972). A smaller race, *L. c. cheesmani* Thomas, inhabits the Rub' al Khali, and it is probably the race of An Nafud as well (Harrison 1972). Its back is light pinkish sandy buff, making it practically invisible against the sand.

Several members of the order Carnivora occur in the Al Jawf region. Five members of the family Canidae, one of Mustelidae, one of Hyaenidae, and four of Felidae are considered below.

Asiatic jackal, *Canis aureus* Linnaeus.

Widespread, uncommon, generally absent from waterless tracts. The jackal has been collected at Azraq, Jordan and from eastern Saudi Arabia (Harrison 1968). A few jackals are probably resident in Al Jubah and Wadi as Sirhan where there are many farms and water is available throughout the year. I saw a jackal in Feb. 1983 at Laija (29°42'N, 39°40'E), about 18 km south of Al Jawf town. Laija is a gravel plain 3 km wide and several kilometres long, surrounded by dunes of An Nafud. Water was available at several Bedu camps along the edge of this plain. Flocks of sheep were grazing the newly sprouted annuals on the sands.

Arabian wolf, *Canis lupus arabs* Pocock.

The first record of the wolf in Saudi Arabia was made by Doughty (1888). He found it in the Harrat (25°30'N, 40°E) and in northern Hejaz. Bromage (1954) saw a pack of five wolves on the edge of Wadi as Sirhan near the Saudi-Jordanian border, and one of them was shot. (The Arabian wolf is smaller than wolves of northern Eurasia and generally hunts alone or in pairs, rather than in packs). Saudis maintain that the wolf still occurs in Al Harrah and in Al Labbah. There may be some mixing with feral dogs, however these dogs generally remain nearer towns or farms.

Arabian red fox, *Vulpes vulpes arabica* Thomas.

The red fox is ubiquitous in the study area, found everywhere except in the centres of the large sand deserts (Harrison 1968). This subspecies is smaller and paler than northern ones. It makes its lair in rocky crevices or burrows into dunes of sand. I found a lair with several burrows in the side of a deep pit in the dunes east of Sakakah. I once watched a fox digging a burrow under the roots of a *Haloxylon persicum* saltbush in the Great Nafud a few kilometres south of At Tawil. The fox is frequently seen by day, although primarily nocturnal. Near farms and towns in Al Jubah it frequently preys on domestic poultry and scavenges rubbish. In the open desert it probably hunts small mammals, birds and reptiles.

Ruppell's sand fox, *Vulpes ruppelli sabaea* Pocock.

This is strictly a desert fox, but not restricted to sandy areas. It is smaller than the red fox and has much larger ears. There are specimens in the British Museum from 8 km and 80 km west of Al Jawf town and from southeast of the study area in the Nafud as Sirr (Harrison 1968). It was recorded east of the study area at Rafha and 62 km west of Badanah, where it is said to have hunted rodents in sandy wadis (Lewis, Lewis and Harrison 1965). Ruppell's sand fox is not spoken of in the Al Jawf region and must be quite rare, although possibly mistaken at great distance for the red fox on occasion.

Fennec fox, *Fennecus zerda* Zimmermann.

The fennec has not yet been reported from northern Saudi Arabia. There is a single specimen from Kuwait in the British Museum (Harrison 1968). One would expect to find the fennec in the Great Nafud. It is a small fox with extremely large ears and a very pallid coat.

Honey badger, ratel, *Mellivora capensis* (Schreber).

The ratel has been reported from Badanah, east of the study area by Lewis and Atallah (1966). As it feeds on lizards and small mammals, there is a possibility that it occurs in the wadis of the Al Jawf region.

Striped hyaena, *Hyaena hyaena* Linnaeus.

The hyaena is widespread in the Arabian peninsula, except for the interiors of the sand deserts (Harrison 1968). I found scats and tracks of hyaenas at Jebel al Amud (31°N, 39°21'E) in eastern Al Harrah on two occasions in the spring of 1983. Many flocks of sheep and herds of camels were in the area at the time, and water from rain was locally available. I saw a hyaena in the summer on the edge of An Nafud north of Laija (29°48'N, 39°39'E). I found tracks of another in the autumn about 10 km southeast of Khaw'a village (29°45'N, 40°23'E). I backtracked this one a couple kilometres (shallow sand over Al Widyan limestone) to where it had been feeding on a dried leg of camel. Saudis in Sakakah report that hyaenas come to farms in outlying areas of Al Jubah.

Wild cat, *Felis silvestris* Schreber.

Saudi project assistants maintain that the wild cat lives in Al Harrah. Harrison (1968) reported it from near Jeddah and from Kuwait ; Atallah (1966) recorded it just west of Al Harrah at Shishan , Jordan. Dr. I.A. Nader (pers. comm.) informs me that the wild cat is often confused with feral domestic cats. Its presence in Al Harrah remains to be confirmed by collection, although its presence in similar country at Shishan suggests it may well occur farther east.

Caracal, *Caracal caracal* Pocock.

There is no historical record of the caracal in the Al Jawf region, although it is likely that it once occured here. It is certainly now extinct in the study area. Dickson (1949) reported it from Kuwait, and it is known both Iraq and

Jordan. A caracal has been recently collected from the Asir region of southwest Saudi Arabia (Nader 1984).

Cheetah, *Acinonyx jubatus* Schreber.

The cheetah is extinct in the Arabian peninsula. Carruthers (1909) saw cheetah tracks near Tayma oasis (southwest of An Nafud) and again later west of Al Busayta on the north side of Jebel Tubayq (Carruthers 1935). Dickson (1949) reported cheetah in the area of Kuwait. The cheetah seems to have become extinct in Saudi Arabia about 1950 when four were killed near Turayf on the TAP line (Trans Arabian Pipeline) in the northwest of the study area by ARAMCO workers (Harrison 1968).

In the order Artiodactyla, five members of the family Bovidae are of interest.

Nubian ibex, *Capra ibex nubiana* F. Cuvier.

Formerly the ibex ranged widely in the mountains of the western parts of the Arabian peninsula. Doughty (1888) first mentioned it in the Harrat and farther east on Jebel Ajja near Ha'il (south of An Nafud). Carruthers (1909, 1935) found the ibex in the Sherarat wilderness at Hausa Well in the Tubayq area and near Jaraniyat, 80 km southwest of Mulaih. Raswan (1935) reported it from the At Tawil massif. In mid-century the ibex was still being reported in the basalt ranges of Jebel Shammar near Ha'il. It may have continued to exist in certain parts of Al Harrah this late as well, according to Saudis in the Al Jawf region (pers. comm.). But the ibex is gone from Al Harrah now. I found a couple dozen basalt boulders with petrographs of ibex (also an ostrich, hands, signs) at the head of the gorge of Wadi al 'Usayd, where the wadi turns west to cut through the Al Misma range in central Al Harrah. (Carruthers (1935) also noted that this species figures in the paleolithic and neolithic rock drawings in the Jebel Tubayq area). There is a permenant spring in the gorge of Wadi al 'Usayd. According to Harrison (1968), the ibex requires to drink frequently. It seems probable that hunters once lay in ambush for ibex at this gorge.

The sandstone massif of At Tawil is the one place in the Al Jawf region where there are still ibex to be found. The small population seems to be centered between jebels Hilmah and Hisan, where slopes are steepest and valleys are narrowest and filled with sand. On occasion they range as far west as Al Baridah, 20 km west of Hilmah. I saw a pair with small horns in a small wadi near Jebel Hilmah one morning in early Sep. 1983. They scampered up a steep slope and disappeared over a ridge.

Arabian oryx, *Oryx leucoryx* Pallas.

The oryx became extinct in the Arabian peninsula about 1972 ; the northern population has not been reported since the Second World War. Doughty (1888) encountered oryx at Tayma and at Medain Salih. By the turn of the century oryx numbers had been reduced to the point where there two separate populations. The southern population lived on the edges of the Rub' al Khali. Carruthers (1935) found the northern population rather local in 1900, restricted to the western half of An Nafud and the region to the northwest, centered between Tayma and Al Jawf and extending to Jebel al Tubayq. He collected three specimens

in Wadi Fajr and saw tracks near Hausa Well, south of Wadi Hedrij in Al Tubayq. He also saw an oryx in Wadi Naygal, 50 km NNW of Tayma. The oryx still occured in the Dahana, the connecting sand strip between An Nafud and Rub' al Khali, as late as 1917 (Carruthers 1935). Raswan (1935) reported seeing oryx in Al Busayta beyond Mayku and in Wadi as Sirhan. There have been no reports of the northern population since mid-century.

Formerly Arabian oryx lived in herds of up to 100 head. In this century group size has been ten or less. The oryx is independent of water for months at a time, deriving all necessary moisture from succulent plants and from dew in the winter. Along with the ostrich and the goat, the oryx can consume the intensely bitter fruit of the wild cucumber *Citrullus colocynthis,* which contains much moisture. It is believed that the oryx preferred the gravel plains northwest of An Nafud, but that it would retreat into the sand dunes to seek refuge or when pasturage was plentiful following rains. Grasses such as *Stipagrostis plumosa* were preferred food. *S. plumosa* is plentiful on the wind-blown sands of the plains bordering the northwest side of An Nafud. During the dry season, the oryx would have had to depend on various shrubs and forbs which maintain relatively high water content and nutritive value.

Mountain gazelle (Arabic : idmi), *Gazelle gazella arabica* Lichtenstein.

Formerly widespread and common in the mountains of the western Arabian peninsula. Not gregarious, usually solitary or in small parties. Saudis maintain that it once occured in Al Harrah and At Tawil (pers. comm.). It is reputed to be less wary than the Persian gazelle, explaining why it has disappeared from the study area. The mountain gazelle is able to subsist without free water, obtaining necessary moisture from succulent plants (Harrison 1968). In western Saudi Arabia it often is found in company with the dorcas gazelle. This species has a flank stripe.

Dorcas gazelle (Arabic : afri), *Gazella dorcas saudiya* Carruthers and Schwarz.

Smaller, paler, and with shorter legs than the mountain gazelle, this race is typically without flank stripe (Harrison 1968). Formerly widespread across northern Saudi Arabia to Kuwait, western Iraq, Jordan, and down the great gravel plains of western Arabian peninsula. Probably occured in study area. It appears to be extinct in the Al Jawf region now. This species is not gregarious, living alone or in small groups.

Persian gazelle, goitered gazelle (Arabic : rhim), *Gazella subgutturosa marica* Thomas.

Widespread and formerly common in sand deserts, limestone plateaux and gravel plains, but lacking from the mountains (Harrison 1968). Facial, flank and pygal markings are typically obsolete in this race. This species does not leap and bound like the other two gazelles. It runs low and fast with outstreatched head and neck. It is more wary than the other two, perhaps explaining why it has survived in the study area. There are specimens in the British Museum from Kuwait and from the Al Jawf region, including Al Busayta and An Nafud (29°46'N, 40°56'E ; 29°45'N, 40°28'E). Raswan (1935) saw Persian gazelles in

western An Nafud 80 km from Tayma. Formerly herds of 50 to 100 head were encountered.

The Persian gazelle is extremely rare or absent from most of the study area today. There is a small population in eastern Al Harrah. Emir S. al Sidery remembers seeing one to two dozen gazelles together in recent years (pers. comm.) I have only seen singles or pairs on rare occasions in eastern Al Harrah near Ar Raha, Jebel al Amud and Wadi al Louaysia. The population appears to be restricted to the area east of Wadi al 'Uayli. Some areas here are inaccessable to motor vehicles. Farther west the terrain is more open.

Saudi project assistants reported seeing three gazelles at the edge of Al Widyan, 30 km east of Sakakah in 1982. There are hiding places in the escarpment along the edge of the Al Jubah basin. A few gazelles may still be found in Al Widyan. There are reliable reports of them in eastern An Nafud, outside the are reliable reports of them in eastern An Nafud, outside the study area. Reports of a more substantial population in south-western An Nafud in the area east of Tayma, south of Al Khunfah, and northwest of Jebel Shammar seem well founded, coming from many sources.

DISCUSSION

Today the highway from Sakakah to 'Ar'ar passes down a bleak and barren Wadi 'Ar'ar. Saudis in Sakakah remember when a child could become lost in the forest of tall shrubs in that valley. Recounting his 1922 passage down the wadi, Philby (1923) described a scene that seems gone forever. « Another 12 miles brought us at midday to the wells of Abal Duful in the trough of the broad shallow depression of Wadi 'Ar'ar, which we had now been following for the best part of 60 miles from its watershed in the uplands east of the Juba depression. The whole march had been uneventful, we had seen no human being, gazelles had been seen in thousands, and our Suluba had procurred some for our larder ».

A portion of this spectacle could be brought back in a wildlife reserve. The greatest problem to be overcome is that of Human occupation of the range-land. Herdsmen are using all of the land in the Al Jawf region for their domestic livestock. It is not likely that herdsmen and wildlife could co-exist on the same range at the present time. A programme of conservation education should have the highest priority, but the results from such a programme would not be felt immediately. If the Human problem can be resolved, the remaining problems of wildlife management and range management would not be so difficult. If several thousand square kilometres of desert could be set aside for a wildlife reserve, and if its borders and regulations were respected, one could again see desert wildlife in abundance.

The Administration of Al Jawf Province has expressed a keen interest in protecting the Persian gazelles in eastern Al Harrah. It is also desirous of re-introducing Arabian oryx to the Al Jawf region. Although Al Harrah does not seem suited to oryx, it would make an excellent wildlife reserve for many other mammals and birds. For oryx, I would recommend continuing the wildlife and habitat reconnaissance in the areas used by the northern population in this century in order to select a site for their eventual re-introduction. A programme of

conservation education in the schools and towns should be begun as soon as it can be organized. For any conservation programme to be successful, it must have the understanding and support of the local population.

Al Harrah is the area in the Al Jawf region best suited to the creation of a wildlife reserve. The eastern third, east of Wadi al 'Uayli (5 000 km²), is less used by the Bedu than other areas. Flora and fauna are more diverse and abundant here than elsewhere. Mountain gazelle, Nubian ibex and ostrich *Struthio camelus* could be re-introduced to complement the wildlife already living here (Persian gazelle, wolf, striped hyaena, fox, hare). The avifauna would benefit from a reserve as well. In the spring the endangered Houbara bustard *Chlamydotis undulata* nests here ; the rare saker falcon *Falco cherrug* passes in the spring also (Green 1984). In the centre of this volcanic area is a limestone depression and valley. A re-introduction centre and wildlife field station could be established along Wadi Tirba in this valley. The wadi is broad and contains a wider variety of plants than found elsewhere in Al Harrah. It would be easy to fence one or two square kilometres for such a centre. The vehicle tracks to Sakakah, Al Jawf and Turayf are good, and the track to Tabarjal is passable. Man's present use of this rangeland is the major obstacle to be overcome or resolved.

The At Tawil massif and neighboring Al 'Urayq portion of An Nafud has interesting potential for wildlife reserve status. The scenery is spectacular. A small population of Nubian ibex lives here, and there are foxes and hares. Mountain gazelle, Persian gazelle and ostrich could all be re-introduced. Here again, Man's occupancy of the rangeland is the major problem to be resolved.

Two areas outside the study area need to be investigated to see if they have better potential for the creation of a pilot wildlife reserve. One area is Al Tubayq, west of Al Busayta. The other is the region south of At Tawil as far as Tayma oasis on the western edge of An Nafud. If Arabian oryx are to be re-introduced into northern Saudi Arabia, it would seem reasonable to put them in the range where they were last living in this century (provided the Human problem can be resolved). This area lies between Al Jawf and Tayma, between the An Nafud and Al Tubayq.

Creation of a fenced reserve in either Al Harrah or At Tawil has been suggested. Such a reserve for artiodactyla would require a predator-proof fence around an area of 25 to 40 km². Supplemental feeding and watering would be required, and fallure of annual rains at the fenced site would present considerable feeding problems. Care would have to be taken not to overstock the small range. As a pilot reserve, a fenced reserve would have the highest likelihood of success, considering the present problems of control of Man and his activities in the desert.

It is not too late to save the remnant wildlife of the Al Jawf region. The new « Range and Animal Development Research Centre » should be able to find solutions to the problems. With modern techniques of range and wildlife management, a portion of the desert could once again support wildlife in the abundance known here a century ago.

ACKNOWLEDGEMENTS

This investigation was carried out while I was working for the FAO. I am grateful to the research centre at Al Jawf and to my project collegues for their assistance.

thank Dr. H. Jungius of the IUCN for this information on the Arabian oryx in Saudi Arabia and for his suggestions concerning fenced reserves and re-introduction centres for large mammals. I am indebted to Dr. I.A. Nader for bringing to my attention the report of the ratel at Badanah and for his suggestions and criticism of this paper.

BIBLIOGRAPHY

ATALLAH, S.I., 1966. — *In :* International Jordan Expedition. Mammals. Ed. by J.M. BOYD. *Nature, Lond.,* 212 : 664.

BROMAGE, T.N., 1954. — Wolves in the Middle East. *Field, Lond.,* 22 Apr. 1954 : 703.

CARRUTHERS, D., 1909. — Big game of Syria, Palestine and Sinai. *Field, Lond.,* 114 : 1135.

CARRUTHERS, A.D.M., 1935. — *Arabian adventure : to the Great Nafud in quest of oryx.* London, H.F. & G. Witherby Publ. 208 pp.

DICKSON, H.R.P., 1949. — *The Arab of the desert.* London, Allen & Unwin Publ. 664 pp.

DOUGHTY, C.M., 1888. — *Travels in Arabia deserta* (2 vols.). London, Jonathan Cape Publ. I : 623 pp ; II : 690 pp.

GREEN, A.A., 1984. — Avifauna of the Al Jawf region, northwest Saudi Arabia. *Sandgrouse,* 6 : 48-58 + 6 plates.

HARRISON, D.L., 1968, 1972. — *The mammals of Arabia* (Vol. 2, vol. 3). London, Ernest Benn Ltd. II : 193-383 ; III : 384-670.

LEWIS, R.E., and S.I. ATALLAH, 1966. — A note on the occurence of *Mellivora capensis* ssp. in northern Saudi Arabia (Mellivorinae : Mustelidae). *Zeit. Säugetierk.,* 31 : 390-392.

LEWIS, R.E., J.H. LEWIS, and D.L. HARRISON, 1965. — On a collection of mammals from northern Saudi Arabia. *Proc. Zool. Soc. Lond.,* 144 : 61-74.

NADER, I.A., 1984. — A second record of the caracal lynx *Caracal caracal schmitzi* (Matschie, 1912) for Saudi Arabia (Mammalia : Carnivora). *Mammalia,* 48 : 148-150.

RASWAN, C.R., 1935. — *The black tents of Arabia.* London, Hutchinson Publ. 220 pp.

PHILBY, H. St. J., 1923. — Jauf and the North Arabian Desert. *Geographical J.,* 62 : 241-259.