

Mammals of Jordan

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Abstract: A total of 78 species of mammals belonging to seven orders (Insectivora, Chiroptera, Carnivora, Hyracoidea, Artiodactyla, Lagomorpha and Rodentia) have been recorded from Jordan. Bats and rodents represent the highest diversity of recorded species. Notes on systematics and ecology for the recorded species were given.

Key words: Mammals, Jordan, ecology, systematics, zoogeography, arid environment.

Introduction

The mammalian diversity of Jordan is remarkable considering its location at the meeting point of three different faunal elements; the African, Oriental and Palaearctic. This diversity is a combination of these elements in addition to the occurrence of few endemic forms. Jordan's location resulted in a huge faunal diversity compared to the surrounding countries. It shelters a huge assembly of mammals of different zoogeographical affinities. Most remarkably, Jordan represents biogeographic boundaries for the extreme distribution limit of several African (e.g. *Procavia capensis* and *Rousettus aegyptiacus*) and Palaearctic mammals (e. g. *Erinaceus concolor*, *Sciurus anomalus*, *Apodemus mystacinus*, *Lutra lutra* and *Meles meles*).

Our knowledge on the diversity and species richness of the Jordanian mammals is a result of continuous efforts over the past 40 years. Several studies accounted for the various mammalian species of Jordan. We list here the most outstanding contributions (ATALLAH 1977, 1978, QUMSIYEH 1996, AMR 2000a).

The surviving mammals of Jordan comprise 78 species, belonging to seven orders (Insectivora, Chiroptera, Carnivora, Hyracoidea, Artiodactyla, Lagomorpha and Rodentia). Chiropterans and rodents represent the highest diversity of known species, while lagomorphs and hyracoids are the lowest.

In this account we list the surviving mammals of Jordan, including some reintroduced species.

Table 1: Summary to the mammalian taxa occurring in Jordan

Order	No. of Families	No. of Species
Insectivora	2	5
Chiroptera	8	24
Carnivora	5	16
Hyracoidea	>1	1
Artiodactyla	2	5
Lagomorpha	1	1
Rodentia	7	26
Total	26	78

Order Insectivora

Order Insectivora contains the most primitive placental mammals. A pointed snout and a small brain case characterises members of this order. Some insectivores have a cloaca, where both the genital and the urinary tracts share a common duct. In Jordan, this order is represented by two families; Erinaceidae (hedgehogs) and Soricidae (shrews).

Family Erinaceidae

This family includes the hedgehogs. Animals of this group are characterised by their spiny dorsum, short tail and small eyes. Hedgehogs are nocturnal animals feeding mostly on small animals (insects and small lizards).



Fig. 1: Insectivores: **a:** *Paraechinus aethiopicus*: The Ethiopian Hedgehog is associated with arid regions of Jordan. **b:** *Crocidura suaveolens*: The Lesser White-toothed Shrew is a rare species found in humid and densely cultivated areas in northern Jordan and Azraq oasis.

Erinaceus concolor MARTIN 1838
European hedgehog

This is the largest hedgehog in Jordan. Although it was recorded from Azraq area (personal observation), this species has a higher preference for woodlands rather than arid areas. Tafilah area might represent the southern most limits for the distribution of this species in Jordan (ATALLAH 1977). It was recorded in several localities within the Mediterranean area (AMR 2000a).

Hemiechinus auritus (GMELIN 1770)
Long-eared Hedgehog

This is the smallest species of hedgehogs in Jordan. ATALLAH (1977) indicated that this species could tolerate extreme arid conditions. Contrary to the European Hedgehog, the Long-eared Hedgehog digs its burrows, or seeks refuge in depressions under

stones. Its food includes various groups of insects, centipedes and land snails. It is known from West Dohaybeh, Amman, Dana, Karak, Irbid and Azraq (AMR 2000a).

Paraechinus aethiopicus (EHRENBERG 1832) Ethiopian Hedgehog (Fig. 1a)

This is a medium-sized hedgehog with relatively large ears. This is a true desert species adapted to survive in arid habitats. The Ethiopian hedgehog feeds on frogs, and several groups of insects. It was reported to hibernate during winter, but awakes every few days to feed. Females may produce 2 to 3 litters per year. It is known from Wadi edh Dhuleil, Qasr Al-Hallabat, Petra, Wadi Arabah, Mafrak, Al Jafr and Wadi Ramm (AMR 2000a).

Family Soricidae

Shrews are distinguished by their small size and their long, narrow and pointed snout. The family includes the smallest living mammals, where some species do not exceed 4 cm long and weigh 2 grams. So far, only two species are known to occur in Jordan.

Crocidura suaveolens (PALLAS 1811)
Lesser White-toothed Shrew (Fig. 1b)

The Lesser White-toothed is the larger-sized shrew known to Jordan. AMR et al. (1997) reported on the presence of 12 skulls for this shrew from owl pellets from the Azraq Nature Reserve. BATES & HARRISON (1989) collected specimens from different habitats ranging from long dry grasses, thick vegetation along streams and forested areas as in Ajlune. BENDA & SADLOVA (1999) collected a specimen from Ajlune containing a single embryo. The authors recovered skulls of this species from owl pellets from Shaumari Wildlife Reserve.

Suncus etruscus (SAVI 1822)
Savi's Pigmy Shrew

Small shrew, less than 90 mm in total length. It occupies semi arid and moist habitats. ATALLAH (1977) reported on coleopteran exoskeleton recovered from stomach contents of the Pigmy Shrew collected from Azraq.

Order Chiroptera

This is the largest group of mammals occurring in Jordan. So far, 24 bat species belonging to eight families were recorded. The majority of the bat fauna of Jordan are insectivorous inhabiting all habitats with a higher preference to humid areas along the western side of the country. Only one species of fruit-eating bats, *Rousettus aegyptiacus*, is found in Jordan.

Several studies focused on the taxonomy and distribution of the bats of Jordan (ATALLAH 1977, DE BLASÉ 1972, QUMSIYEH 1980, QUMSIYEH et al. 1986, 1992, BATES & HARRISON 1989, QUMSIYEH et al. 1998).

Suborder Megachiroptera

Family Pteropodidae

This family includes the fruit-eating bats. The tail is very short and wing span may reach up to 70 cm. Only one species belonging to this family is known to occur in Jordan.

Rousettus aegyptiacus (E. GEOFFROY 1810) Egyptian Fruit Bat (Fig. 3a)

This is the largest bat found in Jordan. This bat feeds on oranges and other fruit trees. In a cave near Al-Hemma, more than a thousand bats were seen during May 1983 (AMR et al. 1987). Another large colony was observed at Wadi Ben Hammad, where thousands of bats were active in a cave along the stream sides (AMR 2000a). This bat does not hibernate but becomes inactive in cold weather. This is an African species that has penetrated deep into the Eastern Mediterranean and it seems to continue to expand its range in Jordan, Palestine and Lebanon (ATALLAH 1977, QUMSIYEH et al. 1998). QUMSIYEH et al. (1998) collected juveniles from northern Jordan during February.

Suborder Microchiroptera

Family Rhinopomatidae

(Mouse-tailed bats)

Bats of this family possess a long tail similar to that in mice. The second digit is equipped with four phalanges. Ears are well



Fig. 2: Bats:
Rhinopoma hardwickii: The Lesser Mouse-tailed Bat occurs in arid habitats with large colonies.

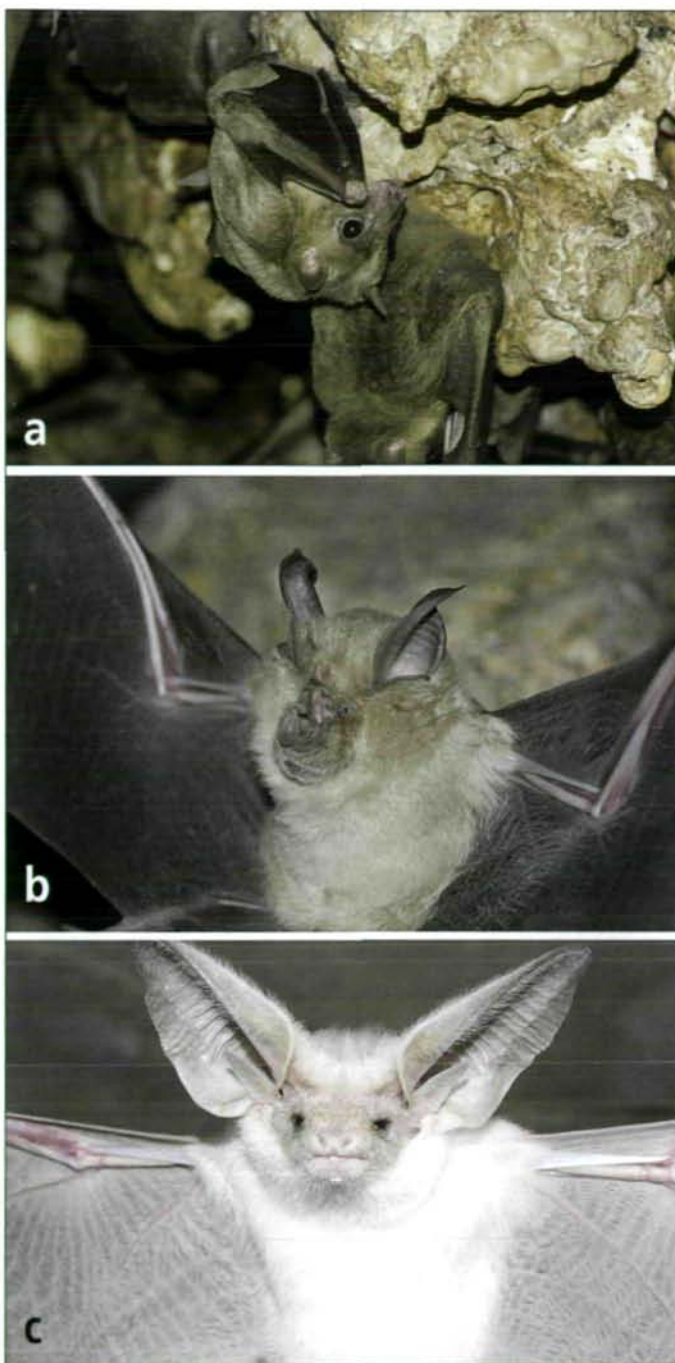
developed and connected together by a connecting membrane. Tragus present. The snout is characterised by the presence of a dermal ridge.

Rhinopoma hardwickii GRAY 1831 Lesser Mouse-tailed Bat (Fig. 2)

This bat favours arid and dry habitats and prefers open caves. ATALLAH (1977) reported that *R. h. hardwickii* as abundant among ruins with colonies of 25-200 bats. Also, he indicated that this species remains active all year round. ATALLAH (1977) suggested that *R. hardwickii* does not hibernate, based on collection dates. A group of 30-40 bats were observed in a cave at Wadi Fidan during June, where they were active (QUMSIYEH et al. 1992, 1998).

R. hardwickii is a small form compared with *Rhinopoma microphyllum* where cranial broadest length does not exceed 17,5 mm and the forearm is usually shorter than tail,

Fig. 3: Bats:
a: *Rousettus aegyptiacus*: the largest bat known in Jordan. This bat is found in large colonies taking refuge in large caves in northern Jordan.
b: *Rhinolophus ferrumequinum*: The Greater Horse-shoe Bat is associated with dense forests in northern Jordan.
c: *Otonycteris hemprichi*: This is a desert dwelling species found in large colonies.



not exceeding 50 mm (ATALLAH 1977). ATALLAH (1977) considered the population in Jordan as *R. h. cystops* Thomas, however, QUMSIYEH (1985) recognised the Jarash population as *R. h. arabium* Thomas. It was recorded from Al-Majdal An-Naqah, Wadi Fidan, Petra, Tabaqat Fahl.

***Rhinopoma microphyllum* (BRÜNNICH 1782) Greater Rat-tailed Bat**

This is the largest of the mouse-tailed bats occurring in Jordan. The Greater Rat-tailed Bat is a xerophilous species that in-

habit caves, houses, ruins along with *R. hardwickii*. Further details are given by SCHLITTER & QUMSIYEH (1996). Apparently, *R. microphyllum* is a rare species. The Greater Rat-tailed bat roosts along with *R. hardwickii*, where both species prefer dry and arid habitats in Jordan. Confusion may occur in diagnosing this species and *R. hardwickii* (QUMSIYEH et al. 1998). Records of this species include the following localities; Tabaqat Fahl, Al-Majdal, Petra.

Family Emballonuridae

(Sheath-tailed Bats)

Species of this family are characterised by a projecting tail through the dorsal surface of the tail membrane. The tragus is well developed. Two species have been so far recorded from Jordan.

***Taphozous perforatus* E. GEOFFROY
1818 Tomb Bat**

Medium sized bat. Forearm 61-65 mm. The tomb bat was found in a cave with abundance of fruit bats. It was also collected from a small cave by the Dead Sea and in a desert house (HARRISON 1964).

***Taphozous nudiventris* CRETZSCHMAR
1830 Naked Bellied Tomb Bat**

The naked bellied tomb bat is a rare species in Jordan. It is quite common along the Tigris and the Euphrates in Iraq (AL-ROBAE 1968). It roosts in deserted and old buildings as well as narrow crevices. Mating usually occurs during September and October, while hibernation extends from November to March (AL-ROBAE 1968).

HARRISON (1977) stated that *T. nudiventris* travels long distances at night looking for prey. Large fat deposits in the abdominal regions as in *Rhinopoma* are exhibited by *T. nudiventris* and seem to be a source of reserve nutrition for hibernation (QUMSIYEH 1996). It was reported recently from the Jordan Valley by DARWEEH et al. (1997) near the Dead Sea.

Family Rhinolophidae

Members of this family are distinguished by the presence of a leaf located an-

terior to the nostrils with a single lancet. Ears without tragus. The tail is connected with the membrane.

***Rhinolophus blasii* PETERS 1866**
Peters' Horseshoe Bat

Little was reported on the ecology of this species. However, it prefers small caves as most other *Rhinolophus* species. 30-40 female bats were found in a cave near the Jarash forests on October 1976. The number of bats became less after two visits, suggesting migration. Another flourishing colony of both sexes was located in a small cavern in Wadi Faynan near Wadi Arabah (QUMSIYEH et al. 1992). This is a very dry, desert habitat. It is thus possible that both a desert form and a mountain form of *Rhinolophus blasii* occur in Jordan (QUMSIYEH et al. 1998).

QUMSIYEH (1980) collected a single specimen from Mogharet Al-Roum, Jarash. It was also reported from Tabaqet Fahal, Karak, Jarash Refugee Camp and Amman (QUMSIYEH et al. 1986), Wadi Faynan in Wadi Arabah (AMR & DISI 1988).

***Rhinolophus clivosus* CRETZSCHMAR 1828**
Arabian Horseshoe Bat

In Jordan, it was collected from deserts and dry habitats as in Wadi Arabah, Quwayrah, Wadi Fidan, Petra and Wadi Rum. It is associated with small caves scattered along dry desert mountains. This species was taken from stone huts, storehouses, buildings and desert caves as large colonies (HOOGSTRAAL 1962). It resembles *R. ferrumequinum* in its connecting process, however, smaller in size. It is distinguished from *R. blasii* and *R. euryale* by its blunt connecting process of the sella (ATALLAH 1977).

The Jordanian specimens are referable to the nominate subspecies *R. c. clivosus* originally described from the western coast of Saudi Arabia. Specimens of *R. c. brachynathus* of Egypt are smaller than those of *R. c. clivosus* (QUMSIYEH et al. 1998).

***Rhinolophus euryale* BLASIUS 1853**
Mediterranean Horseshoe Bat

The Mediterranean Horseshoe Bat hibernates as solitary individuals and coexists

with *M. schreibersi* in large caves (QUMSIYEH et al. 1998). It was collected from Dibbin Forest with dense pine and oak trees (QUMSIYEH 1985). Caves and crevices are very common in this area, providing shelter for this species.

Rhinolophus ferrumequinum
(SCHREBER 1774) Larger Horseshoe Bat
(Fig. 3b)

This is the largest horseshoe bat in Jordan. The larger horseshoe bat is common in the northern part of Jordan especially the mountains and forested regions. It is associated with the Mediterranean biotope. It was collected from the eastern mountains with mild temperature and dense tree cover. Hibernating individuals were collected in the Dibbin Forest on November and active ones in August (QUMSIYEH et al. 1998). The Larger horseshoe bat may share caves with *R. euryale*. In the Dibbin Forest, it was noticed that *R. hipposideros* occurred in the same cave as this species but usually roots closer to the exit (QUMSIYEH et al. 1998). The species was collected from the following localities; Quwaylibah, Jarash, Suwaylih, Dibbin, Zubiya (AMR 2000a).

***Rhinolophus mehelyi* MATSCHIE 1901**
Mehely's Horseshoe Bat

The status and distribution of the Mehely's Horseshoe Bat is poorly known due to confusion with *R. euryale* (QUMSIYEH et al. 1998). The single record of this species is from An-Naqah in Wadi Arabah. This locality is close to eastern mountains overlooking Wadi Arabah and close to the southern shores of the Dead Sea.

***Rhinolophus hipposideros* (BECHSTEIN 1800) Lesser Horseshoe Bat**

This is the smallest horseshoe bat in Jordan. The lesser Horseshoe Bat is the smallest species of the genus *Rhinolophus* in the Near East. It is a Mediterranean species with a limited distribution to the northern mountains of Jordan. It was collected from Dibbin National Forest and Zubiya Forest (QUMSIYEH et al. 1986, 1992).

The Lesser Horseshoe Bat is found as a solitary animal in caves, ruins, and other dark dwellings. Because individuals are found solitary, it is not known how abun-

dant this species is. It is rarely encountered but may be more common and widespread than the meagre collection reports indicate.

Family Hipposideridae

(Leaf-Nosed Bats)

This family resembles family Rhinolophidae in the presence of a noseleaf. The leaf-nosed bats lack a sella or a connecting process. This family is represented by a single species in our area.

Asellia tridens (E. GEOFFROY 1813) Trident Leaf-nosed Bat

The Trident Leaf-nosed Bat is a desert adapted colonial species. Its colonies were found in caves and underground shelters and buildings. Roosting sites in Iraq are abandoned during winter suggesting a migratory behaviour (HARRISON 1957). AL-ROBAE (1966) stated that the Trident Leaf-nosed Bat has two quarters; winter quarters which they inhabit until April, and summer quarters. Gestation period is assumed to be 9-10 weeks with a single newborn. It was reported from An-Naqah and Petra (AMR 2000a).

Family Nycteridae

(Slit-faced Bats)

Species of this family are characterised by a deep furrow surrounded by cutaneous projections on the muzzle. The ears are long, rounded and fleshy. The most distinctive feature is the bifurcated last caudal vertebra. This family includes small to medium sized insectivorous bats. In the Middle East, this family is represented by one species, *Nycteris thebaica*.

Nycteris thebaica E. GEOFFROY 1818 Egyptian Slit-faced Bat

This species was recorded recently from Al Raddas in Wadi Mujib (AL-OMARI et al. 2000). It was caught by insect net while flying at low altitude. Al Raddas is a barren mountainous area overlooking the Dead Sea with many caves and crevices. This is an African species with many localities in southern Arabia, Egypt, Sinai. It inhabits ruins, bungalows, abandoned well shaft and caves (NADER & KOCK 1982). The Egyptian Slit-faced Bat feeds on grasshoppers (HARRI-

SON & BATES 1991). This feeding behaviour may explain its low flying pattern. Females give birth to a single individual.

Family Vespertilionidae

These are the night bats, characterised by the absence of any leaf-like structure at the nostrils. Ears are not connected together.

Eptesicus bottae (PETERS 1869) Botta's Serotine Bat

This is a rare species reported from Jordan only at Wadi Rum (BATES & HARRISON 1989). Botta's serotine is found in the arid regions in the south including Wadi Arabah, the southeastern Jordan desert, Petra and probably An Naqab.

Miniopterus schreibersi (KUHLE 1817) Schreiber's Bat

This species has a wide range of distribution. It is known to share the same habitat with *R. euryale* and *Rh. ferrumequinum*. The long-winged bat is a European species adapted to more mesic habitats (QUMSIYEH et al. 1998). HARRISON (1959) referred to a specimen collected from Jarash as *M. s. pulcher*. It was reported from Magharat el Wardani in the Dibbin Forest (QUMSIYEH 1980). Female colonies were observed in Algeria suggesting communal feeding (QUMSIYEH 1996). Remains of this species were derived from owl pellets in Palestine (DOR 1947).

Myotis emarginatus (E. GEOFFROY 1806) Notch-eared Bat

The notch-eared bat is associated with mesic habitats. It is known in the northern mountains of Jordan with dense vegetation and forests. It is distributed throughout Europe and North Africa (ATALLAH 1977). It was reported from the Dibbin National Forest (QUMSIYEH et al. 1986).

Myotis capaccinii (BONAPARTE 1837) Long-Fingered Bat

This species was reported from Tabqat Fahl (QUMSIYEH et al. 1986). They also indicated that coloration of the Jordanian form is similar to *M. c. bureschi* collected from Lebanon and Palestine by HARRISON (1964).

Myotis nattereri* (KUHL 1817)*Natterer's Bat**

This bat was collected from Dibbin Forest (QUMSIYEH 1980). Probably this species shares the same habitat during roosting with *R. ferrumequinum* and *M. cappaccinii* in Lebanon (ATALLAH 1970). A large colony of about 250 individuals, mostly non-pregnant females and sub adults were observed in the Dibbin Forest in July (QUMSIYEH 1996). Females with a single young were seen by HARRISON (1964).

Otonycteris hemprichi* PETERS 1859*Hemprich's Long-eared Bat (Fig. 3c)**

The distribution of Hemprich's long-eared bat is confined to the arid parts of Jordan. It was reported from Wadi Rum (BATES & HARRISON 1989), near Quraiqira and Disah in Wadi Arabah (QUMSIYEH et al. 1992). Large colonies were observed near Burqa. *Otonycteris hemprichi* roosts in the fissures in rocky habitats with little vegetation. The wing morphology and the smooth flight pattern indicate the ability to feed close to the ground surface. A specimen was caught in a mouse trap also indicating foraging close to the ground in Egypt (QUMSIYEH et al. 1998). ATALLAH (1966) collected specimens from a deserted hut near Azraq. Births are usually by June. Four different subspecies have been described of which *O. hemprichi jin* CHEESMAN & HINTON, is the most common form in southwestern Asia. It was reported from the following sites; Wadi Rum, Wadi Fidan and Disah, Karak, Burqa (AMR 2000a).

Pipistrellus ariel* THOMAS 1904*Egyptian Desert Pipistrelle**

Very little is known about the ecology of this bat. It differs from *P. savii*, *P. pipistrellus* and *P. bodenheimeri* by the unicuspid first upper incisor (QUMSIYEH et al. 1998). Reported only from Disah (AMR 2000a).

Pipistrellus bodenheimeri* HARRISON*1960 Bodenheimer's Pipistrelle**

This species was originally described 40 km N of Eilat, Wadi Arabah. QUMSIYEH et al. (1992) reported this species from Wadi Arabah. *P. bodenheimeri* is the smallest form of the genus *Pipistrellus* occurring in the Middle East (ATALLAH 1977). It appears

that this species is restricted to Arabia, Palestine and Jordan. This is a desert oasis inhabitant as its localities suggest. The biology of Bodenheimer's pipistrelle was studied by YOM-TOV et al. (1992). AMR (2000a) reported this species from Wadi Ram, Ghawr As Safi, Petra.

Pipistrellus kuhli* (KUHL 1817)*Kuhl's Pipistrelle**

Perhaps this is the most common bat occurring in Jordan due to its adaptability to inhabit a wide range of habitats. It was collected from mesic and from dry desert habitats. It is widely distributed through North Africa and Arabia. It occurs in human settlements in cities and villages. Ten individuals (one male and nine females) were found roosting in a deserted brick wall in Al-Hazim area, eastern desert (QUMSIYEH et al. 1998). This species is known from Azraq ad Duruz, Azraq ash Shishan, Aqaba, Ar-Ramtha, Suwaylih and Al-Hazim (ATALLAH 1966, AMR 2000a). Birth probably occurs during late April and May in many areas in the Near East (LEWIS & HARRISON 1962, HARRISON 1964).

Plecotus austriacus* (J. FISCHER 1829)*Grey Long-eared Bat**

The Grey Long-eared Bat is a solitary species roosting in caves, abandoned mines, ruins, and underground tunnels (QUMSIYEH et al. 1998). This bat is well adapted to "hovering" flight. While resting, its long ears are held back close to its body. Among other distinctive features of this bat is that it flies with its ears in an erect posture. HARRISON (1964) observed a female with a single small fetus in March. The species is known from; Wadi Arabah (Gharandal), Ras an Naqb, Disah, Petra (AMR 2000a).

Family Molossidae

The tail projects freely beyond the interfemoral membrane. The tragus of the ear is small and rudimentary, while the anti-tragus is very large.

Tadarida teniotis* (RAFINESQUE 1814)*European Free-tailed Bat**

The European Free-tailed Bat was found to live in cracks and fissure along rocks cliffs

or caves. Besides its presence in mild Mediterranean areas, this species can live in extremely dry habitats. Its ability to fly at high altitudes and for long distances is perhaps responsible for lack of specific records (QUMSIYEH et al. 1998). The European Free-tailed Bat flight pattern is unique (fast and direct) owing to unique adaptations of their wings (QUMSIYEH et al. 1998). Females with a single embryo were collected in Lebanon (LEWIS & HARRISON 1962). AMR (2000a) reported this species from Fyad ed Dahikayah, Jubayha, Jarash, Ghawr As-Safi, Wadi Ram, Petra.

Order Rodentia

Rodents are one of the largest and most diversified groups of mammals. The group includes a huge diversity that ranges from small mice to the large sized porcupine inhabiting different type of habitats including forests, agricultural fields, arid mountains with rocky cliffs, sand dunes and flat deserts.

In Jordan, the order is represented by seven families (Spalacidae, Hystricidae, Sciuridae, Dipodidae, Gliridae, Cricetidae and Muridae) with 16 genera and 26 species.

Family Hystricidae

Hystrix indica KERR 1792 Indian Crested Porcupine

This is the largest rodent in Jordan. It can reach up to 1m in length. The Indian Crested Porcupine is a colonial animal. It lives in a wide variety of habitats, ranging from arid to humid Mediterranean. It shelters in wadis of rocky nature and may live in small caves or in constructed burrows. They feed on fleshy vegetation and bulbs such as *Urginea maritima*, which is common along relatively dry wadis and cliffs. They forage at night and can travel long distances away from their retreat. *Hystrix indica* is a generalist, adaptable animal with a wide range of distribution. A Female gives birth to 2-4 young, and she brings water in the hollow terminal spines to the young animals. KINGDON (1990) observed the courtship behaviour of the porcupine, the female initiate courtship by moving closer towards the male in a procaptive posture with the quills laid flat. Many locals relish the porcupine's

meat (Al Nees) as a delicacy and for medicinal purposes. Perhaps this is responsible for the decline of *H. indica* population throughout Jordan. Details about local trapping method practised by the locals were discussed by AMR et al. (1987). It was reported from Irbid, Aqraba, King Hussein Bridge, Wadi Arabah around Wadi Fidan area (AMR & DISI 1988). Other reports include; Aqraba, Wadi al-Mawjib, Dana, Wadi Arabah, Jordan Valley, Irbid, Petra (AMR 2000a).

Family Dipodidae

(Jerboas)

The elongated hind limbs and short forearms characterise members of this family. This is an adaptation for saltatorial movement. Two genera are recognised in Jordan, *Allactaga* and *Jaculus*. Both contain one species that are found in dry arid parts of the country.

Allactaga euphratica THOMAS 1881 Five-toad Jerboa

The Five-toad Jerboa is a true desert species and restricted to the arid habitats of Jordan. It is mostly associated with wadis in dry parts of the country and avoids sand habitats. It keeps the burrow entrance plugged during daytime. Burrows may reach up to 50 cm. deep and about one meter long (LEWIS et al. 1965). They become active after sunset and look for food close to the burrow site. Females may give birth up to nine young. The Five-toed jerboa is a very rare and secretive animal; it was never encountered during the present study. Previous records include Azraq, Ma'an, Amman, Mafraq, Qasr Amrah and Jawa (AMR & DISI 1988, SEARIGHT 1987).

Jaculus jaculus (LINNAEUS 1758) Three-toed Jerboa (Fig. 4a)

The ecology of the Three-toed Jerboa is well studied (LEWIS et al. 1965). It is a nocturnal species and remains active for the first 3 to 4 hours after dark. Burrows are situated in levelled, arid areas and may reach up to 120 cm deep. The entrance is plugged by sand during the daytime. In Jordan, HATTOUGH-BOURAN (1990) reported on the burrowing habits of this species in different

forms of hammada soil. Burrows are dug in hammada with more than one opening in addition to the main entrance. The burrow consists of several food chambers, a nest and several blind alleys. Three-toed Jerboa is a successful desert colonial species, with a wide range of distribution in the Arabian Peninsula, Iraq, Jordan, Syria and Palestine. It is mostly associated with open gravel plains. Females produce 2-7 new born after a gestation period that lasts for about 25 days (LEWIS et al. 1965, KHADIM et al. 1979). The Three-toed Jerboa is one of the food items for the Little Owl, *Athene noctua*, and the Eagle Owl, *Bubo bubo* (AL-MELHIM et al. 1997, AMR et al. 1997, RIFAI et al. 2000a).

The Three-toed jerboa inhabits all arid habitats in Jordan. No other rodents are known to share its burrow. This jerboa was found along with *G. nanus*, *G. henlyi* and *M. crassus*. Distribution in Jordan includes; Al-Jafr, Azraq area, Qasr Amrah, Jawa area, Reishah, Ruwayshid, Wadi Fidan. Shawmari Wildlife Reserve, Azraq ash Shishan (observations), Hazim, Safawi (owl pellets), Rwieshid (Dumaythat), Hashad, Faydat ad Dahikiyah (observations), Buqay'awiyah (owl pellets), Qattafi, Al Wisad, Wadi Rum and Qasr Burqu' (AMR 2000a, ABU BAKER & AMR 2003a, ABU BAKER & AMR 2004).

Family Gliridae

Eliomys melanurus (WAGNER 1839) Southwest Asian Garden Dormouse (Fig. 4b)

This species has a remarkable distribution pattern, despite being originally an arboreal species. It occurs in very arid and densely vegetated habitats (ABU BAKER & AMR 2003a). It was collected among black lava rocky habitats in the Eastern Desert and from rocky areas of Dana Nature Reserve. The Southwest Asian Garden Dormouse became adapted to a non-arboreal life style 1.2 million years ago (BATES 1996). It feeds on insects, snails and centipedes. Females give birth to 2-9 young, and become fully mature by one year (KINGDON 1990).

Family Spalacidae

Nannospalax leucodon (NORDMANN 1840) Palestine Mole Rat

The distribution of the Palestine Mole Rat is apparently associated with terra rossa soil, the abundant soil type covering the Mediterranean province of Jordan. This mole is an aggressive fossorial solitary species. Its presence is immediately confirmed by the existence of the variously sized mounds that reflects its activity in open fields. Burrows are subdivided into three layers; the outer most is for food storage with connections to peripheral feeding tunnels (NEVO 1961). Gestation period lasts for about one month and they give birth to 3-4 new born annually. Farmers consider the Palestine Mole Rat as a serious pest. It causes damage to potatoes, summer crops and other bulbs. This species has been reported from several localities throughout the country (AMR et al. 1987, AMR 2000a). NEVO (1969) reported on several chromosomal species in Palestine.

Family Muridae

(Rats and Mice)

Apodemus mystacinus (DANFORD & ALSTON 1877)

Broad-toothed Field Mouse (Fig. 4c)

This species is confined to the humid Mediterranean mountains of Jordan. It is associated with oak forests scattered along the mountains extending from northern Jordan up to the Dana Nature reserve in the south. It is quite common in densely forested areas such as Zubiya and Dibbin. The Broad-toothed Field Mouse can climb oak trees, where it can seek refuge when alarmed. AMR & DISI (1998) recovered this species from the stomach of the Coined Snake, *Coluber nummifer*. Females give birth to 4-5 new born during April to October.

The distribution of *Apodemus mystacinus* extends from the forested regions of northern Jordan, along the eastern mountains reaching Dana nature reserve southwards (ATALLAH 1978, BENDA & SADLOVA 1999, AMR 2000a).

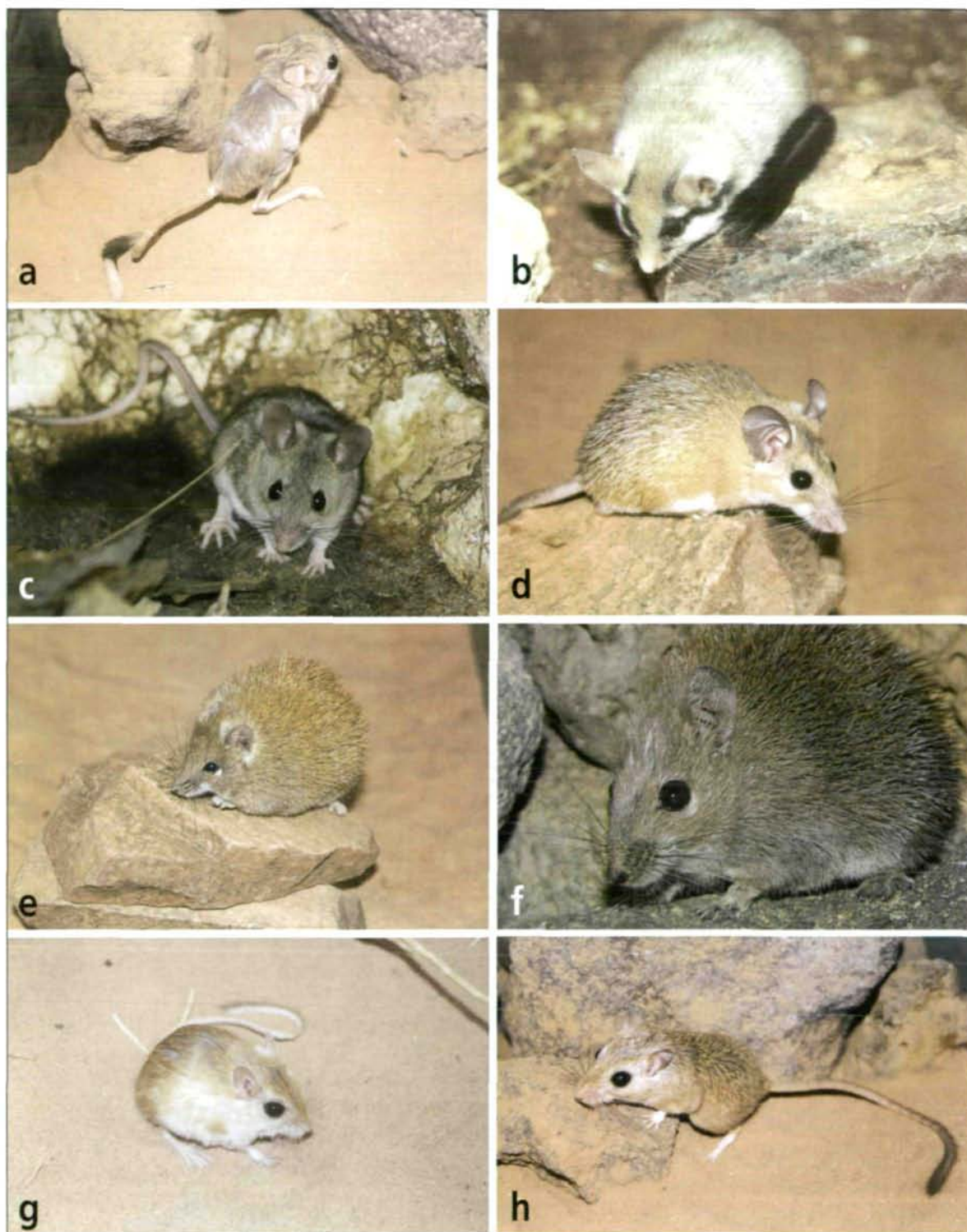


Fig. 4: Rodents: **a:** *Jaculus jaculus*: The Three-toed Jerboa is a common rodent for all arid habitats in Jordan with a wide range of distribution. It is mostly associated with open gravel plains. **b:** *Eliomys melanurus*: The distribution of the garden dormouse in Jordan is noteworthy since it is originally an arboreal rodent. It was collected from arid mountains of Wadi Rum desert as well as the juniper forests at Dana Nature Reserve. **c:** *Apodemus mystacinus*: This species is confined to Mediterranean oak forests along the Northern mountains extending to Dana Nature reserve in the south. It is well adapted to rocky and arboreal life styles. **d:** *Acomys cahirinus*: This is a rock dwelling species found along the mountain ranges of the rift valley covering diversified habitats of arid, semi arid and humid habitats. **e:** *Acomys russatus*: The Golden Spiny Mouse lives along with *A. cahirinus* in the southern arid mountains of Wadi Ramm where it was forced to shift its activity pattern into the diurnal type. **f:** *Acomys lewisi*: The melanestic form of the Golden Spiny Mouse was found to be a strictly rock-inhabitant along very arid rocky cliffs within the lava desert. **g:** *Gerbillus andersoni*: *G. andersoni* is found in areas of light sand dunes dominated with *Anabasis articulata* where it lives in association with the hairy-footed gerbil, *G. cheesmani* and the Fat Sand Rat, *Psammomys obesus*. **h:** *Gerbillus dasyurus*: This gerbil is one of the most common rodents inhabiting arid and semi arid habitats in Jordan with an observed preference for rocky cliffs and wadis.

***Apodemus hermonensis* FILIPPUCCI,
SIMSON & NEVO 1989**

This species was recently recorded from Jordan (BENDA & SADLOVA 1999) from Ajlun Mountains. *Apodemus hermonensis* was erected based on biometrical and electrophoretic studies of specimens originated from Palestine (FILIPPUCCI et al. 1989). In the forests of Palestine, Lebanon and probably Syria, *Apodemus fawcettii* and *Apodemus sylvaticus* are known to exist sympatrically (HARRISON & BATES 1991). Furthermore, studies in Asia Minor revealed that *Apodemus sylvaticus* and *Apodemus hermonensis* are two separate species (FILIPPUCCI et al. 1996).

***Rattus rattus* (LINNAEUS 1758) Black Rat**

This is a common species occurring in cities, villages and farming areas. Its populations are increasing rapidly in association with urban and agricultural expansion. The Black Rat is a serious pest causing extensive damage to grain storage areas, as well as to clothing, chicken farms and electrical wiring of buildings. The Black Rat successfully invaded remote areas in the country. Now it is well-established in farms in the Badia and southern Jordan. This was facilitated by vehicles transporting animal feed and other agricultural crops.

Not only considered as "a disgusting animal" by the local, it is also an important reservoir for zoonotic diseases such as Leishmania and bubonic plague.

***Rattus norvegicus* (BERKENHOUT 1769)
Norway Rat**

It is not as common as *R. rattus* and did not establish itself very well in Jordan. The Norway Rat can live in close quarters with humans in buildings, trash filled streets, sewer systems, grain bins and stock feeding areas. Its introduction to our area is not known, and it may have gained entrance through commercial shipping after establishment of the Aqaba Sea port in the early fifties.

***Mus musculus* LINNAEUS 1758
House Mouse**

The House Mouse is a very successful species that is found in all types of habitats,

including deserts. They breed about 12 times per year giving birth to about 5-8 new born each time. Within six weeks, the youngs are able to reproduce. Natural enemies include the Eagle and the Barn Owls (AMR et al. 1997, RIFAI et al. 1998). The House Mouse is commonly found in modern and old houses, shops, hotels, farms.

***Acomys cahirinus* (DESMAREST 1819)
Cairo Spiny Mouse (Fig. 4d)**

This is a pterophyles species associated with rocky terrain, in addition to steppe-desert habitats. The Sinai spiny mouse covers diversified habitats, including mesic and xeric biotopes. It was trapped near ancient ruins at Wadi Tlah. It is strictly nocturnal in contrast to the Golden Spiny Mouse, *Acomys russatus*. In Al Mujib area, *A. cahirinus* and *A. russatus* were found to co-occur. The activity pattern of these two species suggests a comparative exclusion of *A. russatus* by *A. cahirinus* (KRONFELD et al. 1994).

In arid regions, the Cairo Spiny Mouse feeds on land snails. The entrance of its burrow is usually piled with crushed land snails of several genera. Also, the entrance may be plugged by thorny plants, perhaps to prevent intruders (e.g. snakes) from entering. This was observed in dense populations of this species near the Suwaymah and around Zarqa Ma'in. This is a social animal with large colonies. Gestation lasts for 36-40 days, and the young (2 or 3, at most 5) are born mainly in the spring and summer months. Its distribution in Jordan is confined along the rocky southern parts of the Jordan Valley, with confined distribution in the mountains (AMR 2000a).

***Acomys russatus* (WAGNER 1840)
Golden Spiny Mouse (Fig. 4e)**

This species is common among rocky areas along Wadi Araba, the Jordan Valley and in some mesic habitats. It feeds on several halophytic plants such as *Anabasis articulata*, *Atriplex halimus* and *Hammada scoparia* (SHKOLINK & BORUT 1969). The Golden Spiny Mouse is nocturnal in areas where *A. cahirinus* is absent, while it is active in the morning hours and late afternoon in habitats shared with *A. cahirinus* (SHKOLINK 1966). BATES (1994) considered the species

A. lewisi as a synonym for *A. russatus*. *A. lewisi* is darker in colour and apparently is confined to the black lava deserts of Azraq and Jawa (ATALLAH 1978, SEARIGHT 1987, ABU BAKER & AMR 2003a).

***Acomys lewisi* ATALLAH 1967**
Spiny Mouse (Fig. 4f)

The melanistic form of the Golden Spiny Mouse was found to be a strictly rock-inhabitant, it was collected from very arid rocky cliffs within the lava desert in the east. Although this mouse was recorded as diurnal (SEARIGHT 1987, AL-MELHIM et al. 1997), it was never seen or trapped during the day. Small individuals were caught during late summer. The activity of the Golden Spiny Mouse is known to shift to daytime if it coexists with the Cairo spiny mouse, *A. cahirinus*, (KRONFELD et al. 1994) as the in the Dead Sea region.

QUMSIYEH et al. (1986) found that *A. lewisi* and *A. russatus* have the same chromosome number, they state that their result is compatible with the idea that these two forms are conspecific. This genus should get more attention in confirming species and subspecies present with their distribution and biology.

Individuals of this species were successfully kept in captivity, they were fed sunflower seeds and supplied with water. Activity peak in the laboratory was seen in the early morning hours of the day. The ability of interbreeding between the two forms of this species (*A. r. russatus* and *A. r. lewisi*), was tested in the laboratory with an adult *A. r. russatus* male from Wadi Rum and an adult *A. r. lewisi* female from Azraq ed Duruz. No signs for any aggressive behaviour were seen during the time of the experiment. The animals were kept together for several months, however, they failed to reproduce, while controlled groups of *A. r. lewisi* gave birth to 3-5 individuals (ABU BAKER & AMR 2003a).

***Nesokia indica* (GRAY & HARDWICKE 1830) Short-tailed Bandicoot Rat**

Moisture and permanent water bodies are essential for the Short-tailed Bandicoot Rat. Both localities reported in Wadi Arabah are in farming areas with plentiful

water. The burrows are usually located near irrigation channels and water holes and plugged by shrubs. The burrow consists of a nest chamber 30 cm in length, with tunnels reaching more than 4 meters long and 90 cm in depth. It feeds on fleshy roots of *Al-haji* and *Typha* (OSBORN & HELMY 1980). The type specimen of this subspecies originated from "Ghor el Safieh" (=Ghawr as Safi). It was reported from Mu'ab (AHARONI 1932) and Fidan area in Wadi Araba.

Family Cricetidae

Most members of this family have well developed cheek pouches. Tail is usually long and densely covered with hair. This family is subdivided into three subfamilies; Cricetinae, Microtinae and Gerbillinae (CORBET 1978), although some authors placed subfamily Gerbillinae into the family Gerbillidae. One of the most distinctive features of this family is the presence of tuberculated cheekteeth in two longitudinal rows.

Subfamily Cricetinae

This subfamily includes the hamsters. In the Middle East, Cricetinae includes two genera; *Cricetulus* and *Mesocricetus*, where only the first genus is represented by one species in Jordan.

***Cricetulus migratorius* (PALLAS 1773)**
Grey Hamster

Apparently, Jordan represents the most southern distribution range for this species. It lives in diverse habitats including moderate and arid. It was collected from localities in northern Jordan and at high altitudes near Jawa (about 1100 m above sea level). The Syrian Hamster is a nocturnal rodent and was found to share burrows with *Meriones tristrami* in northern Jordan. It was found to breed near wheat cultivated fields. It was previously reported in the Badia region include a specimen from Jawa (SEARIGHT 1987) and a recovery of a skull from Eagle Owl pellets from Dahik (RIFAI et al. 2000a).

Subfamily Gerbillinae

This subfamily constitutes the largest group of rodents occurring in Jordan. It includes small-sized rodents adapted for arid and steppe areas. In Jordan, five genera are represented (*Psammomys*, *Gerbillus*, *Sekeetamys*, and *Meriones*), with a total of 11 species.

Gerbillus andersoni DE WINTON 1902 Anderson's Gerbil (Fig. 4g)

This is a medium sized gerbil closely resembling other hairy-footed gerbils (*G. gerbillus* and *G. cheesmani*). It is slightly larger than *G. gerbillus*. Hair on the back is yellowish with grey buff, darker than *G. gerbillus*. The dark pigmentation of its ears distinguishes this species from the other hairy-footed gerbil found in Jordan. White spots are found above eyes and behind ears (ABU BAKER & AMR 2003b).

G. andersoni is found in areas of light sand dunes dominated with *Anabasis articulata*. It lives in association with the hairy-footed gerbil, *G. cheesmani* and the Fat Sand Rat, *Psammomys obesus* (ABU BAKER & AMR 2003b, 2004). Burrows of *G. andersoni* could not be distinguished from those of *G. cheesmani*. Anderson's gerbil is a strictly nocturnal species.

Gerbillus dasyurus (WAGNER 1842) Wagner's Gerbil (Fig. 4h)

This gerbil prefers rocky areas with low vegetation and high avoidance of sandy soil was clearly observed. HATOUGH-BOURAN (1990) presented a thorough study on the burrow system of the Wagner's gerbil inhabiting Shawmari Wildlife Reserve, she found that the run-off wadis was the most preferred habitat rather than the Hammada type vegetation.

In Safawi area, it constituted 5,1% of the diet content of the little owl (AL-MELHIM et al. 1997). It was mostly found to coexists with the spiny mouse, *A. r. lewisi* in the lava desert. It was collected from different localities of arid and semi arid nature (ABU BAKER & AMR 2003a, b).

Gerbillus cheesmani THOMAS 1919 Cheesman's Gerbil (Fig. 5a)

This is the largest of the known species of the genus *Gerbillus* in Jordan. The distribution of this species is confined to soft wind-blown sand dunes areas. These areas are found mainly in the southern borders of the study area along the Saudi borders. (ABU BAKER & AMR 2003a, b).

Only on peripheries of sand dunes and around mudflats, *G. cheesmani* was found to live in sympatry with *G. nanus*, the later is a naked-soled gerbil inhabiting salty terrain. Other species living in the proximity of *G. cheesmani* includes; *Meriones libycus*, *M. crassus* and *G. henleyi* (ABU BAKER & AMR 2003a, b, 2004).

Gerbillus nanus BLANDFOD 1875 Baluchistan Gerbil (Fig. 5b)

Gerbillus nanus is very much differentiated from other naked-footed species of the genus *Gerbillus* by the appreciable projection of the well developed tympanic bulla beyond the supraocciput (ABU BAKER & AMR 2003b). The Baluchistan gerbil was collected from low sandy wadis with considerable salty nature and characterised by rich plant cover of *Nitraria retusa* or *Tamarix* sp. in Hazim and Azraq. It was found coexisting with either one of the large-sized jirds, *M. crassus* or *M. libycus*.

Gerbillus henleyi (DE WINTON 1903) Pygmy Gerbil (Fig. 5c)

The pygmy gerbil was collected from the Hammada areas with scarce vegetation cover. *G. henleyi* is mostly associated with the Sand jird, *Meriones crassus* and the Three toed Jerboa, *Jaculus jaculus*. This species prefers stony, gravely wadis with ample vegetation. Its burrow is characterised by its small diameter (ABU BAKER & AMR 2003a).

Gerbillus gerbillus (OLIVIER 1801) Lesser Egyptian Gerbil

G. gerbillus is the only representative of the Hairy-footed group of the genus *Gerbillus* in the eastern side of Wadi Araba (ABU BAKER & AMR 2003b). It strictly inhabits areas and patches of soft, wind-blown sand dunes dominated with *Haloxylon persicum*. It was found in association with the Naked-

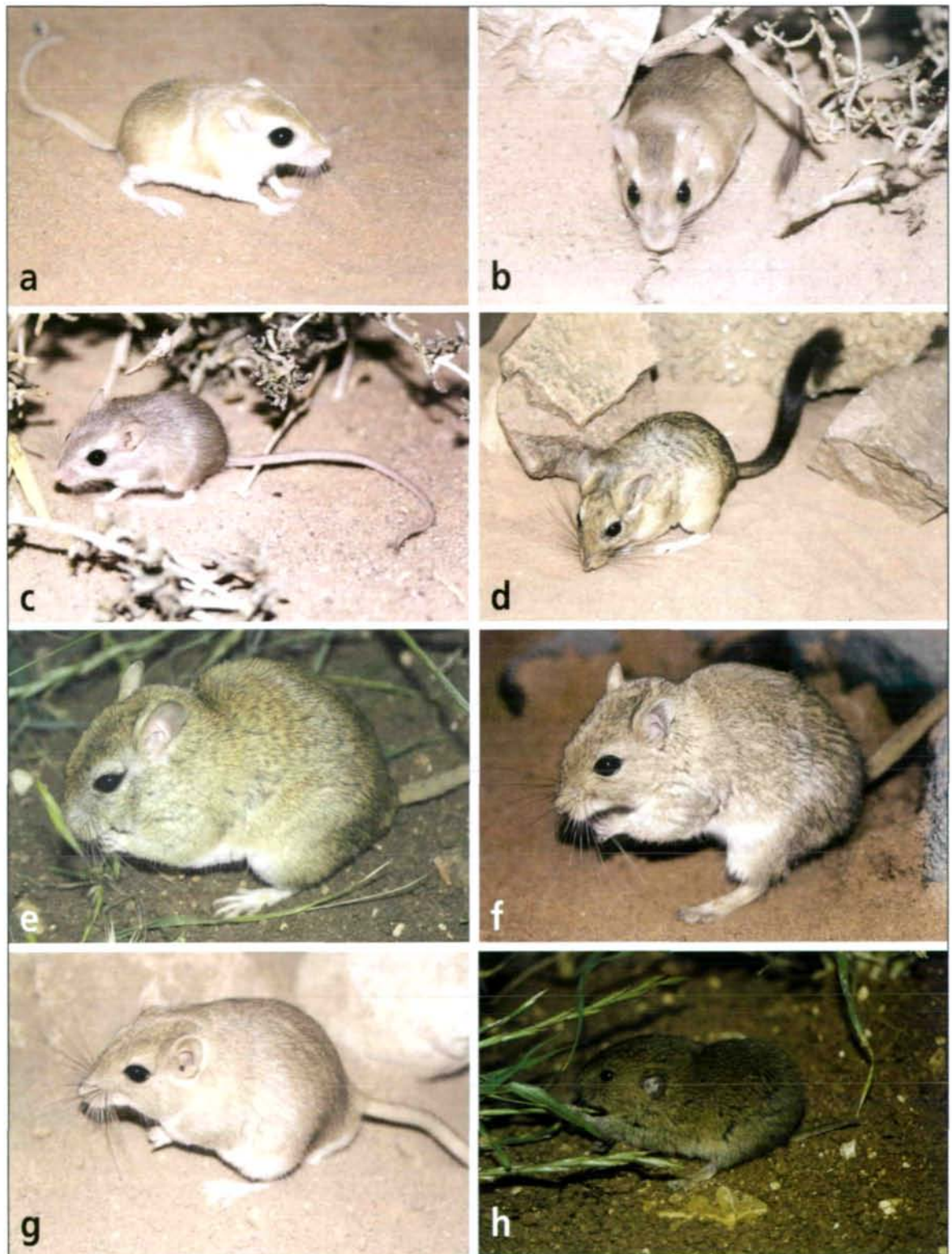


Fig. 5: Rodents:

- a:** *Gerbillus cheesmani*: The distribution of this confined to soft wind-blown sand dunes areas found mainly in the southern desert of Wadi Rum as well as the eastern Desert of Jordan in association with *Haloxylon persicum*, *Hammada salicornica* and *A. articulata* shrubs.
- b:** *Gerbillus nanus*: The Baluchistan gerbil was collected from low sandy wadis with considerable salty nature and characterized by rich plant cover of *Nitraria retusa* or *Tamarix* sp. in areas such as Hazim, Azraq and Al Jafr.
- c:** *Gerbillus henleyi*:

The pygmy gerbil is the smallest rodent known to inhabit the Arabian Peninsula. It was collected from the Hammada areas with scarce vegetation cover. *G. henleyi* is mostly associated with the Sand jird, *Meriones crassus* and the Three toed Jerboa, *Jaculus jaculus*.

d: *Sekeetamys calurus*: This is a rare rodent inhabiting rocky areas in southern Jordan. This species is characterized by its long dark tail.

e: *Meriones tristrami*: This is a rather common jird inhabiting Mediterranean and steppe areas in central and northern Jordan where it is considered an agricultural pest. **f:** *Meriones libycus*: This is the largest rodent recorded from the Eastern Desert. The Libyan jird is a colonial rodent, it was caught in groups around the same borrow system which had several close openings. **g:** *Meriones crassus*: The sand jird is a very common rodent for desert areas collected from a wide range of habitats. It lives in association with either one of the small sized gerbils *G. henleyi* and *G. nanus*. **h:** *Microtus guentheri*: The Levant Mole distributed along the agricultural plains of the Mediterranean biotope. This rodent is a very important agricultural pest. It shares burrows with the Syrian Hamster (*Cricetulus migratorius*) and Tristram Jird (*Meriones tristrami*).

footed gerbil, *G. nanus* around lower wades and salt marshes with *Nitraria retusa* in Rahmeh area.

***Sekeetamys calurus* (THOMAS 1892)**
Bushy-tailed Jird (Fig. 5d)

This species prefers to live around mountain slopes in arid regions. It is a good climber and perhaps lives under boulders. The Bushy-tailed Jird is a nocturnal species with very little knowledge on its biology. Specimens were collected from Wadi Rum (ABU BAKER & AMR 2004).

***Meriones tristrami* THOMAS 1892**
Tristram's Jird (Fig. 5e)

This is a rather common species in Jordan. It inhabits the Mediterranean and steppe areas (AMR 2000a). The burrows system of Tristram Jird were studied by PETTER (1961), where as it could be small (50 cm long) or extensive reaching several meters in length. Gestation period lasts for 24 days, where a female give birth to 6-9 young (ATALLAH 1978).

***Meriones libycus* LICHTENSTEIN 1823**
Libyan Jird (Fig. 5f)

The Libyan Jird is common all over the Syrian Desert; sharing its habitat with other related species. It is known in Wadi Arabah and southern Jordan. Colonies are constructed in hard soil with abundant vegetation. Burrows are very complex and consist of many openings, nest and food chambers. ATALLAH (1977) reported that it feeds on *Citrullus colocynthis*, a common desert annual plant.

This is the largest rodent recorded from the Eastern Desert. It was seen active in the early morning hours at Al-Wisad area. The Libyan jird is a colonial rodent, it was caught in groups around the same borrow system which had several close openings. The Libyan jird was found to coexist with *M. crassus*, *G. nanus* and *G. henleyi* in many areas such as Hazim, Dahik and Ash Shawmari (ABU BAKER & AMR 2003a, 2004).

***Meriones crassus* SUNDEVALL 1842**
Sundevall's Jird (Fig. 5g)

This is one of the most common jirds inhabiting the dry and arid habitats of Jor-

dan. It prefers sand areas and hammada (ATALLAH 1978). According to ATALLAH (1977), Sundevall's jird does not form colonies. ABU DIEYEH (1988) described the burrow system of the silk jird in Wadi Arabah. The burrow has elaborate tunnels that may reach several meters with several food and nesting chambers. It feeds on a variety of food items including desert plants, animal dung and insects (QUMSIYEH 1996). This is a diurnal species, but may also forage at night. It was observed near camel feeding areas, and comes during daytime to feed on barely and other vegetable matters.

The sand jird is a very common rodent in the Eastern Desert and was collected from a wide range of habitats. Colonies of this jird dominated the sand dunes of Hazim area, it was collected from low lands (Marab) between the Harra vegetation and the open areas. It was associated with either one of the small sized gerbils *G. henleyi* and *G. nanus*. Skull remains were recovered from eagle owl pellets at Hazim area (ABU BAKER & AMR 2003a).

It comprised the highest proportion (18.8 and 10.4%) of the diet of both the Eagle Owl at Dahik (RIFAI et al. 2000a) and for the Little Owl from Safawi area (AL-MELHIM et al. 1997) respectively.

***Psammomys obesus* CRETZSCHMAR 1828**
Fat Sand Rat

The ecology of this species was studied by AMR & SALIBA (1986), where they reported on its diurnal activity, feeding habits, burrow system and association with other animals. This is another important reservoir animal for human leishmaniasis, a disease known in Jordan and associated with areas colonised by this jird. The Sand Fat Jird is a colonial species forming large colonies constructed close to *Anabasis* sp. shrubs. It was found to share burrow with the Syrian hamster. During our field studies on the ecology of this jird, population crash is evident. In some areas, previously known to have dense colonies of this jird disappeared entirely, where as new colonies are established in new areas away from the original foci.



Fig. 6: Carnivores: *Canis aureus syriacus*: A pair of the Asiatic Jackal in Azraq Nature Reserve.

Subfamily Microtinae

Microtus guentheri (DANFORD & ALSTON 1880) Levant Vole (Fig. 5h)

The Levant Mole distributed in the Mediterranean biotope. Some colonies are

found in the transitional areas between Irbid and Al Mafraq. This is a colonial species where colonies may exceed 40 burrow systems per 1000 m². It shares burrows with the Syrian Hamster (*Cricetulus migratorius*) and Tristram Jird (*Meriones tristrami*). The Barn Owl (*Tyto alba*) feeds readily on the Levant Vole (RIFAI et al. 1998).

Voles have enormous reproductive abilities. Gestation period lasts for 21 days, and females give birth to up to 10 new born. Each generation may produce 6 to 7 litters per year. This rodent is a very important agricultural pest. Its populations may increase suddenly inflicting severe damage to crops.

Order Carnivora

The most distinctive character of this order is the presence of canines in the upper and lower jaws adapted for cutting, tearing and piercing flesh. The Carnivora of Jordan consists of five families (Canidae, Felidae, Hyaenidae, Herpestidae and Mustelidae), with a total of 18 surviving species. In earlier papers, AMR & DISI (1988), KOCK et al. (1993), QUMSIYEH et al. (1993); AMR et al. (1996) and ABU BAKER et al. (2004), reported on the wild carnivores of Jordan. The original richness of Jordan's carnivore fauna is apparent from engraved rock drawings and mosaics found in ancient castles and churches (VON LOWENSTERN et al. 1977, PONTICELLI 1979, PICCIRILLO 1982, FIRENZE 1983, HATOUGH-BOURAN & DISI 1991).

Family Canidae

(Jackals, Foxes and Wolves)

Canis aureus LINNAEUS 1758
Asiatic Jackel (Fig. 6)

The Jackal is becoming a rare species in Jordan due to the continuous eradication of feral dogs and wolves by poisoning or shooting. It was considered abundant in Jordan around the turn of the century (TRISTRAM 1885, AHARONI 1930, BODENHEIMER 1958). Jackal populations started to decline 40-50 years ago. LEWIS et al. (1968) attributed their sharp population's decline to habitat destruction and perhaps to competition with the red fox. Currently, population of the Jackal is confined to oasis, swamps and



Fig. 7: Carnivores:
Canis lupus pallipes

naturally protected areas such as the Azraq Nature Reserve, Northern end of the Dead Sea and Wadi Rum. This species prefers habitats with cover and avoids open areas. Such cover provides the animal with shelter. Jackals feed on several items of small animals (rodents, hares, birds etc.) as well as to vegetable matter. It is considered as opportunistic omnivore. I personally observed a pack of a mother and three young Jackals in Azraq around the afternoon. It was seen and bone remains were collected from Wadi Rum and Azraq (MOUNTFORD 1965, NELSON 1973, AMR & DISI 1988).

***Canis lupus* LINNAEUS 1758 Wolf (Fig. 7)**

The Wolf is a persecuted animal and is considered an endangered species. The Wolf avoids extreme desert habitats. We have no records from remote open deserts with little or sparse vegetation. The wolf is a more agile and a well adapted species than the Jackal. It was reported from several localities around the country.

The villagers fear the Wolf. It attacks their sheep flocks and many stories indicated that it attacked humans. Poisoned carcasses are frequently used to kill the Wolf, unfortunately, many other carnivores are subsequently found dead.

***Vulpes cana* BLANFORD 1877 Blanford Fox (Fig. 8d)**

Only recently it was recorded from Dana area, near Tafilah (AMR et al. 1996). Blanford's fox is a rare fox in south west Asia. The distribution of *V. cana* is confined to the southwestern arid and semi arid mountains, along the mountain slopes in the south represents the most Northern limit for the distribution of Blanford's fox. The rocky terrain of the Mediterranean part of Dana is mountainous with cliffs, cervices and caves that are scattered throughout the area, Wadi Mujib and Wadi Rum (ABU BAKER et al. 2004). It is believed that the surviving populations in Oman, Rift Valley and the Negev desert are relicts (MENDELSSOHN et al. 1987), and the desert extending across Iraq, Arabia and Jordan is a barrier that limited the distribution of *V. cana*.

Morphological characters of Blanford's fox such as naked foot pads, sharp, curved

claws as well as its short hind legs attributed to its adaptation to live in rocky, steep mountains (GEFFEN et al. 1992).

***Vulpes rueppellii* (SCHINZ 1825) Sand Fox**

The Sand Fox is a desert inhabitant. It was spotted in sand and basalt deserts in eastern Jordan. In Al-Hazim, it coexists along with the Red Fox, *V. vulpes*. It feeds on various small animals and arthropods and vegetable matter (BUNAIAN et al. 2001). LINDSAY & MACDONALD (1986) gave detailed descriptions on the behaviour and ecology of the Sand Fox. It is mostly nocturnal, but was encountered during daytime.

***Vulpes vulpes* (LINNAEUS 1758) Red Fox**

The Red Fox is considered by far the most common wild canid in Jordan. It inhabits all biotopes and perhaps is considered as a pioneer species in newly established cultivated areas in the desert (AMR 2000a). It is quite common in Wadi Arabah and Er Ruwished. Packs of ten or more animals were spotted in northeastern Jordan. The dens may be found along crevices, boulders or patches of scrubs. The red fox is known to feed on small rodents, small birds and reptiles as well as figs, grapes and other fruits.

This is a rather common species in Jordan (AMR & DISI 1988). It was collected from the Eastern Desert as well as from most of the country. This is a very adaptable carnivore that can inhabit all type of habitats. It was observed in many areas of Jordan especially in the northern parts of the country.

Family Felidae

***Caracal caracal* (SCHREBER 1776) Caracal (Fig. 8a)**

The Caracal is one of the most beautiful and rarely encountered wild cats. It prefers semi deserts and can penetrate into mountainous areas with thick vegetation (AMR 2000a). The caracal is nocturnal as well as crepuscular. The Caracal is a hunter by nature. The main food items are gazelles, hares, rodents, rock hyraxes, birds and reptiles. The availability of large prey species and water effect its distribution. They were also reported to feed on carcasses.

Fig. 8: Carnivores:

- a. *Caracal caracal*: The Caracal is one of the most majestic felines in Jordan. This species as well as other wild carnivores is endangered.
- b. *Felis silvestris tristrami*: This is a common species found in mountains and arid habitats of Jordan.
- c. *Felis margarita*: The Sand Cat is one of the most elusive cats in Jordan. It was recorded from the eastern desert and Wadi Rum.
- d. *Vulpes cana*: The Balfour's Fox is the smallest canids known in Jordan. It inhabits rocky terrains along Wadi Araba, the Dead Sea area and Wadi Rum.



WIESBEIN (1988) reported that the Caracal populations in Palestine increased following the poisoning of canids (especially the jackals) by farmers. Food competition was thus minimised for the caracal, allowing its population to increase, also extending their range, according to WIESBEIN, further north and into the Arabah Valley.

***Felis chaus* GÜLDENSTÄDT 1776**
The Jungle Cat

The Jungle Cat is associated with dense vegetation close to permanent water bodies. It takes refuge in thick vegetation of *Typha* and *Phragmites* along the Jordan and Yarmuk Rivers. It is a rare cat with very limited distribution and is considered a threatened species. This cat feeds on birds, small mammals, reptiles and insects.

Its occurrence in Jordan was debatable until recently. KOCK et al. (1993) reported on a specimen collected from the Jordan Valley near the Jordan River. In 1998, two further specimens were found poisoned near Al Baqurah. The distribution area of *F. chaus* is confined to the northwestern parts of Jordan along the Jordan River basin. So far, it is known only from two localities: Damyeh and Al-Baqurah. Both areas are located on the eastern side of the Jordan River. It is possible that its distribution extends to the lower reaches of Jordan River and its main tributaries. Over 30 years ago the upper reaches of the Jordan River were declared military zone, with limited access for local people (ABU BAKER et al. 2003).

***Felis margarita* LOCHE 1858**
The Sand Cat (Fig. 8c)

The Sand Cat, *Felis margarita*, was recorded from Jordan based on an observation made by MOUNTFORD (1965) in Wadi Ram. Later, its presence was substantiated in Wadi Ram by finding a skull (HEMMER 1978). The sand cat was observed in an area dominated by small shrubs near Qasr Burqu (BUNAIAN et al. 1998).

It is currently considered rare, probably due to its largely nocturnal lifestyle and secretive habits, however it may well be more widespread than records suggest. It is extremely sensitive to human disturbance, habitat encroachment and competition from larger predators. Other threats include poisoning and baiting.

***Felis silvestris* SCHREBER 1775**
The Wild Cat (Fig. 8b)

One specimen was trapped and subsequently released at the Shawmari Wildlife Reserve during 1986. The wild cat has been reported from Ghawr Seisaban, Mu'ab (POCOCK 1944) and from Azraq ash Shishan (ATALLAH 1966). Further specimens were collected from Dana Nature Reserve (AMR et al. 1996).

Wild cats have a wide range of habitats ranging from densely forested areas to dry regions with access to permanent water courses. This is true for localities in eastern Jordan.

Family Herpestidae

***Herpestes ichneumon* (LINNAEUS 1758)**
The Egyptian Mongoose

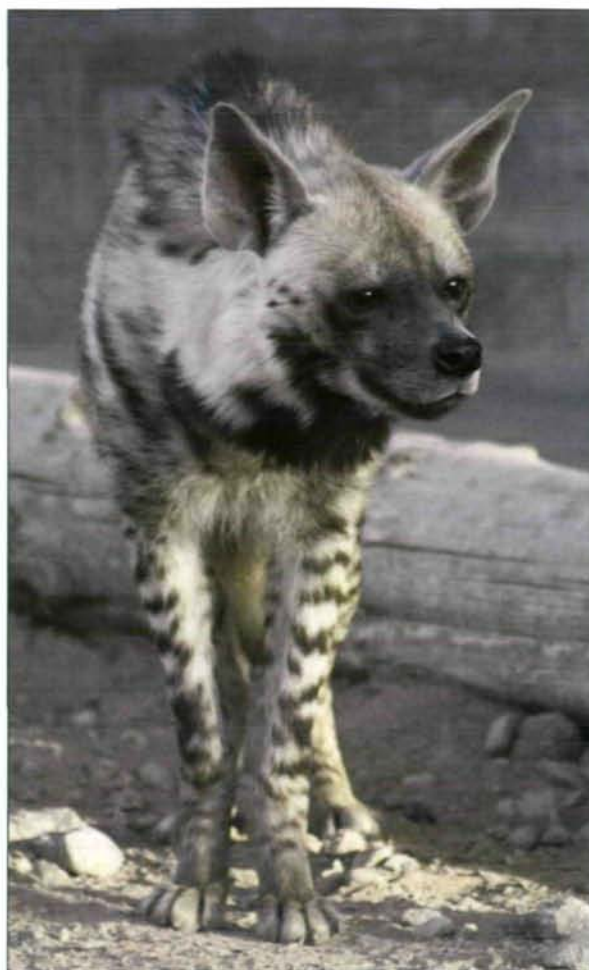
The Egyptian Mongoose is essentially a diurnal carnivore, however, it may also be active at night. It was seen on many occasions during daytime speeding or looking for a prey. The mongoose feeds on a large food spectrum, including plant materials, snails, amphibians, fishes, rodents as well as turtles eggs. In northern Jordan, the mongoose is called as "Akel Al-Hahya-The Snake eater". The mongoose lives in close proximity to chicken farms and cultivated areas in the Jordan Valley and northern Jordan (AMR et al. 1987).

Family Hyaenidae

***Hyaena hyaena* (LINNAEUS 1758)**
The Striped Hyena (Fig. 9)

The Striped Hyena is known as a solitary carnivore and rarely seen in groups, in contrast to the Spotted Hyena. They could be found in all habitats of Jordan, with preference to dry deserts with caves. This is one of the most common carnivores in Jordan. Hyenas are the most frightful animals to the locals; poisoned carcasses and traps are in common use to eradicate and reduce its population around villages and desert dwellers. In Jawa (close to the Syrian borders), three pups and their mother were found killed (BUNAIAN et al. 2001).

Fig. 9: Carnivores:
Hyaena hyaena syriaca: The Striped Hyena is under severe decline due to invasion of human activities deep in its habitat.



Family Mustelidae

Lutra lutra (LINNAEUS 1758) The European Otter

The presence of otters is dependent on continuous flow of fresh water streams or rivers. Since permanent freshwater bodies are limited in Jordan, the otters have a very limited distribution along the Jordan and Yarmuk rivers. Associated vegetation close to their burrows, which are located on the bank of the river, includes *Arundo donax* and *Phragmites australis* (REUTHER et al. 2000).

Signs of footprints and spraints were found in 7 locations along the Jordan and Yarmuk rivers (REUTHER et al. 2000). During the first few decades of this century, the otter was hunted for its skin (BODENHEIMER 1935). Also, the drastic decline of water level and flow in the Jordan and Yarmouk rivers after the Israel diverted the water courses of several side tributaries for the River Jordan, otter's population were reduced to the lowest level. Little is known on

the abundance and biology of this species in our area. Further studies should be undertaken in order to implement protection strategies.

Martes foina (ERXLEBEN 1777) The Stone Marten

The Stone Marten is mostly associated with fertile and wooded parts of the Mediterranean ecozone of Jordan. It can climb trees with astonishing jumping abilities. Females give birth to 3-6 young. NEHRING (1902) described the subspecies *M. f. syriaca* from Wadi Syr (Wadi as Sir). Jordan and Palestine represent its most southern distribution limit. The subspecies occurring in our area, *Martes foina syriaca*, is smaller than the subspecies *Martes foina foina* known from Europe. AHARONI (1930) stated that following the Second World War, *M. f. syriaca* was quite common in Palestine and BODENHEIMER (1958) reported that in 1929 fresh skins of the Stone Marten were sold in the streets of Jerusalem, however, BODENHEIMER (1958) stated that it was rare in the 1950s.

Most of the collected specimens of *M. f. syriaca* were found either shot or poisoned. This necessitates the urgent need to protect this animal through the public awareness and the implementation of protective measures by Royal Society for Conservation of Nature. Scattered pine and oak forests in Jarash and Ajlun represent the last refuge for this handsome animal (AL-SHAFFEE et al. 1997).

Meles meles (LINNAEUS 1758) The Eurasian Badger

The Eurasian Badger prefers to colonise areas close to cultivated areas. Burrows or sets may vary from simple systems that consist of two or more openings to extensive burrows reaching a depth of one meter under the surface. Badgers dig their burrows using their strong claws leaving behind a large pile of excavated soil (LEWIS et al. 1968).

The status and distribution of this species was discussed in details, records from Al Munaysah and Um el Jimal, eastern Jordan, indicate an expansion of the species' range in the east. The population density of the Badger in Jordan is quite low which is

explained by the country's position at the edge of the distribution range (ABU BAKER & AMR 2002).

***Mellivora capensis* (SCHREBER 1776)**
The Honey Badger

The Honey Badger inhabits a wide variety of environments including semi deserts, dry and Mediterranean habitats (AMR 2000a). The Bedouins believe that the "Sil-tah" is a dangerous animal that digs graves and drags the dead.

The black and white contrast in its body coloration has a warning function. Furthermore, the Honey Badger defends itself by its powerful claws and bites and by secreting a suffocating odour from its anal glands (HARRISON 1981).

Vormela peregusna
(GÜLDENSTÄDT 1770)

For many years, southern Jordan was considered the most southern distribution range for *V. peregusna*, however, NADER (1991) reported this species from Turayf, Saudi Arabia. This extends the known distribution further to arid environments in the northern Arabian Peninsula. Turayf is about 180 km southeast of Azraq oasis and its vicinity where it was observed. KOCK (1983) discussed the distribution of the Marbled Polecat in the Middle East. Its distribution extends from southern Turkey, across Syria and Lebanon, to southern Jordan and Palestine, and further east to Iraq and Iran.

Despite the continuous changes in the natural habitats of Jordan, the distribution of the Marbled Polecat expanded. *V. peregusna* is distributed along the Mediterranean biotope and invaded parts of the Irano-Turanian steppes. We have verbal records and personal observations from Al Mafraq and Um Al Jimal area in the northeast as well as from the Azraq area. In some areas as Azraq and Umm Al Jimal, the locals indicated that this animal is new to them, and appeared recently in their farms and villages.

The locals refer to this animal in Arabic as "Fessyah" equivalent to "stinky" due to its unpleasant and offensive smell, when alarmed or trapped. Also, it is claimed as a ferocious predator for chickens and pigeons,



making the polecat a pest. This is evident in the poisoned specimens. Despite of the different measures applied by farmers to control it, as in trapping and poisoning, it appears that the Marbled Polecat is extending its range into new habitats. Perhaps the movement of trucks from one farm to another to collect crops may spread this animal to other farms (RIFAI et al. 1999).

Fig. 10: Hyrax: *Procavia capensis syriaca*: The Hyrax is one of African mammals that penetrated northwards to Jordan. It is associated with rocky habitats.

Order Hyracoidea

This order is an ancient group and is believed that it originated from a primitive ungulate stock. Hyracoidea is an African group that expanded into the southern parts of the Middle East. In Jordan, order Hyracoidea is represented by a single species, the Hyrax, *Procavia capensis*.

***Procavia capensis* (PALLAS 1766)**
(Fig. 10)

The Hyrax is an agile rock climber. It is associated with rocky areas with steep edges. Current populations are found in Wadi Ram, Ghawr as Safi, and most common in Al-Adasyeh, overlooking the Yarmouk River.

A large colony with over than 50 individuals was monitored in Al-Adasyeh. They are active during daytime, and get very close to the river to drink. A detailed account on its distribution and ecology in Jordan was given by RIFAI et al. (2000b).



Fig. 11: Ibex: *Capra ibex nubiana*: The Ibex occupies rocky areas overlooking the Dead Sea area and Wadi Rum. This species is protected and a captive-breeding programme in Wadi Al-Mujib Reserve is active to increase its number.

Order Artiodactyla

(Even-toed Ungulates)

The even-toed ungulates have either two or four (usually) hoofed toes on each foot. The artiodactyla of Jordan constitute the large mammals. Forms of the order are readily divisible into two groups on the basis of structure of the teeth, presence or absence of horns, and structure of the stomach and feet. The pig group has crushing cheek teeth, upper incisors, a simple stomach, no horns, four hoofed toes, and includes the peccaries. The cow group has rasping cheek teeth, no upper incisors, two or four hoofed toes on each foot, complex stomach, and horns or antlers in most species. It includes the deer, elk and allies; cows and allies; and the pronghorn.

Family Suidae

Sus scrofa LINNAEUS 1758

The Wild Boar

This is the only wild boar in Jordan. It is rather common species distributed throughout the Jordan and Yarmouk Rivers basins (AMR 2000a). The wild boar is a pest in the citrus and vegetable farms of the Jordan Valley. It has been seen on many occasions around North Shounah and along the Yarmouk River. According to MEINERTZHA-GEN (1924) and CLARKE (1977), *S. scrofa* was introduced and used to be common at Azraq, but disappeared recently.

This adaptable animal managed to survive in many areas despite extensive hunting and is found in most areas with a permanent source of fresh water. The wild boar was seen in Zubya and Baoon (Ajlune area), and along the Jordan River. Bone remains were excavated from several archaeological sites that dated back to the upper Paleolithic period (BOESSNECK & VON DEN DRIESCH 1978; GARRARD et al. 1988).

Family Bovidae

Capra ibex nubiana F. CUVIER 1825

The Nubian Ibex (Fig. 11)

TRISTRAM (1866, 1876, 1885) reported this species as common from the Moab (east of the Dead Sea) and the hills near the Dead Sea. He also acquired a few specimens from

these localities and from Ain Gedi (Engedi). TRISTRAM (1866) specified other localities where he saw ibex: near Mar Saba, Ain Teraba, Wadi Sudeir, and Jebel Hatrura (near Masada). HART (1891) reported seeing ibexes on Mount Hor while PALMER (1871) saw them at Wadi Hanjurat al Gattar (35 miles SW Dead Sea). CARRUTHERS (1909) noted these animals at Zarqa Ma'in, and HART (1891) reported seeing them at Wadi Arabah. ALLEN (1915) quoted Dr. PHILLIPS who supplied him with the specimens for his report on the mammals of Sinai and Palestine as follows: "The Sinai Ibex persists over all the rugged parts of the Sinai peninsula, near Aqaba and up at least as far as the northeast end of the Dead Sea".

The extensive hunting of this species has greatly reduced its population and it is now on the list of endangered and protected species issued by the Royal Society of Conservation of Nature. The ibex is in dire need of protection. We are not able to state with certainty how many populations have been decimated. The few records of the past and recent records indicate extensive losses in the mountainous regions of the Palestine and Jordan. Although undoubtedly greatly reduced in numbers since TRISTRAM's time (mid 1800s), it manages to persist.

Gazella dorcas (LINNAEUS 1758)

The Dorcas Gazelle

Few specimens of this species were seen at Wadi Arabah area. A male and female were found dead near Wadi Finan during 1980-1981. The dorcas gazelle is included in the list of protected species in Jordan.

Gazella gazella (PALLAS 1766)

Populations of the Mountain Gazelle are declining at an alarming rate, and perhaps it is extinct at the present. A specimen was killed in Salt mountains in summer 1986. TRISTRAM (1866) observed it in the forests of Gilead. Further detailed on the historical status of this species was studied (QUMSIYEH et al. 1996).

Gazella subgutturosa

(GÜLDENSTAEDT 1780)

An account of the artiodactyls of Jordan was given by (QUMSIYEH et al. 1996). A

skull was collected from H-5 in 1950. Dr. MULLER collected a skull from Qa'a Dhuweila during September 1983. CLARKE (1977) noted that a specimen was taken from Qatrana.

Oryx leucoryx (PALLAS 1777)

The Arabian Oryx

In the 19th century, this beautiful antelope was still common in north Arabia and in Belka and Hauran in Jordan (TRISTRAM 1866, 1876) but rare or absent in Palestine. TALBOT (1960) stated that it was already becoming rare in Sinai and the southern deserts of Palestine in 1800. According to MOUNTFORD (1965), a hunter shot three animals at Qatrana in the 1920s. In South Jordan, the species may have persisted into the 1930's as a British Army Unit kept one there (DOLLMAN & BURLACE 1935). The oryx was probably exterminated in Jordan by the Second World War (TALBOT 1960). Persisting populations early in this century were reported near Jebel el Tubayq (CARRUTHERS 1935) and in Al Busayta and Wadi Sirhan (RASWAN 1935) in northern Saudi Arabia near the borders with Jordan. Until very recently the oryx used to inhabit most of the Arabian and Syrian deserts. Its habitat included hamada deserts as well as wadis, sandy deserts, and plateaux. Wild oryx ate succulent plants such as *Aristida* and *Cynomonium* and buds of tamarisk and other shrubs (CARRUTHERS 1935). Many other reported juicy desert plants are eaten including the desert melon, *Citrullus colocynthis* (STEWART 1963). The biology of the oryx in the wild was studied by STEWART (1963) and in reintroduced populations by LLOYD (1965) and HATTOUGH & AL-EISAWI (1988).

Order Lagomorpha

This family includes hares and rabbits. For some time, this order was considered as part of the large order Rodentia. However, the presence of two pairs of upper incisors is a distinctive feature. The front incisors are functional while those on the back are small. In our region only one family, Leporidae, is presented. Hares are very common all throughout the world, especially species of the genus *Lepus*. They are exclusively her-

bivorous and found in varied habitats, including deserts, mountains as well as sandy deserts.

Family Leporidae

Lepus capensis LINNAEUS 1758

Most of the previous collections of this species were made from the Jordanian Desert (including Azraq and Al Jafr) (ATALLAH 1967a, b, SEARIGHT 1987). This is a common desert species feeds on shrubs and vegetation. Recent records are from Dana Nature Reserve.

The Arabian Hare is under severe threats due to the excessive hunting in the Jordanian deserts. During the past 20 years, We personally observed the sharp decline in the Hare population, for example, it was very common in Wadi Arabah in 1975, however, it is quite rare with limited abundance.

Discussion

The mammals of Jordan have different affinities and only one species can be considered as regionally endemic. Several Palaearctic species penetrated southwards where the southern mountain range of Jordan represents their most southern range of distribution such as *Erinaceus concolor*, *Sciurus anomalus*, *Apodemus mystacinus*, *Lutra lutra*, *Martes foina*, *Meles meles*. Additionally, some Afrotropical species expanded their range of distribution to northern Jordan and further north to Syria and Turkey (e.g. *Procapra capensis* and *Rousettus aegyptiacus*).

Other species, especially rodents showed some remarkable habitat selection (Fig. 12) in the arid deserts of Jordan. *G. cheesmani*, for example is an inhabitant of sand dunes and its distribution range extends over Arabia to Iran (ABU BAKER & AMR 2003a, b). This species utilises sand dune islands that are scattered across deserts. Other rodent species are confined to rocky habitats of various types. *Acomys russatus lewisi* is associated with black lava desert habitats, while *A. cahirinus* lives in rocky habitats other than lava desert. Relicts of earlier geological periods are exemplified by the presence of *E. melanurus* in extreme desert habitats, despite the arboreal activity of this species.

Almost all the carnivores of Jordan are considered threatened or endangered. Due to accelerating population growth and habitat changes as well as the human attitude to wild animals (AMR 2000b, AMR & QUATRAMEEZ 2002). Wolves, jackals, hyenas and other small mustelids are declining in their natural habitats. Several studies addressed the status of the carnivores in Jordan and suggested further implementations of conservation efforts (QUMSIYEH et al. 1993, AL-SHAFFEE et al. 1997; RIFAI et al. 1999, REUTHER et al. 2000, BUNAIAAN et al. 2001, ABU BAKER & AMR 2002, ABU BAKER et al. 2003, ABU BAKER et al. 2004).

Up to the present time, several species of the artiodactyls became extinct within the past 50 years. The Oryx, Goitered gazelle and Mountain gazelle have been exterminated entirely with no further recent records. However, extensive efforts were implemented to protect the few remaining populations of this group. Also, establishment of nature reserves for captive-breeding programmes was successful in the re-introduction of the Arabian oryx and the ibex (QUMSIYEH et al. 1996) co-operation on a regional basis is essential in the conservation and breeding of the Arabian gazelle species. Fragmentation of resources in conservation and re-introduction efforts is an obstacle to the success of gazelle conservation in the region. This is particularly true for migratory species like the Arabian oryx and the rhinoceros. Decisions on location of captive-breeding programmes, re-introduction sites and conservation and rehabilitation of range lands should be made in a regional framework to guard against duplication of efforts (QUMSIYEH et al. 1996).

Historical records of the Aurochs, *Bos primigenius*, were reported from ancient strata (about 7000 BC) from Jericho (QUMSIYEH et al. 1996). The Pleistocene presence of the addax and the bubale is documented (BATE 1937). The exact time when these species became extirpated in the Eastern Mediterranean region is unknown and remaining small populations may have existed during the Roman periods with the bubale perhaps surviving to the 19th century (BODENHEIMER 1958). Remains of the red deer, *Cervus elaphus*, were excavated at Tel Hesbon in layers

from the 12th to the 15th century AD (BOESSNECK & VON DEN DRIESCH 1978). *Capreolus capreolus* and *Dama mesopotamica* were common in late Paleolithic caves in Palestine (BATE 1937) and through the 7th to 6th century BC in Jordan (BOESSNECK & VON DEN DRIESCH 1978), whereas both species disappeared perhaps in 19th or the 20th century.

Currently, active research on the conservation of bats is in progress. Bats were also affected by the alarming rate of urbanisation and agricultural expansion all over Jordan. Nine of the 23 bat species recorded in Jordan are listed in the IUCN Red Data Book, which constitutes about 40 % of the total known species.

To this end, further studies on the ecology and conservation of the mammals of Jordan should be encouraged. Documentation of records as well as establishing a natural history museum and a zoological garden are among our ventures in the near future.

Zusammenfassung

Die Säugetiere Jordaniens. In Jordanien wurden 78 Säugetierarten aus 7 Ordnungen (Insectivora, Chiroptera, Carnivora, Hyracoidea, Artiodactyla, Lagomorpha und Rodentia) nachgewiesen. Fledermäuse und Nagetiere weisen die höchste Diversität der nachgewiesenen Arten auf. Zu den nachgewiesenen Arten werden Bemerkungen zur Systematik und Ökologie angeführt.

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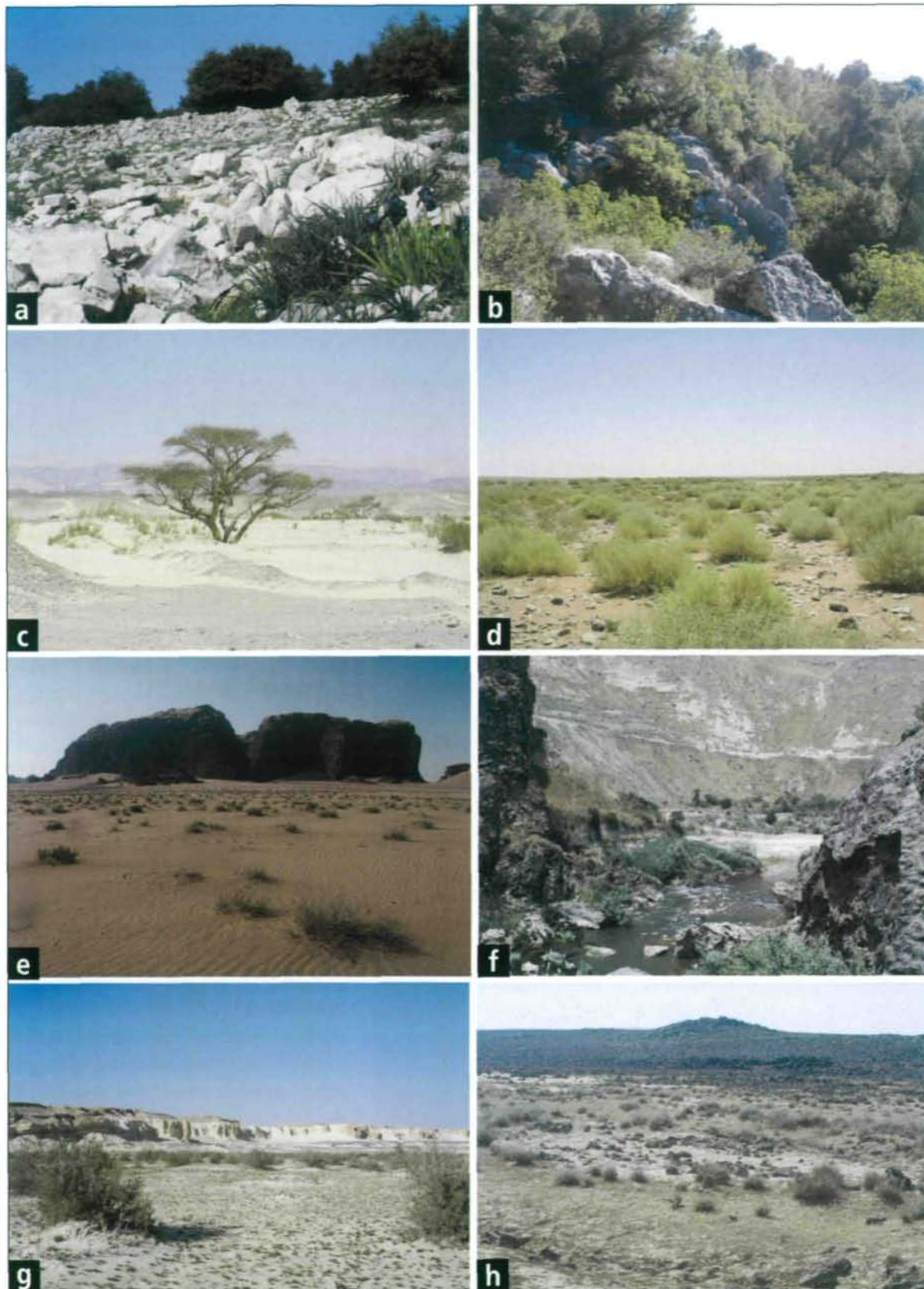


Fig. 12:
Habitats:
a: Rocky Mediterranean habitat with abundance of evergreen oak (*Quercus* sp.) forests in northern Jordan. This habitat is suitable for *Apodemus mystacinus*, *Marets foina*, and *Rhinolophus ferrumequinum*. **b:** Mediterranean habitat with mixed oak, pine and *Arbutus* forests extends along the northern mountain range reaching Jarash area. This area harbors several horseshoe bats and the Persian squirrel. **c:** Afro-tropical zone in Wadi Araba is characterized by the presence of *Acacia* trees and sand dunes. Mammals such as the striped Hyena, many gerbils as well as

vespertilionid bats. **d:** Open Hamada in eastern Jordan with ample bushes of *Seidlitzia rosmarinus*. Several rodent species such as *Jaculus jaculus*, *Meriones libycus* and *Gerbillus cheesmani*. **e:** Wadi Rum in southern Jordan consists of sandstone mountains and corridors of sand. Large mammals as the Nubian Ibex, the Rock Hyrax and the Blanford's Fox are common. **f:** The Yarmouk River Basin in northern Jordan. Several species of bats, the European Otter, the white-toothed Shrew are typical animals known from this area. **g:** Al-Dahik area located in the eastern corner close to Azraq oasis bordering Saudi Arabia. Caracal and hyenas were observed in this area. **h:** Black lava desert in eastern Jordan. Arabian hare, Goitered Gazelle and the Sand Cat were reported from this area.

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