



United Nations
Development
Programme



The Hashemite Kingdom of Jordan
The General Corporation for the
Environment Protection



United Nations
Environment
Programme

Jordan Country Study on Biological Diversity

Mammals of Jordan



This work was prepared for the The General Corporation for the Environment Protection (GCEP). With technical support from the United Nations Environment Programme (UNEP) and funding from the Global Environment Facility (GEF). Project No. GF/6105-92-65, GF/6105-92-02 (2991).



United Nations
Development
Programme



The Hashemite Kingdom of Jordan
The General Corporation for the
Environment Protection



United Nations
Environment
Programme

Jordan Country Study on Biological Diversity

Mammals of Jordan

Zuhair S. Amr (Ph. D.)
Associate Professor in Zoology
Department of Biology
Jordan University of Science & Technology
Irbid, Jordan

This work was prepared for the The General Corporation for the Environment Protection (GCEP). With technical support from the United Nations Environment Programme (UNEP) and funding from the Global Environment Facility (GEF). Project No. GF/6105-92-65, GF/6105-92-02 (2991).

0483/02

Author:	Zuhair S. Amr
Title:	Mammals of Jordan
Subject Heading:	1. Mammals
Publisher:	United Nations Environment Programme
Notes:	Perpared by the National Library

2000

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
﴿وَمَا مِنْ دَابَّةٍ فِي الْأَرْضِ وَلَا طَائِرٍ يَطِيرُ بِجَنَاحَيْهِ إِلَّا أُمِّرٌ أَمْثَالَكُمْ مَا
فَرَّطْنَا فِي الْكِتَابِ مِنْ شَيْءٍ ثُمَّ إِلَىٰ رَبِّهِمْ يُحْشَرُونَ﴾

(الآية ٣٨) سورة الأنعام

*In the name of God
Most gracious, Most Merciful
There is not an animal (That Lives) on the earth
nor a being that flies on its wings, but (forms part of)
communicates like you Nothing have we omitted
From the book and they (all) shall be gathered to
their Lord in the end.*

The Holy Quran

Cattle 38

Foreword

By: Dr. Mazin Qumsiyeh

The mammals of the Fertile Crescent (Iraq, Syria, Lebanon, Jordan and Palestine/Israel) have deservedly received considerable attention from scientists in various fields of natural history. Reasons for this interest are numerous but most importantly is the strategic location of this area at the crossroads of Africa, Europe, and Asia and the religious significance to the three monotheistic religions (Christianity, Islam, and Judaism).

While scientists are supposed to be objective observers of the natural world, no scientist is insulated from the political realities of their up-bringing. It is thus of interest that one observes the continuous ethnocentricity especially coming from scientists in Israel with Jewish history being used to the exclusion of the various histories before and after (a good example of this is the recent work on the "Mammals of Israel" by Yom-Tov and Mendelssohn). Similar biases were evident by European scientists visiting the "Land of the Bible" and writing introductory chapters and material that emphasize the biblical significance of things. A dearth of native scientists in the past is now changing and it is not surprising to start to see signs that the tide is changing and the pendulum swinging the other direction. There is now the beginning of development of native talent in science and of native scientists starting to study the fauna (rather than visitors such as Harrison or European immigrant/settlers such as Boehringer and Mendelssohn). Such native sons/daughters are indeed rare and it is unfortunate that one of the most promising (Sana Atallah) died young and was not able to contribute much while others have emigrated to other lands (in my case and also switched fields). Thus, such native works as that of Dr. Amr brings with it the promise of a new beginning.

As we usher in a new millenium I believe that we will see a revival of the Golden age of science and technology in the Middle East, an area that has lagged behind the so called developed world (Europe, North America, and the Far East). Obviously this Middle East renaissance was hindered by many factors and there are as many opinions on this as there are scholars (from European colonialism, to zionism, to feudalism, to religious fanaticism, to economic and population factors).

Regardless of the actual cause, it is unrea-

listic to think that, in this new age of information technology, the circumstances will not change. I am sure some of my respected Western colleagues (Europe and Israel) maybe tempted to dismiss such beginnings as incomplete and even shallow. This reminds me of the prediction made by the CEO of International Business Machines (IBM) at the dawn of the computer age that computers would never be widely used and "at best" have a world-wide market of a few hundred. While there will obviously be many difficulties and setbacks along the way, I am very optimistic about the possibilities for the future. I emphasize that this work represents a beginning and as in all beginnings, it is neither complete nor "perfect." We look forward to many more contributions by this author.

One must also emphasize that individuals like Ahmed Disi and Zuhair Amr represent the first native Muslim vertebrate biologists in this new era. These contributions would likely be matched or exceeded only by their own additional works or by those of their numerous students. We should all encourage such efforts.

I obviously would be remiss if I did not comment on conservation issues. As human beings, we are significantly altering the environment. In fact, the first clear example of a human community destroying its surrounding to a point where the settlement had to be abandoned occurs in Northern Jordan. Only recently in human history have we as a species become cognizant of the importance of preserving our environment. Human societies thus started to address issues of sustainable development and engaging in environmental impact studies.

In Jordan, the need to document what is there now is a crucial part of these considerations. By understanding what mammalian species exist, their habitat requirements, and their distributions, we are able to rationally address such issues as how best to minimize the ecological impact of the rapidly growing human population and its anticipated economic development. There will be a need for further local studies especially those using ecological tools to follow population trends in mammals. This book is a good foundation for such desperately needed studies. I commend the author on his energy and enthusiasm.

*Mazin Qumsiyeh, PhD, FABMG
Yale University, New Haven, CT*

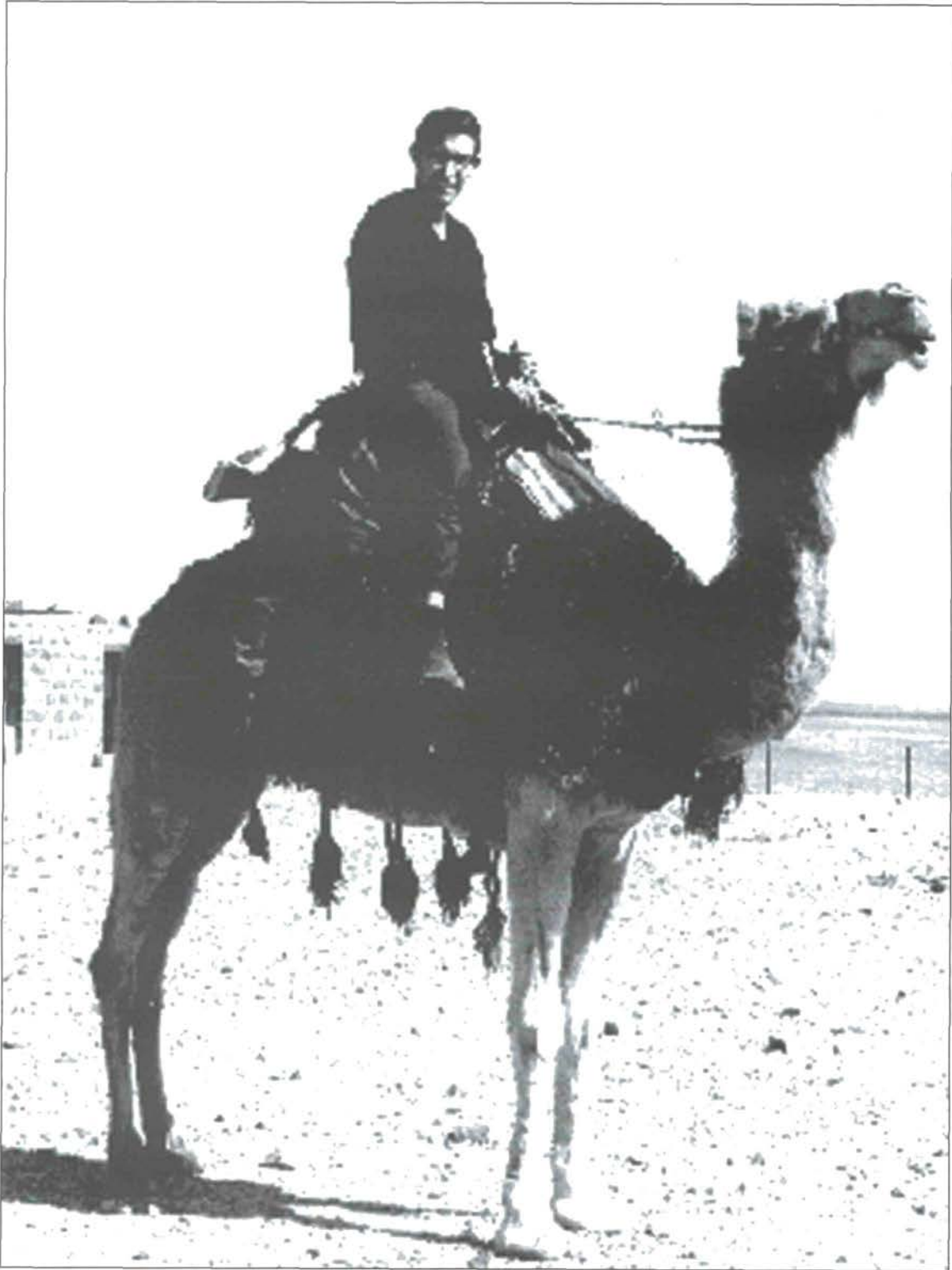
Table of Contents

Foreword	4
Dedication	7
Acknowledgments	8
Chapter 1 Introduction	9
Chapter 2 Mammalogy in Jordan	11
Chapter 3 Mammals in the Holy Quran and Muslim Scholars Contribution	15
Chapter 4 Mammals of Jordan	17
Order Insectivora	18
Family Erinaceidae	18
<i>Erinaceus concolor</i>	18
<i>Hemiechinus auritus</i>	19
<i>Paraechinus aethiopicus</i>	19
Family Soricidae	20
<i>Crocidura suaveolens</i>	21
<i>Suncus etruscus</i>	21
Order Chiroptera	22
Family Pteropodidae	23
<i>Rousettus aegyptiacus</i>	23
Family Rhinopomatidae	23
<i>Rhinopoma hardwickei</i>	24
<i>Rhinopoma microphyllum</i>	24
Family Emballonuridae	25
<i>Taphozous perforatus</i>	25
<i>Taphozous nudiventris</i>	26
Family Rhinolophidae	26
<i>Rhinolohpus blasi</i>	27
<i>Rhinolohpus clivosus</i>	27
<i>Rhinolophus euryale</i>	28
<i>Rhinolophus ferrumequinum</i>	28
<i>Rhinolophus mehelyi</i>	29
<i>Rhinolophus hipposideros</i>	29
Family Hipposideridae	30
<i>Asellia tridens</i>	30
Family Nycteridae	31
<i>Nycteris thebaica</i>	31
Family Vespertilionidae	32
<i>Eptesicus bottae</i>	32
<i>Miniopterus schreibersi</i>	33
<i>Myotis emarginatus</i>	33
<i>Myotis capaccini</i>	34
<i>Myotis nattereri</i>	34
<i>Otonycteris hemprichi</i>	35
<i>Pipistrellus ariel</i>	36
<i>Pipistrellus bodenheimeri</i>	36
<i>Pipistrellus kuhli</i>	36
<i>Plecotus austriacus</i>	37
Family Molossidae	38
<i>Tadarida teniotis</i>	38
Order Carnivora	39
Family Canidae	39
<i>Canis aureus</i>	40
<i>Canis lupus</i>	40
<i>Vulpus cana</i>	41
<i>Vulpes rueppelli</i>	42
<i>Vulpes vulpes</i>	42
Family Felidae	43
<i>Caracal caracal</i>	44
<i>Felis chaus</i>	45
<i>Felis margarita</i>	45
<i>Felis silvestris</i>	46
Family Herpestidae	47

	<i>Herpestes ichneumon</i>	47
	Family Hyaenidae	48
	<i>Hyaena hyaena</i>	48
	Family Mustelidae	50
	<i>Lutra lutra</i>	50
	<i>Martes foina</i>	51
	<i>Meles meles</i>	52
	<i>Mellivora capensis</i>	52
	<i>Vormela peregusna</i>	53
	Order Hyracoidea	55
	<i>Procavia capensis</i>	55
	Order Artiodactyla	56
	Family Suidae	56
	<i>Sus scrofa</i>	56
	Family Bovidae	57
	<i>Capra ibex</i>	57
	<i>Gazella dorcas</i>	57
	<i>Gazella gazella</i>	58
	<i>Gazella subgutturosa</i>	58
	<i>Oryx leucoryx</i>	59
	Order Lagomorpha	60
	<i>Lepus capensis</i>	60
	Order Rodentia	61
	Family Sciuridae	62
	<i>Sciurus anomalus</i>	62
	Family Hystricidae	63
	<i>Hystrix indica</i>	63
	Family Dipodidae	64
	<i>Allactaga euphratica</i>	64
	<i>Jaculus jaculus</i>	64
	Family Gliridae	66
	<i>Eliomys melanurus</i>	66
	Family Spalacidae	67
	<i>Nannospalax leucodon</i>	67
	Family Muridae	69
	<i>Apodemus mystacinus</i>	69
	<i>Apodemus hermonensis</i>	70
	<i>Rattus rattus</i>	70
	<i>Rattus norvegicus</i>	71
	<i>Mus musculus</i>	71
	<i>Acomys cahirinus</i>	72
	<i>Acomys russatus</i>	73
	<i>Nesokia indica</i>	73
	Family Cricetidae	74
	Subfamily Cricetinae	74
	<i>Cricetulus migratorius</i>	74
	Subfamily Gerbillinae	75
	<i>Gerbillus dasyurus</i>	76
	<i>Gerbillus cheesmani</i>	76
	<i>Gerbillus nanus</i>	77
	<i>Gerbillus henleyi</i>	77
	<i>Gerbillus gerbillus</i>	78
	<i>Sekeetamys calurus</i>	78
	<i>Meriones tristrami</i>	79
	<i>Meriones libycus</i>	80
	<i>Meriones crassus</i>	80
	<i>Psammomys obesus</i>	81
	Subfamily Microtinae	82
	<i>Microtus guentheri</i>	82
Chapter 5	The Status of Mammals in Jordan	83
Chapter 6	Mammals of Economic and Health Importance	89
References		93

Dedication

This book is dedicated to the memory of the first genuine Jordanian naturalist, the Late Dr. Sana Attalah.



Dr. Sana Attalah (1943-1970)

Acknowledgments

The Country Study on Biodiversity was facilitated by the United Nations Environment Programme with funding from the Global Environmental Facility (GEF). Thanks and gratitude are also extended to the United Nations Development Programme for its support and facilitation during the study.

This book is the effort of many years of fieldwork and extensive reading to reveal the little known mammals of Jordan. I am indebted to my dear friend Mazin Qumsiyeh, who taught and trained me and shared with me his exceptional knowledge on the mammals of Jordan. I am grateful to him for providing me with many hand drawings, coloured slides and other materials.

Sincere appreciation is extended to Dr. David Harrison for allowing me to use some of his illustrations. To my good friends, Anne Searight (England) and David Modry (Czech Republic) for providing me with coloured slides, I am much indebted. Adwan Shihab (Syria) generously gave permission to use his illustrations for rodents.

I wish to extend my thanks to Darwish Al-Shafee (Jordan Natural History Museum) for allowing me to use his private collection of mammal's photographs. I would like to thank the Kuwait Oil Company for allowing me to use some of the illustrations that appeared in "The Natural History of Kuwait". Also, I extend my gratitude to my apprentice and hopefully my successor, Lina Rifai, who took all the effort to edit the manuscript and help in preparation of diagnosis for each species.

Many thanks are extended to Lydia Kelley, Masjid Tucson, USA for allowing me to use her article on the creation of camel which appeared in "Submitters Perspective".

Also, I wish to honor and commemorate the memory of my student, the Late Fayez Buni-an, who died while studying the ecology of the carnivores in the Eastern Desert.

Appreciations are extended to the Research and Surevys section at the Royal Society for the Conservation of Nature and the Badia Development and Research for facilitating our field trips and their generous support.

I am very grateful to Mr. Brent Huffman (Toronto, Canada), for providing me with the ungulate photographs and Mr. Will Higgs (Gilsland, United Kingdom), for the excellent quality of mammalian skulls. The National Information Center (NIC) is hereby acknowledged.

Finally I wish to thank my wife Najah and my children for the tolerance, patience and love they extended to me during the past years.

CHAPTER 1

INTRODUCTION

The biodiversity of mammals in the Middle East was and is still of great interest for local and European zoologists. Also, this area received the attention due to its religious and geographic location making it a land bridge between Europe, Africa and Asia.

Regionally, the mammals of the Middle East, especially the Arabian Peninsula were best studied by Harrison & Bates (1991). Other books are back dated, as Hatt (1959) for his treatment of the Iraqi mammals, Osborn & Helmy (1980) for Egypt, and Stuart & Clyton (1983) for Kuwait, while still our knowledge of the Syrian mammals remains poorly known and based entirely on Atallah's contribution in the mid 60's. On the other hand, Qumsiyeh (1996) published the first and the most comprehensive treatment of the mammals of the Holy Land, including Jordan. As stated in Chapter 2, mammalogical studies were extensive within the past decade and culminated in additional records as well as to better understanding for the status of the mammals in Jordan. This work is an update for the mammals of Jordan, with emphasis on their distribution, ecology and conservation.

The animal biodiversity in the Middle East is rather interesting; considering its location, where three different faunal elements meet, namely: the Ethiopian, Oriental and Palearctic. The fauna is a combination of these elements in addition to the occurrence of endemic forms. Also, the entire area underwent many geological changes in the past that resulted in the formation of very different habitats and ecological regions.

This area has been influenced by different faunal and floral elements soon after the retraction of the Tythus Sea. Animals of different origins passed through the natural corridors and spread through our area. This is exemplified by several terrestrial animals and

plants that make up the major biodiversity assemblage of the region. Also, the retraction of the post-glacial effect created what is known as "relict species".

Ecological background

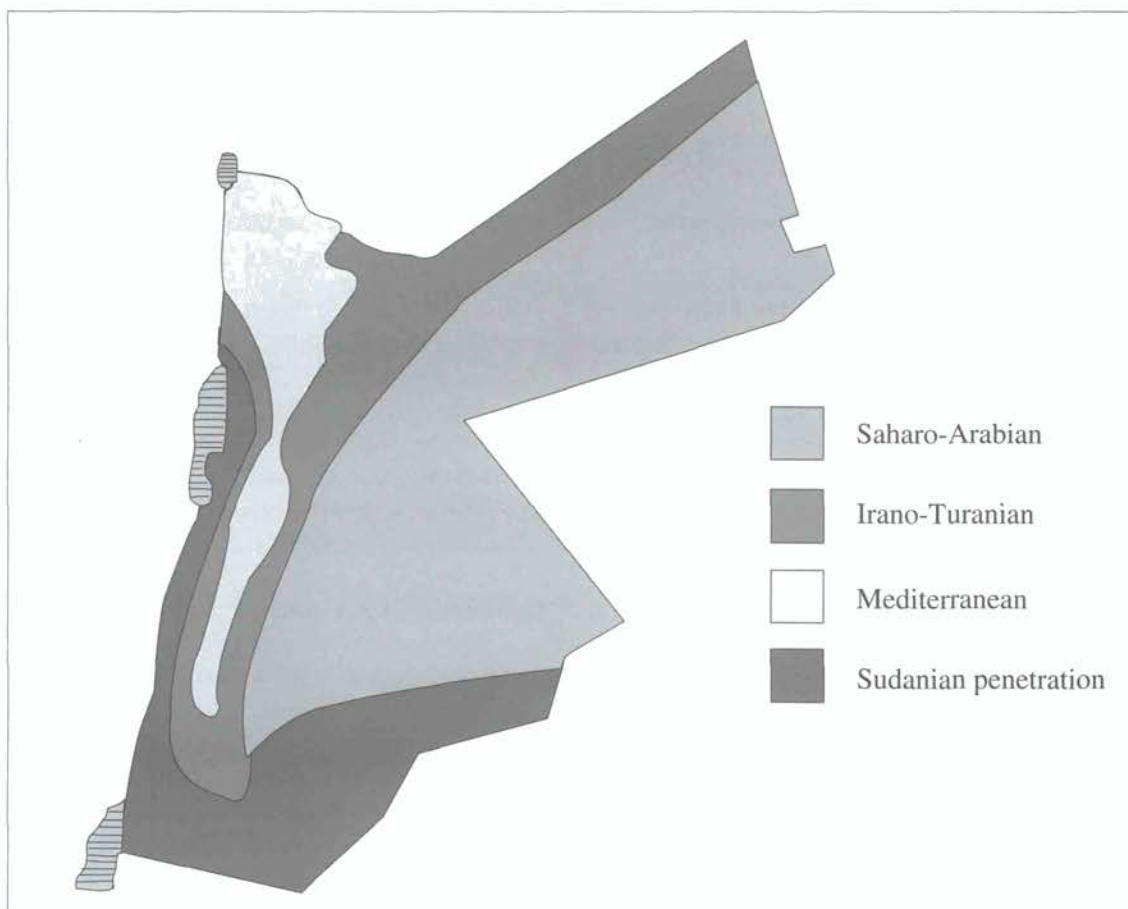
The descriptions below are based entirely on Disi & Amr (1998).

Geological formation:

The geology of Jordan was discussed in detail by Bender (1974) and Abed (1982). Oldest rocks in Jordan are Precambrian in age and crop out around Aqabah and Wadi Arabah. They are dominated by granitoids with minor volcanic and metamorphic. Magnificent outcrops of the Palaeozoic sandstone in southern Jordan are present along the eastern shoulder of Wadi Arabah till the north-east tip of the Dead Sea. The famous Petra is just one example of these outcrops. Tythus calcareous rocks (Cenomanian-Eocene) cover most parts of Jordan. They consist of limestone, marl, dolomite and chalk with a smaller amount of chert and phosphorite towards the uppermost Cretaceous. By the late upper Eocene the Tythus left Jordan due to uplift. The uplift continued in the Oligocene preparing the ground for the opening of the Dead Sea Transform in the middle Miocene. No marine deposits are present in this period, most sediments are gravels and conglomerates with finer sediments and sometimes evaporites in basins like the Dead Sea. Within this period, volcanic activities resulted in the basaltic fields extending from north-west Saudi Arabia, throughout Jordan into southern Syria and Lake Tiberias in Palestine.

Biogeography:

Despite the relatively small area, a number of diverse and distinct biotopes exist in Jordan, allowing diversity, heterogeneity and range expansion of the different faunal elements. Based on phytogeography, annual



Map 1: Map of Jordan showing the biogeographical regions. (Based on Disi & Amr, 1998)

rainfall and soil types (Feinburn & Zohary 1955, Long, 1957, Poore & Robertson, 1964, Al-Eisawi, 1985), Jordan is divided into four main biogeographical regions (**Map 1**):

1. The Mediterranean: this region extends from the northern mountains to the south near Petra. It is characterized by its distinctive *terra rosa* and rendzina soil types. Annual rainfall ranges 400-600 mm and the altitude ranges 900-1,700 m. Oak (*Quercus* sp.), juniper (*Juniperus phoenica*) and pine forests (*Pinus halepensis*) are found along these relatively narrow mountain strips.
2. The Irano-Turanian region: surrounds the Mediterranean one. It extends over about the lower half of the Jordan Valley and reaches Ra's an Naqb in the south. The annual rainfall varies through 150-250 mm at altitudes ranging 400-700 m. The soil is loess and/or calcareous and supports poor scattered vegetation (e.g. *Artemisia herba-alba*, *Anabasis* sp. and *Retama raetam*).
3. The Saharo-Arabian region: occupies the largest portion of the area of Jordan. The soil is extremely poor and comprises hammada, saline, sandy loam or mud flats. The surface is covered by sand-dunes, gravel or pebbles and black laval rocks. The annual rainfall is 50-100 mm. *Artemisia herba-alba*, *Achillea fragrantissima* and *Trigonella* sp. are among the most common plant species.
4. The Sudanian penetration region: covers Wadi Arabah, the eastern borders of the southern end of the Dead Sea and southern Jordan. In Wadi Arabah altitudes range from 400 m below sea level to sea level near Aqabah and 200 m above sea level at Rishah. Soil is predominantly alluvial, saline sand with scattered sand-dunes, lisan marls and others. The annual rainfall ranges 50-100 mm. Vegetation is exemplified by *Haloxylon persicum*, *Acacia* sp., *Calotropis procera* and *Nitraria retusa*.

CHAPTER 2

MAMMALOGY IN JORDAN

The Levant and the Middle East inspired many European naturalists to explore its exquisite terrain, culture and natural history. This area has a biblical history as well as a deeply rooted European influence since the Roman Empire. Pilgrims to the Holy City of Jerusalem and other biblical monuments encountered some of the exotic and peculiar animals, which were sent back to European museums. For over a century, our knowledge of the mammals of Jordan was largely based on European naturalists that roamed the country as early as the 16th century.

In the 16th century, Belon (1588) traveled in the Middle East between 1546 and 1550, he visited Arabia, Palestine and Egypt. His book included valuable observations on the animals of the Orient and is finely illustrated. The eminent student of Carl Linnaeus, Petrus Forsskål (1732-1763) joined the Royal Danish Expedition to the Near East. He collected zoological materials from Egypt and Arabia. His work was published after his death in Yemen by Carl Neibuhr.

Perhaps F. Hasselquist has conducted the earliest scientific study on the animals of the "Holy Land" in 1751, when he traveled in Palestine and later published his book *"Iter Palaestinum"*. In 1826, Eduard Rüppell traveled through the Gulf of Aqabah and northwestern Arabia.

Henry Baker Tristram, Canon of Durham, established the "Palestine Exploration Fund" in 1865. He traveled since 1863-1897 in Lebanon, Syria, Palestine and Jordan. His book, *"Survey of Western Palestine: the Fauna and Flora of Palestine"* was considered for many years as the most comprehensive work for the area (Tristram, 1884).

Under the auspices of the Palestine Exploration Society, H. C. Hart joined Professor

Hull in an expedition to Sinai and the Dead Sea area in 1883-1884. They reached southern Jordan and an account of this journey was published in 1891. In 1891, Hart published his book *"Some Account of the Fauna and Flora of Sinai, Petra and Wadi Arabah"*, where he included several reports of mammals that he saw in Wadi Arabah, Aqabah area and Petra. Hart (1891) reported talking to Towarah Bedouins near Aqabah who *"knew of leopards on Sebal and Umm Shaumer; wolves in Wady Lebweh and neighborhood; hyenas, ibexes, gazelles, hares, jerboas, and mice"*.

Dr. I. C. Phillips from the Museum of Comparative Zoology, Cambridge, Massachusetts (USA), and his assistant W. M. Mann arrived to Aqabah, Jordan, in April 1914. They traveled through Wadi Arabah, Petra, and southern Jordan. Their trip was continued to reach Jerusalem, Mount Hermon and Lebanon. The collection was deposited at the Museum of Comparative Zoology. Allen (1915) published the results of this expedition.

After the First World War, the British mandated Jordan. Members of the British Army staff made many collections from the countries that were under the British mandate in the Middle East. Most of these collections were sent to the British Museum (Natural History). Some of these specimens were used as comparative materials for other studies. Ellerman (1948) used some of these Jordanian specimens to establish a key for the rodents of Southwest Asia.

Bodenheimer (1935 & 1958) reviewed all historical records concerning the mammals of Palestine and some parts of Jordan. Also, he discussed all the mammals of the area based on the previously published reports and on his own observations and collections. He tried to settle the synonymy and the taxonomic errors that were made in the past.

Clarke (1977) prepared a list of the Jordanian mammals based on Harrison (1964, 1968 & 1972) while serving as the director of the Wildlife Protection Programme in Jordan. Nelson (1973) listed the mammals of Azraq. Other reports including records on Jordanian mammals were published by Kock (1969), De Blase (1972), Hemmer (1978), Kock & Nader (1983), Bates & Harrison (1989), Benda & Sadlová (1999), and Disi & Hatough-Bouran (1999).

Ann Searight, a British archeologist visited Jordan several times and made a collection of live rodents from the Eastern Desert (Searight, 1987). She donated some of her collection to the Jordan University Museum and wrote an account on her collection made from the Jawa area.

Dr. David Harrison, a physician in trade served in the Middle East while working with the Royal Armed Forces. He was stationed in Iraq and had the opportunity to visit and collect mammals from the Middle East. In his book, *Footsteps in the Desert*, Harrison (1959) traveled in Jordan. He collected bats from the Jarash area and around Amman. His monumental contribution "*Mammals of Arabia*" appeared in three volumes (1964, 1968 & 1972). An updated condensed version appeared in 1991, together with Paul Bates.



Fig. 1: Dr. David Harrison

Jordanian Mammalogists

The first Jordanian mammalogist who investigated the mammals of Jordan was the Late Dr. Sana Atallah. He was born in Bait Sahor in 20.5.1943 and received his high school education at his native town. He was accepted at the medical school in the American University of Beirut, but his instinctive desires for natural sciences forced him to join the biology department at the same university. He joined the University of Connecticut and received the doctoral degree in 1969.

Since 1963-1968, Atallah worked as a consultant for several national and international agencies concerned with nature and wildlife in the Middle East. He made several collections from Jordan, Syria, Lebanon and Palestine as well as from Iraq, Turkey, Iran and Afghanistan. A number of articles that dealt with the Jordanian mammals were published (Atallah, 1966, 1967a & 1967b). He left a good collection at the Jafr Agricultural Station. Atallah also joined the International Jordan Expedition (1966) where he contributed to the study of the mammals of Azraq. He deposited parts of his collection at the American University of Beirut Museum, several museums in Germany, his private museum at his native town of Bait Sahor, and the Natural History Museum at Pahiavi University in Shiraz, Iran. His manuscript "*Mammals of the Eastern Mediterranean*", published in 1977 and 1978 contained the base line data of the Jordanian mammals and is one of our main references in this regard. Sana Atallah died on the line of duty in 17.12.1970 in Iran.



Fig. 2: Dr. Sana Atallah

Dr. Mazin Qumsiyeh, a relative of Atallah, was determined to follow the steps of his uncle Sana. He started collecting mammals from Jordan, and published a report on the bats of Jordan (Qumsiyeh, 1980). This young naturalist collected a large number of rodents and bats from Jordan and North Africa while pursuing his higher education. He housed these specimens in some American museums. He also contributed in building up the Jordan University Museum mammals collection. Qumsiyeh *et al.*



Fig. 3: Dr. Mazin Qumsiyeh

(1986) studied for the first time the chromosomal number for Jordanian small mammals. This study also contributed in additional records of mammals for Jordan. Subsequently, an updated study on the bats of Jordan was published by Qumsiyeh *et al.* (1992).

Dr. Qumsiyeh published the most comprehensive treatment of the mammals of Jordan and Palestine "*Mammals of the Holy Land*" in 1996. By far, this book was the most updated work with emphasis on conservation.

I am privileged to work with Dr. Qumsiyeh over the past 20 years, where I gained most of my knowledge on the mammals of Jordan. Together we published several treatments on the status of the carnivores, artiodactyls and the bats of Jordan.

Dr. Burhan Gharaibeh, is one of the well-trained mammalogists with great potential. His doctoral thesis on the "*Mammals of Tunisia*" is an outstanding contribution. During his short stay in Jordan, he participated with me in several field studies on the ecology of the mammals of Jordan.



Fig. 4: Dr. Burhan Gharaibeh

Among the young and enthusiastic mammalogists, Ms. Lina Rifai, a recent biology graduate with outstanding passion for nature and animals. Despite her young age, she contributed to the knowledge of the mammals in Jordan. In collaboration with the author of this book, she wrote several species accounts based on field observations (Rifai *et al.*, 1998 & 1999).



Fig. 5: Lina Rifai

The present author collected several mammalian specimens from different parts of the country. He reported on the mammals of North Jordan (Amr *et al.*, 1987) and discussed the ecology of the Fat Sand Jird (Amr & Saliba, 1986). Also, Amr & Disi (1988) reported on the mammals collections housed at the Jordan University Museum. The Jordan Natural History Museum (Yarmouk University) staff collected a large number of mammals, especially from the northern parts of the country. Recently, comprehensive studies on the wild carnivores of Jordan, including recent records and their status were published (Qumsiyeh *et al.*, 1993; Kock *et al.*, 1993; Amr *et al.*, 1996).

As a result of several grants and independent studies, the present author and his graduate students, and with researchers at the Royal Society for the Conservation of Nature, several publications were published (Amr *et al.*, 1996 & 1997; Qumsiyeh *et al.*, 1996 & 1998; Al-Melhim *et al.*, 1997; Darweesh *et al.*, 1997; Al-Shafee *et al.*, 1997; Bunaian *et al.*, 1998; Rifai *et al.*, 1998 & 1999).

CHAPTER 3

MAMMALS IN THE HOLY QURAN AND MUSLIM SCHOLARS CONTRIBUTION

1. The Holy Quran and Mammals

Many animals were mentioned in the Holy Quran. Mammals named in the Quran include the camel, cow, calf, monkey, wild ass, horses, elephant, wolf, dog, whale, sheep, swine, goat, and wild beasts. Verses reported these animals to ratify forbidden food for Muslims, symbols of strength (Horses), and a source of inspiration for God's creation (Camels). Also, God speaks to man that animals were created for his comfort, a source of food, and for travel and other uses.

The universal mercy of Islam is extended to other living creatures of God. Islam has made kindness to animals a part of its faith and cruelty to them a sufficient reason for a person to be thrown into the Fire.

Islam recognizes the entity of animals and clearly states that animals are creatures of God and they have their own ways to communicate among themselves. The Cattle Sura, verse 38, states *"There is not an animal (That Lives) on the earth nor a being that flies on its wings, but (forms part of) communicates like you Nothing have we omitted From the book and they (all) shall be gathered to their Lord in the end"*.

Lydia Kelley, Majid Tucson from an article in *"Submitters Perspective"*, generously provided the following article on the camel's creation.

"Of all the animals mentioned in the scriptures-dogs, horses, donkey, birds, locusts, etc.-God picked the camel as the one we should reflect on. In Quran in 88:17 *"Why do they not reflect on the camels and how they are created ?"* Camels creation is its own miracle. The camel is not always seen as a beautiful animal. But it is absolutely perfect for what it needs to do and where it needs to survive. This is a gift

from God. Without camels, no one could travel in the deserts, so huge sections of the world would be not just difficult to live on, but completely unlivable. All of the camel is practical for his survival and for his service to man. A camel's feet, although hoofed, have large pads that spread out in the soft sand to keep the animal from sinking in. His face is designed as protection from sun and sand. The thick eyebrows, heavy eyelids and thick lashes all keep out sand, and there's even a third eyelid that can close in heavy storms. The still nostrils have special muscles which the camel can close against blowing sand. The ears have thick hair inside the ear, as well as outside to prevent dirt and sand from getting down inside the ear, and possibly causing infection. A camel's hump is a lump of fat. This is used as a source of energy when food is scarce. The hump may actually shrink when no food is available, but the camel can live off it for many days. And it will reform perfectly when food is again available. Because food is so scarce in the desert, the camel must be able to eat anything (even the tents). The lining of the mouth is very tough so that the camel can bite and chew thorny cactus plants without harm to the mouth. Most incredible is how the camel deals with heat and lack of water. First of all, camels have a low metabolic rate, so energy is used slowly. The body temperature has a wide range of normal. It may start the day at 94 and hit 105 in the heat of the afternoon (Human's normal temperature is 98°F and at 101°F, we are sick). The camel is one of few animals that can sweat. The coarse body hair, which acts as a protection against the direct sun, also allows the camel this ability to sweat. Sweating is a more efficient cooling system than panting (as in dogs) as less precious fluid is lost. Additionally, in its incredibly efficient way, the camel does not sweat until its body temperature is near the top of its range. No other creature can process water in the same way. It does not lose

water from blood, only from the tissue. Thus the blood stays properly thin enough to circulate and remove body heat. The camel will only drink when needed and only replace what's lost. If he lost 5 gallons over the last two days, he will drink 5 gallons and walk away. He may not drink at all in winter. And the camel can quickly replace all water lost - 25 gallons in a very short time. Other animals drinking too fast can die from water intoxication. So camels are truly remarkable animals. When we reflect on their creation, as God instructs us to do, we cannot help but marvel at the ways God made them fit perfectly into their niche. May God help each of us to fit our own niche as well."

Muslim Scholars (7th-14th century)

During the Abbasid Caliphs period, various aspects of natural sciences flourished and it was considered by far the most inspiring scientific era. Writers were generously rewarded and admired by the Caliphs. *Bait Al-Hikma* (the House of Wisdom), founded in Baghdad, was the center for scientific exchange between Muslim scientists and early Greek books. All this culminated in an immense amount of books covering various sciences, including zoology.

Since the Eight Century, the Muslim's Scholars wrote accounts on animals. The earliest reference to zoology in the Arabic literature is the comprehensive work of Abu Othman Al-Jahiz (775-868) born in Basra, Iraq. In his book, "*Kitab Al-Haywan*" (the Book of Animals), he gave detailed accounts on many mammals that cover all the poetry, fables and tales in seven monumental volumes. He clearly stated that bats feed on flies, give birth, breast feed their young and menstruate. He described the jerboa as "Its upper limbs are shorter than its legs".

In the 14th century, other two important treaties of zoology were published, the first "*Ajaeb Al-Makhlokat*" (The Wonders of Creatures) by Zakaria Al-Qazwini (1308-1383), born near the Caspian Sea. Al-Qazwini indicated the morphological similarities between different mammals. The second work was "*Hayat Al-Hywan Al-Kubra*", (The Life of Animals), written by Muhammad Bin Musa Al-Damiri (1341-1405), born in Egypt. Although many sections of the book were based on Al-Jahiz, he included many observations of outstanding value.

CHAPTER 4

MAMMALS OF JORDAN

So far, a total of 77 species of mammals are known to occur in Jordan. These species belong to seven orders (Insectivora, Chiroptera, Carnivora, Hyracoidea, Artiodactyla, Lagomorpha and Rodentia). However, more species may be added to our local mammals through continuous studies.

Species descriptions were based on Osborn & Helmy (1980), Harrison & Bates (1991), and Qumsiyeh (1996). Range of distribution and valid names were followed as in the "*Mammal Species of the World*", National Museum of Natural History, Smithsonian Institution (Wilson & Reeder, 1993).

Common names were given as possible, based on Harrison & Bates (1991) and Qumsiyeh (1996). The geographic names for localities and their coordinates follow the Gazetteer of Jordan (Anon., 1990).

Local and IUCN conservation status is given for each species (Chapter 5). Threat categories for the IUCN are as the following: E= Extinct, EW= Extinct in Wild, CE= Critically Endangered, E= Endangered, V= Vulnerable, LR/nt= Lower Risk: near threatened, LR/cd= Lower Risk conservation dependent, and DD= Data deficient.

Table (1)
Summary of 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	25
Total	26	77

KEY TO THE MAMMALS OF JORDAN

1. Forelimb equipped with a membrane, flying forms Order Chiroptera
Forelimb not equipped with a membrane, terrestrials forms 2
2. Hind and forelimbs equipped with hoofs Order Artiodactyla
Hind and forelimbs equipped with claws 3
3. Upper incisors chisel-shaped or tusk like, canines absent 4
Upper incisors not chisel-shaped, canines present 6
4. Hind foot with 3 toes (one vestigial), ears and tail vestigial and very short Order Hyracoidea
Hind foot with 5 toes, ears and tail long 5
5. Four upper incisors Order Lagomorpha
Two upper incisors Order Rodentia
6. Carnassials present Order Carnivora
Carnassials absent Order Insectivora

Order Insectivora

Order Insectivora contains the most primitive placental mammals. A pointed snout and a small brain case characterizes members of this order. Also, some species have a cloaca, where both the genital and the urinary tracts share a common duct. Teeth are sharp and

pointed. Solenodon, tenrecs, otter shrews, golden moles, elephant shrews, shrews and hedgehogs are some examples of this order. This order is represented by two families occurring in Jordan, Erinaceidae and Soricidae.

Key to Order Insectivora

- 1. Body covered by spines, large forms Family Erinaceidae
- Body not covered by spines, small forms Family Soricidae

Family Erinaceidae

This family includes the hedgehogs. They are characterized by the presence of spines that cover the dorsal and the lateral aspects of their body. The tail is short and stumpy. Eyes are rather small but well developed. Hedgehogs are nocturnal animals. They remain in sheltered areas for most of the day, and become active by dusk, where they

seek small animals as prey (insects and lizards). Some species hibernate during winter. Hedgehogs are the most primitive mammals of Jordan. They originated in Africa about 20 million years ago, and did not change from their ancestors. Some became very adapted to live in the arid regions of the Middle East (Bates, 1995).

Key to Family Erinaceidae

- 1. Ears large. Small in size, base of scapular spines with a black bar *Hemiechinus auritus*
- Ears short, base of scapular spines without a black bar 2
- 2. Tips of scapular spines terminate with black. Face dark brown in colour *Erinaceus concolor*
- Tips of the scapular spines not terminating with black. Face white to dark brown in colour *Paraechinus aethiopicus*

***Erinaceus concolor* Martin, 1838**

Proc. Zool. Soc. Lond., 1837:103 [1838].

Common Name: East European Hedgehog.

Distribution: E Europe; S Russia and W Siberia to River Ob; Asia Minor to Palestine and Iran; Greek and Adriatic islands including Crete, Corfu, and Rhodes.

Type Locality: Near Trabzon, Turkey.

Diagnosis: Large in size. Ears short not extending above the spines. Ears covered by fur. Palms and soles are naked. No antero-medial spineless gap on head. Tips of scapular spines black. Fur coarse and colour brownish to grey, with no markings on the face. Five pairs of mammae present in females. Skull is heavy and robust, with small tympanic bullae. First upper incisors are pointed downwards. A distinguishing character from the other two species, is that the low-

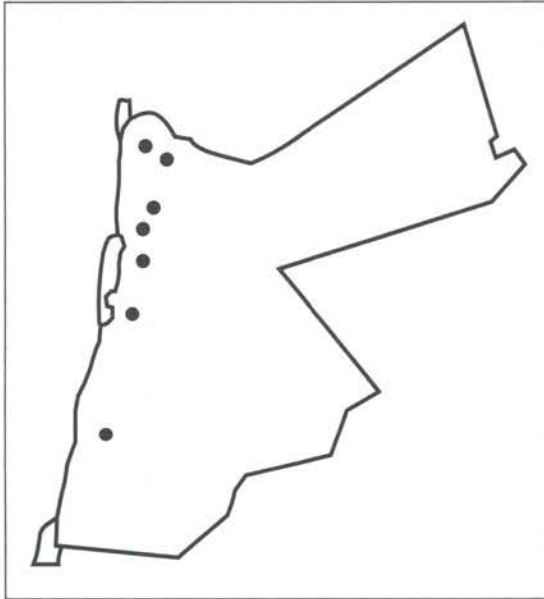
er second premolar possesses an elevated tricuspid crown.

Dental formula: i 3/2 c 1/1 pm 3/2 m 3/3 = 36.

Remarks: It seems that *E. concolor* prefers woodlands rather than arid areas. Atallah (1977) speculated that the southern most limits for the distribution of this species is around At Tafilah. Schoenfeld & Yom-Tov (1985) gave a comprehensive account on the biology of this species in Palestine. The East European Hedgehog is known to survive in relatively colder habitats with rather dense vegetation. Few individuals hibernate for a short time (5 days). Males and females have a similar home range (1.6 ha), and territoriality was not observed among individuals of this species. The European Hedgehog nests under bushes, trees or in rocky crevices, and rarely constructs burrows. Females give birth to three

pups. This species feeds on many groups of insects, centipedes and land snails.

A specimen caught from the Jarash area was kept in the laboratory and was fed fresh-water snails, eggs and vegetables.



Map 2: Distribution of *Erinaceus concolor*.

Localities: Al Hummar, Al Jubayhah, At Tafilah, Irbid, Jarash, Mahis, Ar Ramtha.

***Hemiechinus auritus* (Gmelin, 1770)**

Nova Comm. Acad. Sci. Petropoli, 14:519.

Common Name: Long-eared Hedgehog.

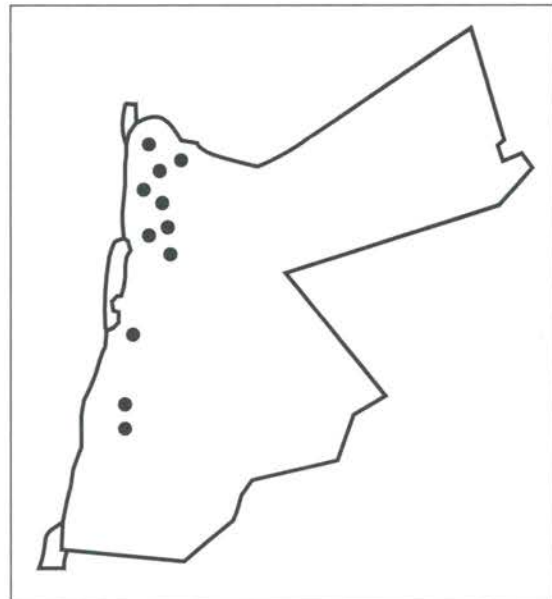
Distribution: Steppe zone from E Ukraine to Mongolia in the north and from Libya to W Pakistan in the south.

Type Locality: S Russia, "in regione Astrachanensi.

Diagnosis: Smallest species of hedgehogs in Jordan. Presence of very long and pointed ears is a distinctive feature for this hedgehog. Ears are not covered by hair. Tips of dorsal spines are white. Base of the scapular spines black. A gap in the forehead spines is lacking. Face with white hair and with little brown hair around the eyes, but without a facial mask. The muzzle has a grey tint. Belly buff white. 4-5 pairs of mammae present in the female. Small and delicate skull. Large tympanic bullae. First upper incisors are pointed forward. Elevated crown of lower second premolar biscuspid.

Dental formula: $i \frac{3}{2} c \frac{1}{1} pm \frac{3}{2} m \frac{3}{3} = 36$.

Remarks: Atallah (1977) collected this species from the Amman area. He indicated that this species could tolerate extreme arid conditions. The Long-eared Hedgehog breeds in May until October with most births during the summer (2-3 new born). Gestation lasts for about 37 days and the new born are hairless but with soft spines. They may hibernate for as long as 40 days in their burrows. Home range for males is about 4.9 ha. while 2.8 ha. for females. Contrary to the European Hedgehog, the Long-eared Hedgehog digs its burrows, or seeks refuge in depressions under stones. It feeds on various insects, centipedes and land snails (Schoenfeld & Yom-Tov, 1985).



Map 3: Distribution of *Hemiechinus auritus*.

Localities: Amman, Dana Nature Reserve, Irbid, Al Karak, West adh Dohaybeh.

***Paraechinus aethiopicus* (Ehrenberg, 1832)**

Symb. Phys. Mamm., 2, sig. k, footnote.

Common Name: Desert Hedgehog, Ethiopian Hedgehog.

Distribution: Sahara from Mauritania to Egypt and Awash, Ethiopia; Arabia deserts; insular populations on Djerba (Tunisia), Bahrain and Tanb (Persian Gulf).

Type Locality: Sudan, "In desertis dongolanis habitat".

Diagnosis: Medium-sized hedgehog. Ears large, slightly rounded at the tips and extending beyond the upper surface of the spines.

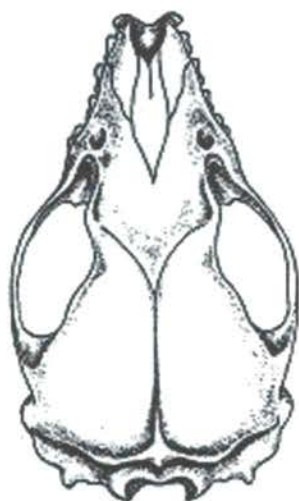
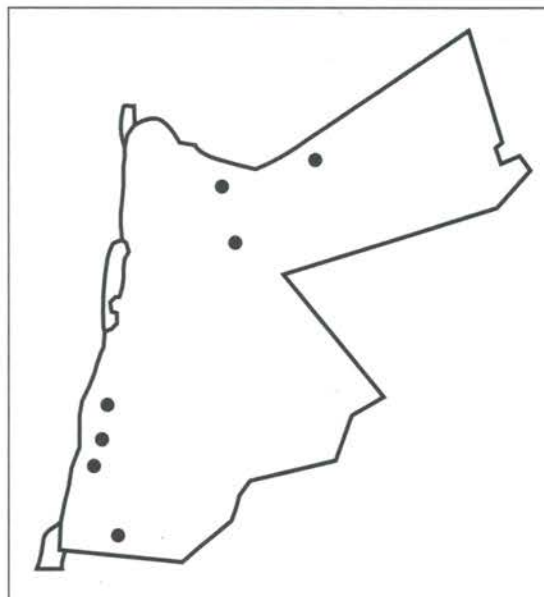


Fig. 6: Dorsal view of *Paraechinus aethiopicus* skull. After Harrison (1981).



Map 4: Distribution of *Paraechinus aethiopicus*.

Dark terminal end of the dorsal spikes. Antero-median gap of spines on head is a distinguishing character of this species. The ventral side is pure white, legs and feet are dark brown. Possesses a distinctive facial mask, the muzzle being dark grey to black, else face is white from eyes up to the forehead. This animal is much lighter in colour than other hedgehogs in Jordan, both bases and tips of the spines are white. Fur fine and dense. Skull is robust and broad, with a wide braincase. Strongly inflated tympanic bullae, with their cavities extending into the pterygoids. Jordanian specimens lack the small second upper premolar.

Dental formula: $i\ 3/2\ c\ 1/1\ pm\ 2\ or\ 3/2\ m\ 3/3 = 34\ or\ 36.$

Remarks: Probably two subspecies of the

Ethiopian Hedgehog are found in Jordan; *P. a. pectoralis* (Heuglin, 1861) originally collected from the Petra area, and *P. a. ludlowi* Thomas 1919, which was collected from Azraq ash Shishan (Atallah, 1977). Amr *et al.* (1997) reported that the Ethiopian Hedgehog is part of the Eagle Owl's diet in the Azraq area.

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.

Localities: Al Mafraq, Petra, Qasr al Hallabat, Wadi Arabah, Wadi edh Dhuleil, Wadi Ramm.

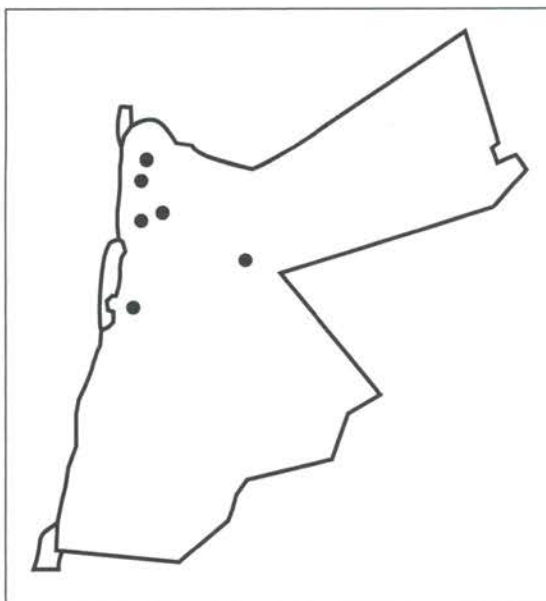
Family Soricidae

This family contains the shrews, identified by 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. They are short

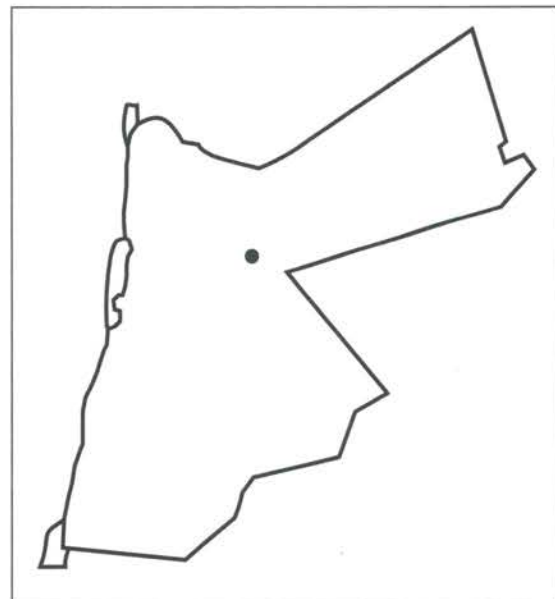
legged, with five toes per foot. Shrews are known for their extremely high metabolic rate as well as rapid heart pulse. They feed exclusively on lower invertebrates and insects.

Key to Family Soricidae

1. Upper jaw with 3 unicuspid teeth, 26 teeth, large size (100 mm) *Crocidura suaveolens*
 Upper jaw with 4 unicuspid teeth, 30 teeth, small size (50-60 mm) *Suncus etruscus*

Crocidura suaveolens* (Pallas, 1811)Zoogr. Rosso-Asiat.*, 1:139.**Common name:** Lesser White-toothed Shrew.**Distribution:** Far East through most of the temperate regions of Asia to Armenia, northern Arabian Peninsula through Turkey and southern Europe and North Africa (Qumsiyeh, 1996).**Type Locality:** Khersones, Crimea, southern former USSR.**Diagnosis:** Body length more than 100 mm. Bicoloured tail is dark and long, being more than half in length of the head and body length. Fur colour brownish grey dorsally, ventral colour lighter. No sharp line on the flanks separating the dorsal and the ventral aspect. Upper jaw with 3 unicuspid teeth.**Dental formula:** $i\ 3/1\ c\ 1/1\ pm\ 1/1\ m\ 3/3 = 28$.**Remarks:** Recent collection of owl pellets from the Azraq Nature Reserve, yielded a total of 12 skulls for this shrew (Amr *et al.*, 1997). Some pellets included 3-4 skulls. Bates & Harrison (1989) collected specimens from different habitats ranging from long dry grasses, thick vegetation along streams and forested areas as in Ajlun. Similar habitats were reported in Turkey where the Lesser White-toothed Shrew was collected from hedges with reed on a dried river bed, and areas with dense vegetation of *Rubus* sp. *Crataegus* sp. and *Phragmites* sp. (Felten *et al.*, 1973). Hellwing (1970) gave an account on the breeding of this species in captivity, with an average gestation period of about 29 days, litter size ranges fromMap 5: Distribution of *Crocidura suaveoleus*.

1 to 7, with an average of 3. Benda & Sadlová (1999) collected a specimen from Ajlun containing a single embryo.

Localities: Ajlun, Azraq ash Shishan, Al Karak, Wadi Sakib, Wadi Zarqa.***Suncus etruscus* (Savi, 1822)***Nuovo Giorn. de Letterati, Pisa*, 1:60.**Common name:** Savi's Pigmy Shrew, Pygmy White-toothed Shrew.**Distribution:** S Europe and N Africa (Morocco, Algeria, Tunisia, Egypt); Arabian Peninsula and Asia Minor to Iraq, Turkmenistan, Afghanistan, Pakistan, Nepal, Bhutan, Burma, Thailand and Yunnan (China).**Type Locality:** Italy, Pisa.**Diagnosis:** Small shrew, less than 90 mm in total length. Tail longer than head-body length, usually bicoloured covered by short hair. Base of tail hair whitish, upper part brown. Fur colour grey to light brown dorsally, ventral side whitish. Sharp line on the flanks separating the dorsal and the ventral aspects. Extremely small and delicate skull. Upper jaw with 4 unicuspid teeth.**Dental formula:** $i\ 3/1\ c\ 1/1\ pm\ 2/1\ m\ 3/3 = 30$.**Remarks:** Very little is known about the biology of Savi's Pigmy Shrew. It occupies semi arid and moist habitats. Atallah (1977) reported on coleopteran exoskeleton recovered from stomach contents of the Pigmy Shrew collected from Azraq.Map 6: Distribution of *Suncus etruscus*.**Localities:** Azraq ash Shishan.

Order Chiroptera

Order Chiroptera includes the flying bats, one of the most successful mammal group that spread throughout the world. The modification of the forelimbs into a membranous wing-like structure enabled bats to fly and cross continents. Eight families are represented in Jordan. The Megachiroptera or the flying foxes are fruit-eating bats, while the Microchiroptera are insect-eating bats.

Bats are crepuscular or nocturnal; they seek flying insects and look for a water source to drink. Bat's eyes are usually small in size,

with some exception as the fruit bats. They depend entirely on echolocation to make their way and capture its prey. In Jordan, some bats hibernate during winter, while other migrate on seasonal basis.

Within the past two decades, the Chiroptera of Jordan were studied extensively (Atallah, 1977, De Blase, 1972, Qumsiyeh, 1980, Qumsiyeh, *et al.* 1986; 1992 & 1998; Bates & Harrison, 1989). So far, 24 bat species were recorded from Jordan.

Key to Order Chiroptera

1. Large bat, tail short or absent Family Pteropodidae Fig (7.A)
 Small bat, tail well developed 2
2. Tail arises from the upper middle of the interfemoral membrane...Family Emballonuridae Fig (7.B)
 Tail arises from the margin or completely surrounded by the interfemoral membrane 3
3. Tail arises from the margin of the interfemoral membrane, and extends considerably after the membrane 4
 Tail is entirely enclosed by the interfemoral membrane 5
4. Tail is long, thin, and almost free from the interfemoral membrane. Family Rhinopomatidae Fig (7.C)
 Tail is short and thickFamily Molossidae
5. Nose leaf absent 6
 Nose leaf present.....7
6. Muzzle without a vertical median furrow Family Vespertilionidae
 Muzzle with a vertical median furrow Family Nycteridae
7. Posterior nose leaf triangular, horizontal nose leaf horizontal and deeply notchedFamily Rhinolophidae Fig (7.D)
 Posterior nose leaf tridentate, anterior nose leaf flat and not elaborateFamily Hipposideridae

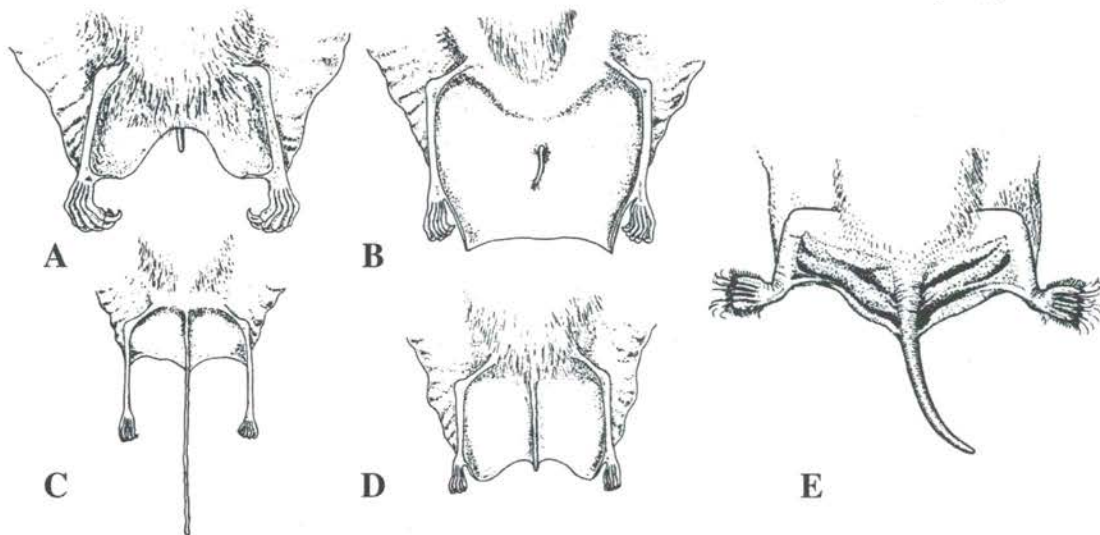


Fig. 7: Tail and interfemoral membrane for five bat families. A. Family Pteropodidae. B. Family Emballonuridae. C. Family Rhinopomatidae. D. Family Rhinolophidae. (After Harrison, 1981). E. Family Molossidae (After De Blase & Martin, 1974)

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)**
Ann. Mus. Hist. Nat. Paris, 15:96.

Common name: Egyptian Fruit Bat.

Distribution: Senegal to Egypt, Cyprus, and Turkey, south to South Africa; Pakistan to Yemen; adjacent small islands.

Type Locality: Egypt, Giza.



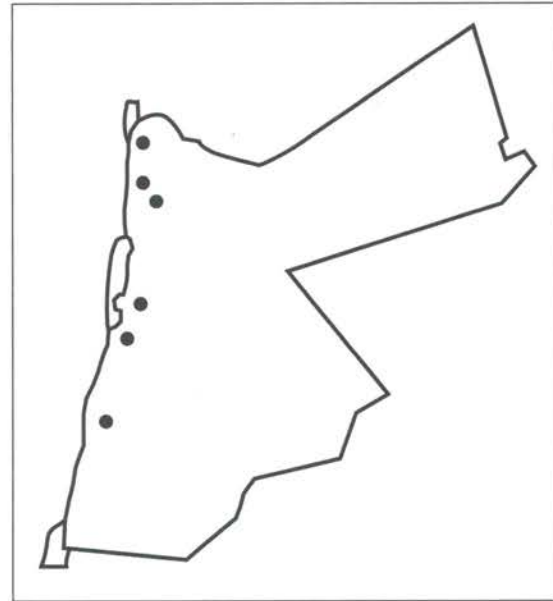
Fig. 8: *Rousettus aegyptiacus*. After Harrison (1981).

Diagnosis: Large bat. Wingspan may reach about 55 cm, males being larger than females. Snout long, similar in shape to that of a fox. The antitragal lobe is not well developed. Pelage colour is light grey in young animals, might turn pale brown in adults. The wing-membrane is attached to the first toe. Second finger equipped with a claw. Tail very short, does not extend more than 10 mm beyond the margin of the interfemoral membrane. Small upper incisors with small space in between, while the lower incisors nearly touch each other. Distinctive features for this species are the ear margins that form a complete ring and the tympanic bullae being without an external bony auditory capsule. This species also has low crowns on cheekteeth.

Dental formula: $i\ 2/2\ c\ 1/1\ pm\ 3/3\ m\ 2/3 = 34$.

Remarks: This is the largest bat occurring in

Jordan. The Fruit Bat feeds on oranges and other fruit trees. In a cave near Al Hammah, 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. This bat does not hi-



Map 7: Distribution of *Rousettus aegyptiacus*.

berate but becomes inactive in cold weather.

The Fruit Bat is an African species that has penetrated deep into the Eastern Mediterranean and it seems to continue to expand its range in Jordan (Qumsiyeh *et al.*, 1998). In Lebanon, females give birth in June to August (Atallah, 1977), while in March to May in Egypt (Qumsiyeh, 1985). In northern Jordan, juveniles were obtained in February (Qumsiyeh *et al.*, 1998).

Localities: Al Hammah, Wadi al Mawjib, Amman, Ghawr as Safi, Tabaqat Fahl, Wadi Ben Hammad, Wadi Fidan, Zarqa River.

Suborder Microchiroptera
Family Rhinopomatidae
Mouse-tailed Bats

Bats of this family possess a long tail, the second digit is equipped with four phalanges. Ears are well developed and connected together

by a connecting membrane. Tragus present. The snout is characterized by the presence of a dermal ridge.

Key to Family Rhinopomatidae

1. Small form, forearm less than 61 mm, tail longer than forearm..... *Rhinopoma hardwickei*
 Large form, forearm more than 61 mm, tail shorter than forearm..... *Rhinopoma microphyllum*

***Rhinopoma hardwickei* Gray, 1831**

Zool. Misc., 1:37.

Common name: Lesser Mouse-tailed Bat, Lesser Rat-tailed Bat.

Distribution: Burma to Morocco, south to Mauritania, Nigeria, and Kenya; Socotra Isl (Yemen).

Type Locality: India.

Diagnosis: Small bat. Forearm never over 60 mm, greatest length of the skull not over 20 mm. Tail longer than forearm. Dorsal pelage pale greyish brown, underside lighter. Naked



Fig. 9: *Rhinopoma hardwickei*. Drawn by M. Qumsiyeh.

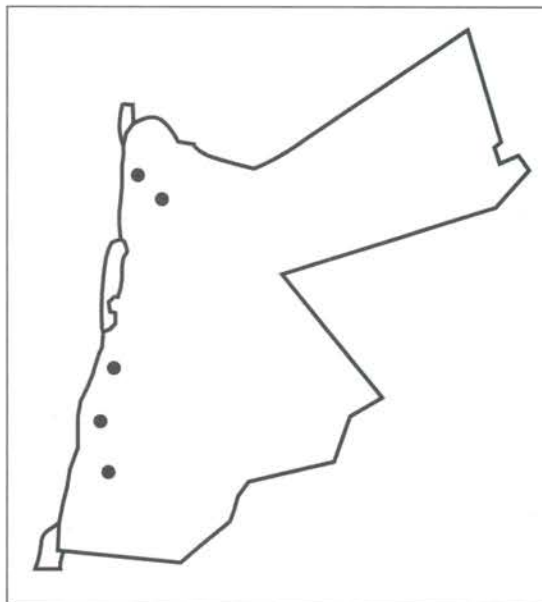
on posterior back and belly. Few hair on face and throat. Skull small and not very robust. Large tympanic bullae.

Dental formula: i 1/2 c 1/1 pm 1/2 m 3/3 = 28.

Remarks: This bat favours arid and dry habitats and prefers open caves. Atallah (1977) reported that *R. h. hardwickei* as being 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. hardwickei* 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; Qumsiyeh *et al.*, 1998).

Rhinopoma hardwickei 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, not exceeding 50 mm (Atallah, 1977). Atallah (1977) considered the population in Jordan as *R. h. cystops* Thomas, how-



Map 8: Distribution of *Rhinopoma hardwickei*.

ever, Qumsiyeh (1985) recognized the Jarash population as *R. h. arabium* Thomas.

Both species of mouse-tailed bats are found in Jordan but older records probably include many mis-identifications (Qumsiyeh *et al.*, 1998). A cave at Al Majdal near Dibbin Forest harbored about 500 individuals of both *Rhinopoma* species.

Localities: Al Majdal An Naqah, Petra, Tabqat Fahl, Wadi Fidan.

***Rhinopoma microphyllum* (Brünnich, 1782)**

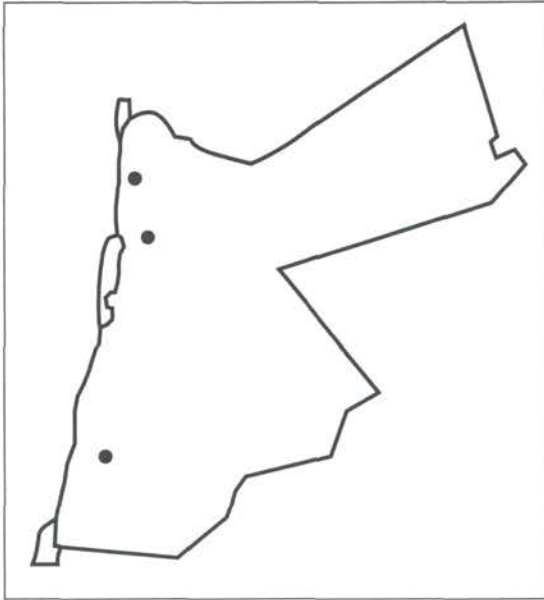
Dyrenes Historie, 1:50.

Common name: Greater Rat-tailed Bat.

Distribution: Morocco and Senegal to Thailand; Sumatra.

Type Locality: Egypt, Giza.

Diagnosis: Largest of the mouse-tailed bats. Forearm over 60 mm. Tail shorter than forearm. Muzzle points upwards and is nearly black. Tragus is sickle shaped. Pelage colour uniformly pale greyish brown dorsally, and paler on the underside. Posterior abdomen naked, face and throat nearly naked. Skull



Map 9: Distribution of *Rhinopoma microphyllum*.

large and robust. Small tympanic bullae.
Dental formula: $i\ 1/2\ c\ 1/1\ pm\ 1/2\ m\ 3/3 = 28$.
Remarks: The Greater Rat-tailed Bat is a xerophilous bat that inhabit caves, houses, ruins along with *R. hardwickei*. Further details are given by Schlitter & Qumsiyeh (1996). Apparently, *R. microphyllum* is a rare species. The Greater Rat-tailed Bat roosts along with *R. hardwickei*, where both species prefer dry and arid habitats in Jordan. Confusion may occur in diagnosing this species and *R. hardwickei* (Qumsiyeh *et al.*, 1998).
Localities: Al Majdal, Petra, Tabaqat Fahl.

Family Emballonuridae
Sheath-tailed Bats

Species of this family are characterized 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.

Key to Family Emballonuridae

- 1. Large form. Fur does not extended around the belly, not reaching the tail base.....*Taphozous nudiventris*
-*Taphozous perforatus*
- Small form. Fur extended around the belly to the tail base..... *Taphozous perforatus*

***Taphozous perforatus* E. Geoffroy, 1818**

Descrip. de L'Egypte, 2:126.

Common name: Tomb Bat.

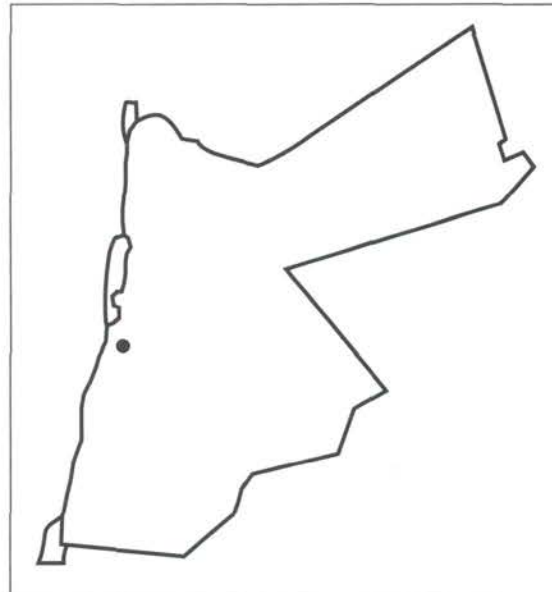
Distribution: Senegal to Botswana, Mozambique, Somalia and Egypt; S Arabia; S Iran; Pakistan; NW India.

Type Locality: Egypt, Kom Ombo.

Diagnosis: Medium sized bat. Forearm 61-65 mm. Tragus is broad without a developed basal lobule. Base of wing membrane covered with fur. Interfemoral membrane and wing-membranes brown. Dorsal pelage colour is brown, with hair bases white, underside is greyish brown. Fur extending to the base of the tail. Skull small and slender. Weak sagittal crest.

Dental formula: $i\ 1/2\ c\ 1/1\ pm\ 2/2\ m\ 3/3 = 30$.

Remarks: 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).



Map 10: Distribution of *Taphozous perforatus*.

Localities: Ghawr as Safi.

***Taphozous nudiventris* Cretzschmar, 1830**

In Rüppell, *Atlas Reise Nordl. Afr., Zool., Säugeth.*, p. 70.

Common name: Naked Bellied Tomb Bat.

Distribution: Mauritania, Senegal, and Guinea-Bissau to Egypt, south to Tanzania and east to Burma.

Type Locality: Egypt, Giza.

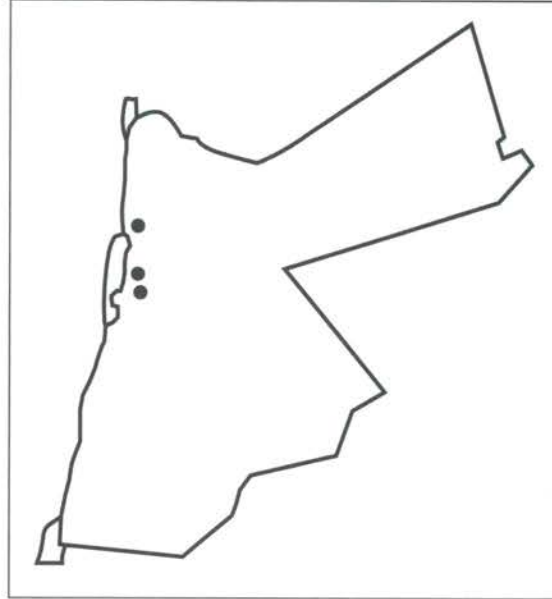
Diagnosis: Large bat. A distinctive tragus with a wide curved anterior and a rather wide base. Muzzle blackish brown, with very few hairs. Pelage colour dorsally light brown, lighter on the underside with a greyish tone. Feet covered with long hair which extend beyond the back of toes, the lower back and abdomen are entirely naked. Skull large and robust with a well developed sagittal crest.

Dental formula: i 1/2 c 1/1 pm 2/2 m 3/3 = 30.

Remarks: The Naked Bellied Tomb Bat is a rare species in Jordan. It is quite common along the Tigris and the Euphrates in Iraq (Al-Robaae, 1968).

Taphozous nudiventris 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-Robaae, 1968).

Harrison (1977) stated that *T. nudiventris*



Map 11: Distribution of *Taphozous 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 Darweesh *et al.* (1997).

Localities: near the Dead Sea (between South Shunah and Suwaymah), Wadi al Mawjib.

Family Rhinolophidae

Members of this family are distinguished by the presence of a leaf located anterior to the nostrils with a single lancet. Ears without

tragus. The tail is connected with the membrane.

Key to Family Rhinolophidae

1. Large form. Forearm may reach up to 60 mm. Lancet is knoblike.....*Rhinolophus ferrumequinum*
 Small form. Forearm never exceeds 60 mm. Lancet not as above.....2
2. The connecting process of the sella is blunt from a side view3
 The connecting process of the sella is not blunt from a side view..... 5
3. Forearm more than 40 mm in length..... 4
 Forearm never longer than 40 mm.....*Rhinolophus hipposideros*
4. Blunt connecting process of sella*Rhinolophus clivus*
 Upwards pointing connecting process, not blunt*Rhinolophus blasi*
5. Lancet triangular..... *Rhinolophus euryale*
 Lancet tapered abruptly, with a concave base..... *Rhinolophus mehelyi*



Fig. 10: Lateral view of the sella of A. *Rhinolophus mehelyi*, B. *Rhinolophus euryale*.

***Rhinolophus blasi* Peters, 1866**

Monatsb. K. Preuss. Akad. Wiss. Berlin, 1866:17.

Comon name: Peter's Horseshoe Bat.

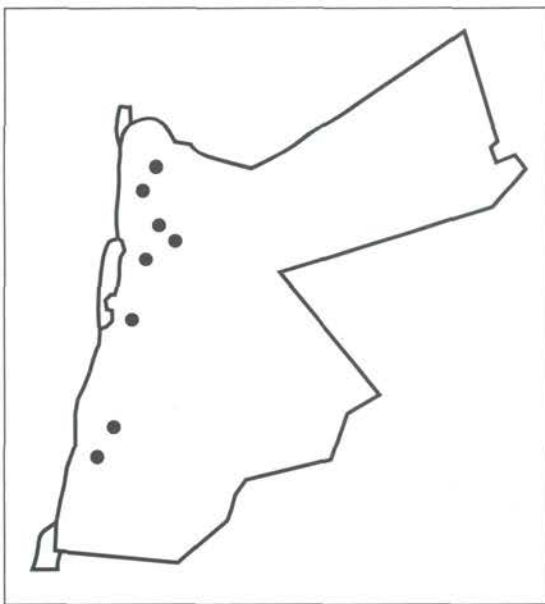
Distribution: Transvaal (South Africa) to S Zaire; Ethiopia; Somalia; Morocco; Algeria; Tunisia; Turkey; Yemen; Palestine; Jordan; Syria; Iran; Yugoslavia; Albania; Bulgaria; Rumania; Transcaucasia and Turkmenistan; Afghanistan; Pakistan; Italy; Greece; Cyprus.

Type Locality: SE Europe.

Diagnosis: This is a medium-sized bat. Forearm not exceeding 50 mm, and greatest length of skull up to 20 mm. First phalanx of the fourth finger is around 1/2 of the length of the second. Sella wedge-shaped with a upwards pointing connecting process, noseleaf broad. Lancet blunt. Fur pale brown, more buffy brown, and lighter on the underside. Wing membrane extends to ankles.

Dental formula: $i\ 1/1\ or\ 1/2\ c\ 1/1\ pm\ 2/3\ m\ 3/3 = 30\ or\ 32.$

Remarks: 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 blasi* occur in



Map 12: Distribution of *Rhinolophus blasii*.

Jordan (Qumsiyeh *et al.*, 1998).

Qumsiyeh (1980) collected a single specimen from Mogharet Al-Roum, Jarash. It was also reported from Tabaqat Fahl, Al Karak, Jarash Refugee Camp and Amman (Qumsiyeh *et al.*, 1986), Wadi Faynan in Wadi Arabah (Amr & Disi, 1988).

Localities: Amman, Ash Shawbak, Jarash, Al Karak, Madaba, Tabaqat Fahl, Wadi Faynan, Zubiya.

***Rhinolophus clivosus* Cretzschmar, 1828**

In Rüppell, Atlas Reise Nordl. Afr., Zool., Säugeth., p. 47.

Common name: Arabian Horseshoe Bat.

Distribution: Turkmenistan to Afghanistan; Arabia to Algeria; subsaharan Africa to Liberia, Cameroon and South Africa.

Type Locality: Saudi Arabia, Muwaylih (= Mohila).

Diagnosis: It is characterized by it is large size reaching 43.0-52.1 mm for the forearm and 19.1-21.9 mm for the greatest length of the skull. The connecting process of the sella is blunt from a side view. Fur usually rather long and smoke to drab grey in colour dorsal-



Fig. 11: *Rhinolophus clivosus*. After Harrison (1981).

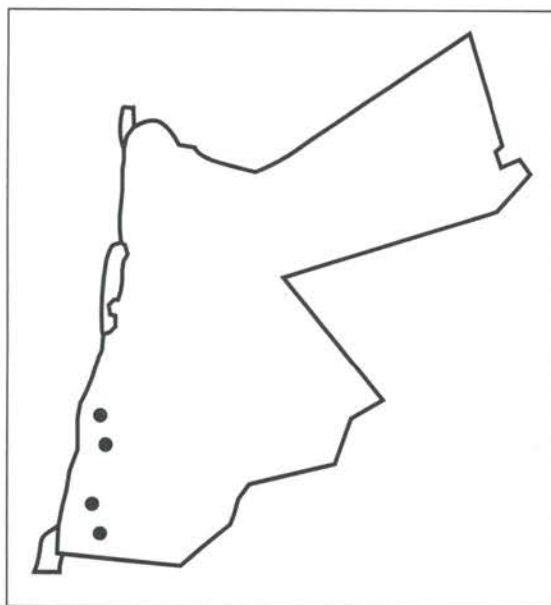
ly, a bit paler on the underside. Small and light skull. Weak sagittal crest.

Dental formula: $i\ 1/1\ or\ 1/2\ c\ 1/1\ pm\ 2/3\ m\ 3/3 = 30\ or\ 32.$

Remarks: In Jordan, it was collected from deserts and dry habitats as in Wadi Arabah and Wadi Ramm. 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. blasi* 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. brachygnathus* of Egypt are smaller than those of *R. c. clivosus* (Qumsiyeh *et al.*, 1998).



Map 13: Distribution of *Rhinolophus clivosus*.

Localities: Petra, Quwayrah, Wadi Fidan, Wadi Ramm.

***Rhinolophus euryale* Blasius, 1853**

Arch. Naturgesch., 19(1):49.

Common name: Mediterranean Horseshoe Bat.

Distribution: Transcaucasia to Palestine and S Europe; Turkmenistan; Iran; Algeria; Morocco; Tunisia; various Mediterranean islands; perhaps Egypt.

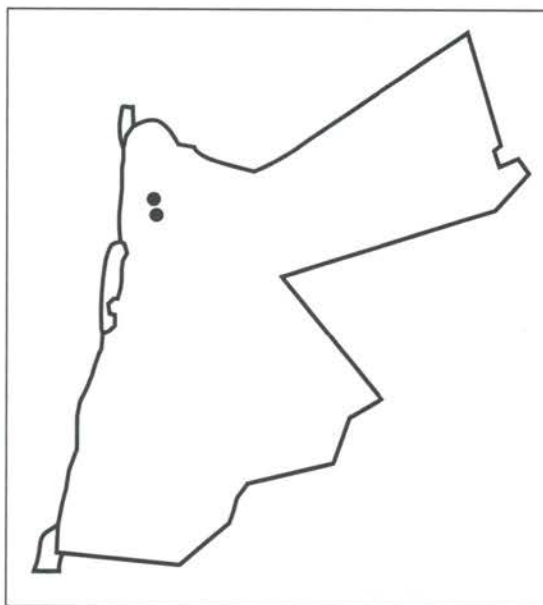
Type Locality: Italy, Milan.

Diagnosis: Medium-sized bat, forearm 45-50 mm. Greatest length of skull not exceeding 20 mm. Connecting process of sella acutely pointed in a side view. Lancet triangular. First phalanx of fourth finger reduced, being around 1/3 of the length of the second. Fur colour varies from brown to greyish. Ventral colour lighter than dorsal, sometimes with a whitish streak along the middle. Braincase rounded in shape. First upper premolar small, producing a distinctive space between canine and second premolar.

Dental formula: i 1/1 or 1/2 c 1/1 pm 2/3 m 3/3 = 30 or 32.

Remarks: 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 with dense pine and oak forests (Qumsiyeh, 1985). Caves and crevices are very common in this area, providing shelter for this species.



Map 14: Distribution of *Rhinolophus euryale*.

Localities: Dibbin, Jarash.

***Rhinolophus ferrumequinum* (Schreber, 1774)**

Die Säugethiere, 1:174, pl. 62.

Common name: Larger Horseshoe Bat.

Distribution: S England to Caucasus Mtns south to Morocco and Tunisia (but not Egypt) through Iran and Himalayas to China and Japan.

Type Locality: France.

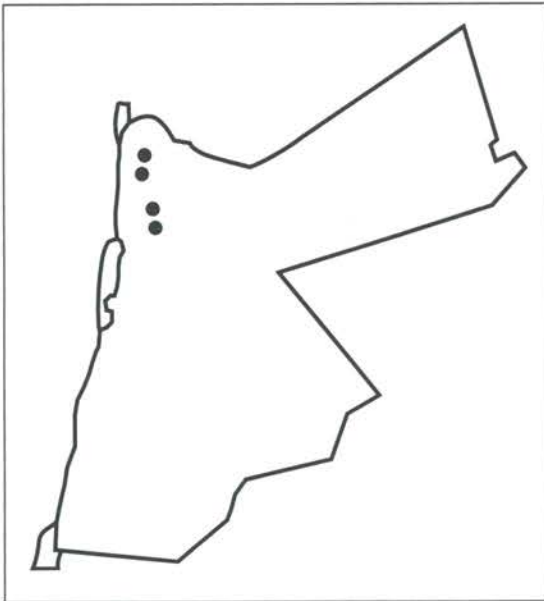
Diagnosis: Largest of the horseshoe bats in Jordan. Forearm length up to 60 mm. Distinguishing feature of this bat is the short and bluntly pointed connecting process of the sella. Lancet is knoblike. Lips covered with hair. Antitragal lobe well developed, tragus is absent. Few white hair on the dorsal side of the feet. No fur on wingmembranes. Fur quite long, colour greyish to greyish-brown, with juvenile animals being greyer. Ventral colour lighter, buffy brown. Big and robust skull. Well developed sagittal crest. Small upper incisor. First upper premolar minute to absent and lies externally of toothrow.

Dental formula: i 1/1 or 1/2 c 1/1 pm 2/3 m 3/3

3 = 30 or 32.

Remarks: The Larger Horseshoe Bat is common in the northern part of Jordan especially the mountains and forested regions.

The Larger Horseshoe Bat 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 in 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 roosts closer to the exit (Qumsiyeh *et al.*, 1998).



Map 15: Distribution of *Rhinolophus ferrumequinum*.

Localities: Dibbin, Jarash, Quwaylibah, Suwaylih, Zubiya.

***Rhinolophus mehelyi* Matschie, 1901**
Sitzb. Ges. Naturf. Fr. Berlin, p. 225.

Common name: Mehely's Horseshoe Bat.

Distribution: Portugal, Spain, France, Rumania, Yugoslavia, Bulgaria, Greece, Transcaucasia; Morocco to Cyrenaica (Libya); Mediterranean islands, Iran, Afghanistan, Asia Minor, Palestine, Egypt.

Type Locality: Rumania, Bucharest.

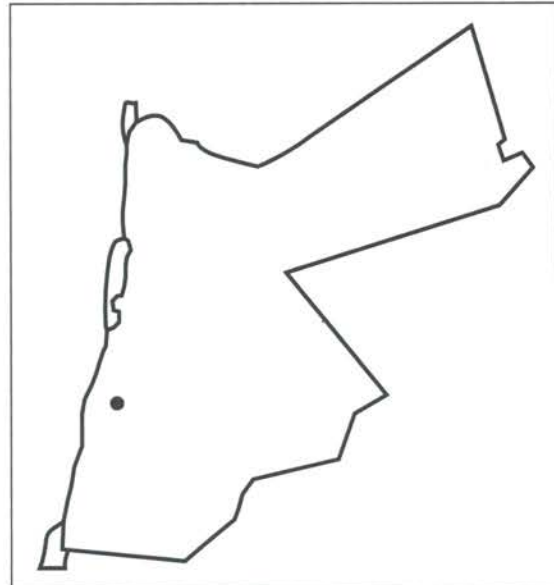
Diagnosis: Medium-sized horseshoe bat. Greatest length of skull can get slightly bigger than 20 mm. Lancet tapered abruptly, with a

concave base. Connecting process of sella short and acutely pointed. Weak sagittal crest.

Dental formula: i 1/1 or 1/2 c 1/1 pm 2/3 m 3/3 = 30 or 32.

Remarks: 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. Irrigation canals and small dams are in close proximity to the collecting site.



Map 16: Distribution of *Rhinolophus mehelyi*.

Localities: An Naqah.

***Rhinolophus hipposideros* (Bechstein, 1800)**

In Pennant, Allgemeine Ueber. Vierfuss. Thiere, 2:629.

Common name: Lesser Horseshoe Bat.

Distribution: Ireland, Iberia and Morocco through S Europe and N Africa to Kirghizia and Kashmir; Arabia; Sudan; Ethiopia.

Type Locality: France.

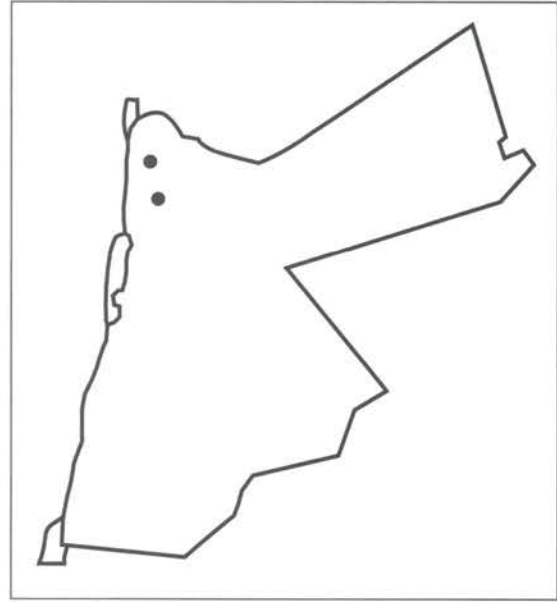
Diagnosis: Smallest of the horseshoe bats in Jordan. Forearm never longer than 40 mm, greatest length of skull less than 16 mm. Lancet is tall, thick and triangular in shape. Connecting process of sella is blunt in a side view, with its lower extremity projecting distinctively downwards. Fur long and colour ranges

from greyish brown to deep brown, with the underside being paler. Skull is very small and delicate. Very small canine, nearly same size as second upper premolar.

Dental formula: $i\ 1/1$ or $1/2\ c\ 1/1\ pm\ 2/3\ m\ 3/3 = 30$ or 32 .

Remarks: 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 abundant this species is. It is rarely encountered but may be more common and widespread than the meager collection reports indicate.



Map 17: Distribution of *Rhinolophus hipposideros*.

Localities: Dibbin, Zubiya.

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)

Ann. Mus. Hist. Nat. Paris, 20:265.

Common name: Trident Leaf-nosed Bat.

malia; Socotra (Yemen).

Type Locality: Egypt, Qena, near Luxor.

Diagnosis: This bat has a characteristic dor-

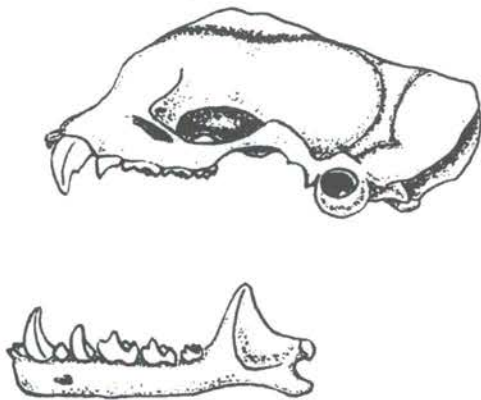
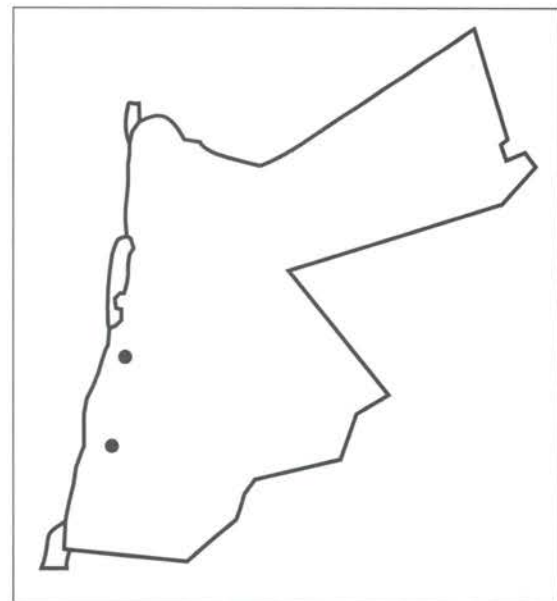


Fig. 12: *Asellia tridens*. After Harrison & Bates (1991).

Distribution: Pakistan to Arabia, Sinai peninsula (NE Egypt) and Palestine; Egypt to Morocco, Senegal, Chad, Sudan and S So-



Map 18: Distribution of *Asellia tridens*.

sal nose leaf, with three projections. Central projection pointed, outer two blunt. Large, tall ears. Thin tail, tip extending a very short distance beyond the interfemoral membrane. Fur colour variable, in general greyish-brown dorsally, with whitish hair on the shoulders, underside is much paler, nearly white, getting lighter towards the posterior. Also orange-brownish variants are known to occur. Very well developed sagittal crest.

Dental formula: $i\ 1/2\ c\ 1/1\ pm\ 1/2\ m\ 3/3 = 28$.

Remarks: The Trident Leaf-nosed Bat is a desert adapted colonial species. Its colonies

were found in caves and underground shelters and buildings (Kowaliski & Rzebik-Kowalska, 1991). Roosting sites in Iraq are abandoned during winter suggesting a migratory behaviour (Harrison, 1957). Al-Robaae (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.

Localities: An Naqah, Petra.

Family Nycteridae Slit-faced Bats

Species of this family are characterized by a deep furrow surrounded by cutaneous projections on the muzzle. The ears are tall, 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

Descrip. de L'Egypte, 2:119.

Common name: Egyptian Slit-faced Bat.

Distribution: Central Arabia; Palestine; Sinai; Egypt to Morocco, Senegal, Benin, Somalia and Kenya, thence south to South Africa in open country; Zanzibar and Pemba.

Type Locality: Egypt, Thebes (near Luxor).

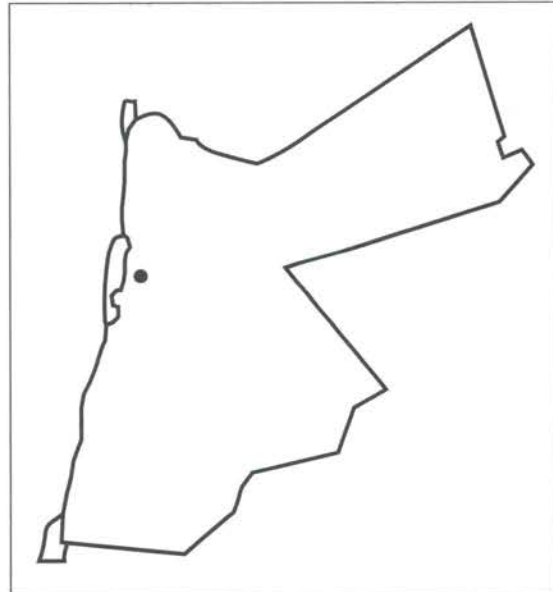
Diagnosis: Small-sized bat. Ears large and separate. Upper and lower lip hairy with a deep median groove. Fur long and dense, light brown in colour above and lighter being whitish or greyish white below. Wings broad.

Dental formula: $i\ 2/3\ c\ 1/1\ pm\ 1/2\ m\ 3/3 = 32$.

Remarks: This species was recorded recently from Al Raddas in Wadi al Mawjib. It was caught by an insect net while flying at low altitude. Harrison & Bates (1991) cited the observations of Yerbury & Thomas (1895), where they captured this bat by "a butterfly net". 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 and Sinai. It inhabits ruins, bungalows, abandoned well shaft and caves (Nader & Kock, 1982; Harrison & Bates, 1991). The Egyptian Slit-faced Bat feeds on grasshoppers (Yerbury & Thomas, 1895 in Harrison & Bates, 1991) and scorpions (Felten, 1956). This feeding behav-

ior may explain the low flying pattern. Females give birth to a single individual.

It was reported from Ayn Gedi and Jericho near the Dead Sea (Qumsiyeh, 1985; Yom-Tov *et al.*, 1992a)



Map 19: Distribution of *Nycteris thebaica*.

Localities: Al Raddas.

Family Vespertilionidae

These are the night bats, characterized by the absence of any leaf-like structure at the nostrils. Ears are not connected together. Tragus is well developed. The second finger is equipped with a small phalanx and one

metacarpal, while the third finger has three phalanges.

In Jordan this family is represented by ten species into six genera.

Key to Family Vespertilionidae

1. Two incisors on each side of the upper jaw 2
 One incisor on each side of the upper jaw *Otonycteris hemprichi*
2. Four cheekteeth behind the canine in the upper jaw *Eptesicus bottae*
 More than four cheekteeth behind the canine in the upper jaw 3
3. Six teeth on each side of upper jaw *Myotis* 4
 Five teeth on each side of upper jaw 6
4. Feet long, exceeding about 3/4 of the length of the tibia. Wing membrane is attached to the leg at or above the ankle *Myotis capaccini*
 Feet short, not exceeding 1/2 of the length of the tibia. Wing membrane is attached to the outer digit.....5
5. Ears long, tragus large *Myotis nattereri*
 Ears short, tragus small *Myotis emarginatus*
6. Small in size, forearm 30-37 mm in length. *Pipistrellus* 7
 Medium in size, forearm 45-47 mm in length *Miniopterus schreibersi*
7. First upper incisor unicuspid.....8
 First upper incisor bicuspid..... *Pipistrellus bodenheimeri*
8. Wing membrane with whitish borders..... *Pipistrellus kuhli*
 Wing membrane without whitish borders..... *Pipistrellus ariel*

***Eptesicus bottae* (Peters, 1869)**

Monatsb. K. Preuss. Akad. Wiss. Berlin, 1869:406.

Common name: Botta's Serotine Bat.

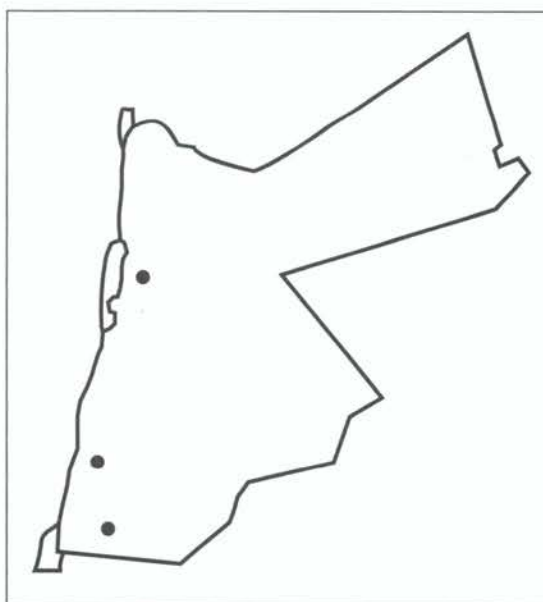
Distribution: Turkey, Egypt, and Yemen, east to Mongolia and Pakistan.

Type Locality: Yemen.

Diagnosis: Medium-sized bat. Forearm length around 50 mm, greatest length of skull not exceeding 19 mm. The tip of the tail projects very slightly from the membrane. Fur long and colour pale brown, with blackish membranes, ears and face. Underside is white. Small skull, with weak sagittal crest. The small second premolar is not present.

Dental formula: $i \ 2/3 \ c \ 1/1 \ pm \ 1/2 \ m \ 3/3 = 32.$

Remarks: This is a rare species reported from Petra and Wadi Ramm. Botta's Serotine is found in the arid regions in the south including Wadi Arabah, the southeastern Jordan desert, and probably An Naqb.



Map 20: Distribution of *Eptesicus bottae*.

Localities: Wadi al Mawjib, Disah, Petra, Wadi Ramm.



Hemiechinus auritus (Photo: D. Shafee)



Erinaceus concolor (Photo: D. Shafee)



Paraechinus aethiopicus (Photo: D. Modry)



Rhinolophus ferrumequinum (Photo: M. Qumsiyeh)



Rhinopoma hardwickii (Photo: M. Qumsiyeh)



Otonycteris hemprichi (Photo: M. Qumsiyeh)



Plecotus austriacus (Photo: D. Modry)



Eptesicus bottae (Photo: M. Qumsiyeh)



Taphozous nudiventris (Photo: Kuwait Natural History)



Vulpes rueppelli sabaea (Photo: M. Qunsiyeh)



Vulpes cana (Photo: RSCN)



Vulpes vulpes (Photo: D. Shafee)



Canis lupus (Photo: A. Budairi)

***Miniopterus schreibersi* (Kuhl, 1817)**

Die Deutschen Fledermäuse, Hanau, p. 14.

Common name: Schreiber's Bat.

Distribution: S Europe and Morocco through the Caucasus and Iran to most of China and Japan; most of Indo-Malayan region; New Guinea; Solomon Isls (including Bougainville Isl); Australia; subsaharan Africa; Madagascar; Bismarck Arch.

Type Locality: Rumania, Banat, near Coroni, Kolumbacs Cave.



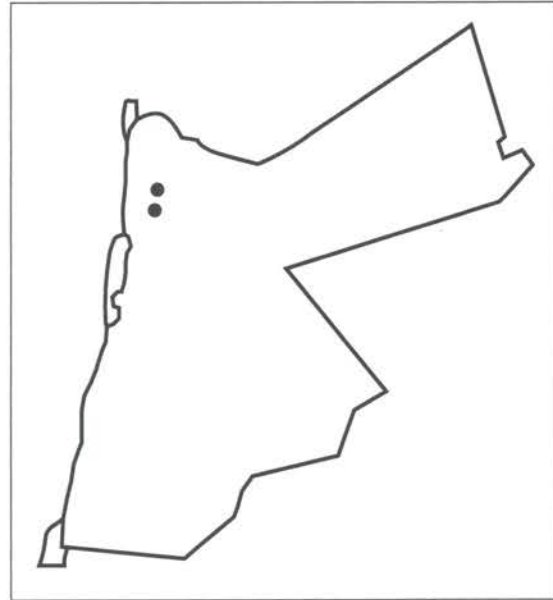
Fig. 13: *Miniopterus schreibersi*. After Harrison & Bates (1991).

Diagnosis: Small bat. Ears short with a cylindrical tragus. Second and third metacarpals are almost equal. Third finger has an elongated second phalanx. Short muzzle with distinctive, abruptly elevated cranium. Interfemoral membrane light brown and semitranslucent, while wing membranes are much darker. Relatively long tail, not extending beyond interfemoral membrane. Fur colour is greyish brown, with the underside being greyish white. Fur is much shorter on top of head and chest. Very characteristic for this species is that the skull is inflated anterior to the braincase. Unusually large upper first premolar. The two upper incisors are nearly equal in size, with the second one being more robust.

Dental formula: $i\ 2/3\ c\ 1/1\ pm\ 2/3\ m\ 3/3 = 36$.

Remarks: This species has a wide range of distribution. It is known to share the same habitat with *R. euryale* and *Rh. ferrumequinum*. The Schreiber's 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 (Qum-

siyeh, 1996). Remains of this species were derived from owl pellets in Palestine (Dor, 1947).



Map 21: Distribution of *Miniopterus schreibersi*.

Localities: Jarash, Dibbin.

***Myotis emarginatus* (E. Geoffroy, 1806)**

Ann. Mus. Hist. Nat. Paris, 8:198.

Common name: Notch-eared Bat.

Distribution: S Europe, north to Netherlands and S Poland, Crimea, Caucasus and Kopet Dag Mtns, east to Uzbekistan and E Iran; Israel; Morocco; Algeria; Tunisia; Lebanon; Afghanistan.

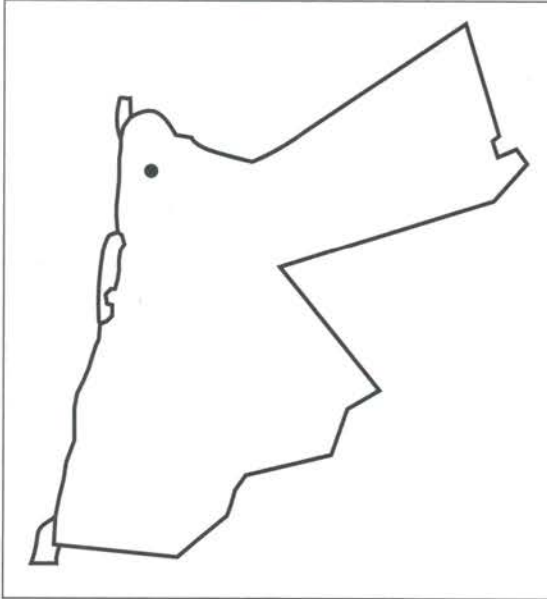
Type Locality: France, Ardennes, Givet, Charlemont.

Diagnosis: Small bat. Forarm not exceeding 45 mm, greatest length of skull not greater than 17 mm. Ear with conspicuous lateral notch. Tragus sharply pointed and about half the height of pinna. Lack a fringe of hair on the interfemoral membrane. Wing membranes attached to outer toe. Only extreme tail tip extending beyond interfemoral membrane. Dorsal side of tibia slightly haired, up to the ankle. Fur distinctively reddish-brown dorsally and woolly in texture. Underside paler with a more orange-brown colour. Small and delicate skull with a bit elevated braincase.

Dental formula: $i\ 2/3\ c\ 1/1\ pm\ 3/3\ m\ 3/3 = 38$.

Remarks: The Notch-eared Bat is associated with mesic habitats. It is known in the northern mountains of Jordan with dense vegeta-

tion and forests. It is distributed throughout Europe and North Africa (Atallah, 1977). It was reported from the Dibbin National Forest (Qumsiyeh *et al.*, 1986).



Map 22: Distribution of *Myotis emarginatus*.

Localities: Dibbin.

***Myotis capaccini* (Bonaparte, 1837)**

Fauna Ital., 1, fasc. 20.

Common name: Long-Fingered Bat.

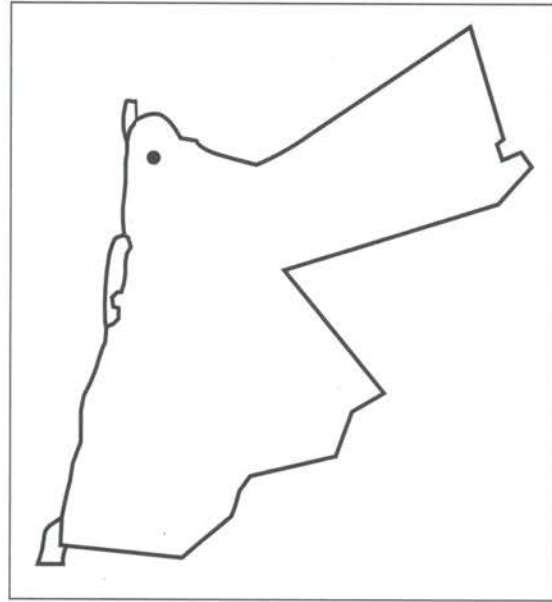
Distribution: Mediterranean zone and islands of Europe and NW Africa; Turkey; Palestine; Iraq; Iran; Uzbekistan.

Type Locality: Italy, Sicily.

Diagnosis: Small bat. Forearm less than 42 mm in length. Ear with a distinct indentation. Tragus half the height of pinna. Feet distinctively large, about 3/4 of the tibia. Tail extends a few millimeters beyond the interfemoral membrane. Wing membranes attached to tibia above the ankle. Fur short and colour is light brown dorsally, underside is whitish. Interfemoral membrane with hairs ventrally and dorsally. Femur and tibia densely haired down to the ankle. Skull similar to *M. emarginatus*, but less elevated.

Dental formula: $i\ 2/3\ c\ 1/1\ pm\ 3/3\ m\ 3/3 = 38$.

Remarks: This species was reported from Tabaqat Fahl. Qumsiyeh *et al.* (1986) indicated that colouration of the Jordanian form is similar to *M. c. bureschi* collected from Lebanon and Palestine by Harrison (1964).



Map 23: Distribution of *Myotis capaccini*.

Localities: Tabaqat Fahl.

***Myotis nattereri* (Kuhl, 1817)**

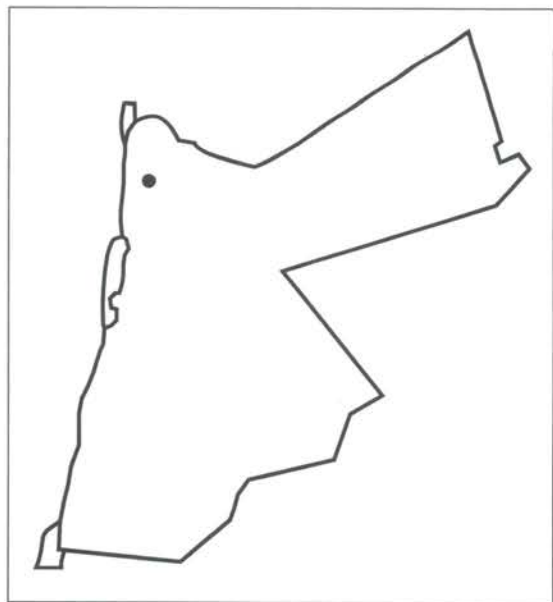
Die Deutschen Fledermäuse. Hanau, p. 14, 33.

Common name: Natterer's Bat.

Distribution: Europe (except Scandinavia); NW Africa; Turkey; Palestine; Iraq; Crimea and Caucasus to Turkmenistan.

Type Locality: Germany, Hessen, Hanau.

Diagnosis: Small bat. Ears tall and narrow, with a long tragus. Ears with a very weak indentation laterally. Tail membrane hairy along



Map 24: Distribution of *Myotis nattereri*.

the hind margin. Wing membrane attached to the outer toe. Extreme tip of tail extending beyond interfemoral membrane. Fur long and colour grey to greyish brown dorsally, underside whitish. Skull with anterior part of braincase well elevated.

Dental formula: $i\ 2/3\ c\ 1/1\ pm\ 3/3\ m\ 3/3 = 38$.

Remarks: Probably this species shares the same habitat during roosting with *R. ferrumequinum* and *M. cappaccini* in Lebanon (Attalah, 1970). A large colony of about 250 individuals, mostly non-pregnant females and sub adults were observed in the Dibbin Forest in July (Qumsiyeh, 1980). Females with a single young were seen by Harrison (1964).

Localities: Dibbin.

***Otonycteris hemprichi* Peters, 1859**

Monatsb. K. Preuss. Akad. Wiss. Berlin, 1859:223.

Common name: Hemprich's Long-eared Bat.

Distribution: The desert zone from Morocco and Niger through Egypt and Arabia to Tadzhikistan, Afghanistan, and Kashmir.

Type Locality: Egypt, Nile Valley south of Assuan (Aswan).

Diagnosis: Large-sized bat, with relatively large ears, but not joined. Forearm over 65 mm. Two pairs of pectoral nipples present.



Fig. 14: *Otonycteris hemprichi*. After Harrison (1981).

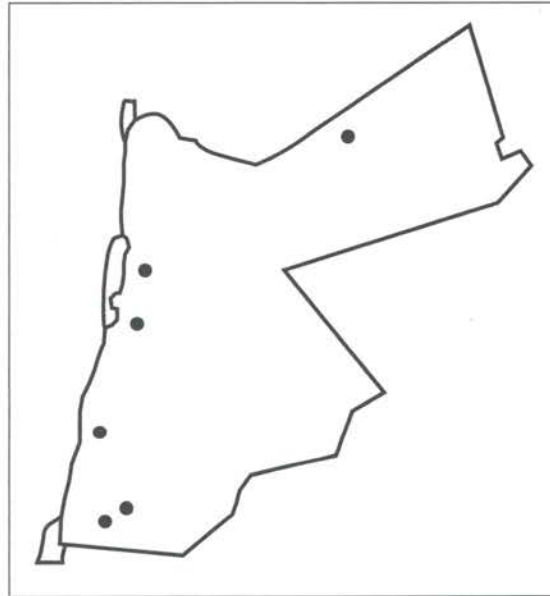
Tragus large and lanceolate in shape. Thick but semitranslucent yellow-brown membranes, getting lighter towards the outer margins, were they are whitish. Fur long and colour pale greyish dorsally, hairtips on back are pale purplish, underside white. Large skull with very large tympanic bullae. Large, single upper incisor and a powerful upper canine

Dental formula: $i\ 1/3\ c\ 1/1\ pm\ 1/2\ m\ 3/3 = 30$.

Remarks: The distribution of Hemprich's Long-eared Bat is confined to the arid parts of Jordan. It was reported from Wadi Ramm (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).

O. hemprichi was reported from arid habitats in North Africa and Arabia. Atallah (1966; 1967b) collected specimens from a deserted hut near Azraq, Jordan. Births are usually by June. Four different subspecies have been described of which *O. hemprichi jin* Cheesman and Hinton, is the most common form in southwestern Asia.



Map 25: Distribution of *Otonycteris hemprichi*.

Localities: Wadi al Mawjib, Disah, Al Karak, Qasr Burqu', Wadi Fidan, Wadi Ramm.

***Pipistrellus ariel* Thomas, 1904**

Ann. Mag. Nat. Hist., ser. 7, 14:157.

Common name: Egyptian Desert Pipistrelle, Pygmy Pipistrelle.

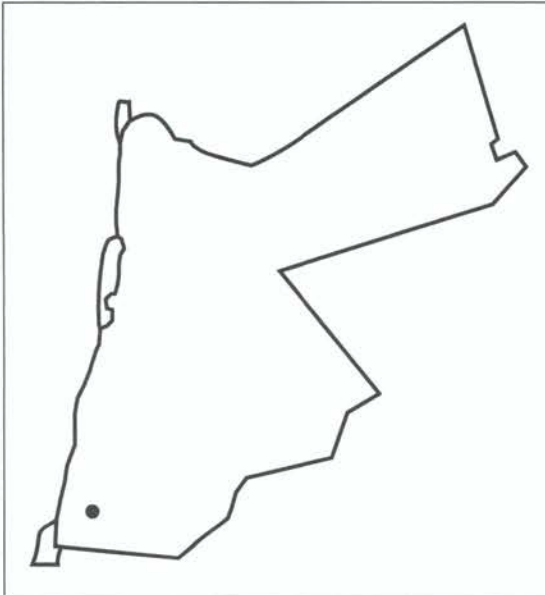
Distribution: Egypt, N Sudan.

Type Locality: Sudan, Kassala Province, Wadi Alagi.

Diagnosis: Small bat. Forearm length not exceeding 31 mm. Ears are tall and narrow. Well developed tragus, antitragus not very well developed. Muzzle is distinctively pointed and also quite narrow. Second upper incisor long, 2/3 of the unicuspid first upper incisor. Similar to *P. bodenheimeri*.

Dental formula: $i \ 2/3 \ c \ 1/1 \ pm \ 2/2 \ m \ 3/3 = 34$.

Remarks: 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).



Map 26: Distribution of *Pipistrellus ariel*.

Localities: Disah.

***Pipistrellus bodenheimeri* Harrison, 1960**

Durban Mus. Novit., 5:261.

Common name: Bodenheimer's Pipistrelle.

Distribution: Palestine, S Yemen, Oman, Socotra.

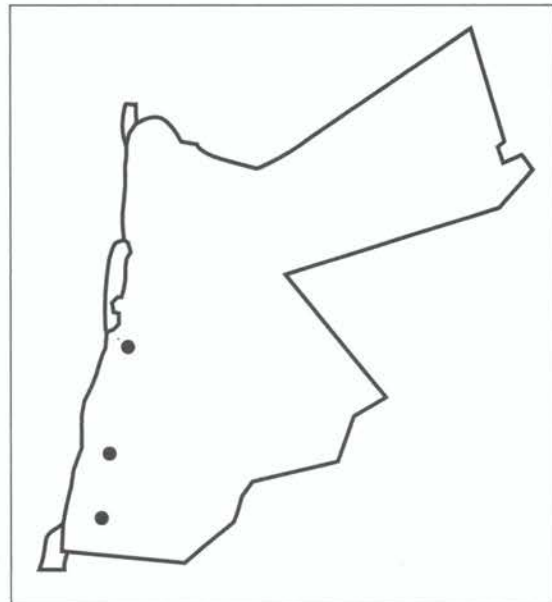
Type Locality: Palestine, 40 km N Eilat, Wadi Arabah.

Diagnosis: Small bat. Forearm 26-31 mm. Ears large with unusually well developed antitragus and a well developed tragus. Muzzle distinctively broad and rounded. Interfemoral membrane is very light in colour, being translucent, while the wing membranes are very

dark (blackish) in colour. Fur long and colour pale buff dorsally and whitish on the underside, contrasting with the dark wing membranes. First upper incisor usually bicuspid. Second incisor large, 3/4 of the first.

Dental formula: $i \ 2/3 \ c \ 1/1 \ pm \ 2/2 \ m \ 3/3 = 34$.

Remarks: 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.* (1992b).



Map 27: Distribution of *Pipistrellus bodenheimeri*.

Localities: Ghawr as Safi, Petra, Wadi Ramm.

***Pipistrellus kuhli* (Kuhl, 1817)**

Die Deutschen Fledermäuse, Hanau, p. 14

Common name: Kuhl's Pipistrelle.

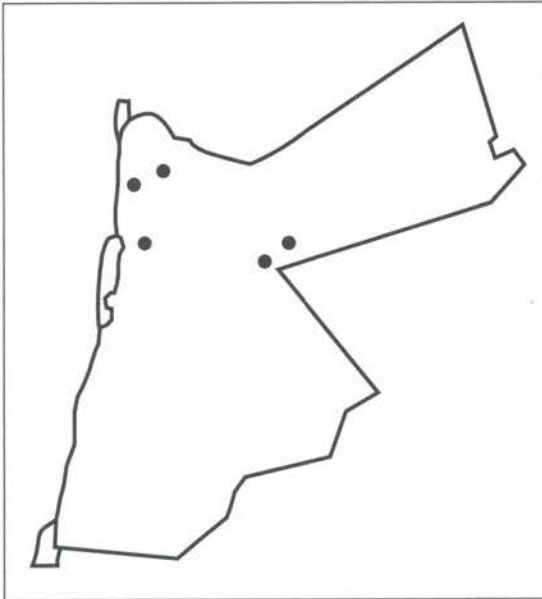
Distribution: S Europe through the Caucasus to Kazakhstan and Pakistan; SW Asia; most of Africa; Canary Isls. (Spain).

Type Locality: Italy, Friuli-Venezia Giulia, Trieste.

Diagnosis: Small bat. Forearms 30-37 mm in length. Well developed antitragus, tragus tall and narrow. Wing membrane with a distinct white posterior margin. Fur colour pale buff dorsally, underside white. Skull robust. First upper incisor unicuspid and tall. Very small second upper incisor.

Dental formula: $i\ 2/3\ c\ 1/1\ pm\ 2/2\ m\ 3/3 = 34$.

Remarks: Perhaps this 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. 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 (Atallah, 1966; 1967b). Birth probably occurs during late April and May in many areas in the Near East (Lewis & Harrison, 1962; Harrison, 1964). Remains of Kuhl's Pipistrelle were recovered from the Barn Owl pellets (Dor, 1947).



Map 28: Distribution of *Pipistrellus kuhli*.

Localities: Al Hazim, Aqraba, Ar Ramtha, Azraq, Suwaylih.

***Plecotus austriacus* (J. Fischer, 1829)**

Synopsis Mamm., p. 117.

Common name: Grey Long-eared Bat.

Distribution: England, Spain, and Senegal to Mongolia and W China; Canary (Spain) and Cape Verde Isls.

Type Locality: Austria, Vienna.

Diagnosis: Small bat. Forearm length up to 42 mm. Ears very large and joined across the head. Tragus large and slender. Nostrils open dorsally. Tail is relatively long, with only the tip extending beyond the interfemoral membrane. Fur colour pale dorsally, un-

derside is whitish with black hair bases. Skull delicate, with a large, inflated and elongated braincase, rostrum short and narrow. Rostrum with a distinct median groove. External nares are unique by possessing a posterior fissure. Large tympanic bullae. First upper incisor bicuspid, lower incisors tricuspid.

Dental formula: $i\ 2/3\ c\ 1/1\ p\ 2/3\ m\ 3/3 = 36$.

Remarks: 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

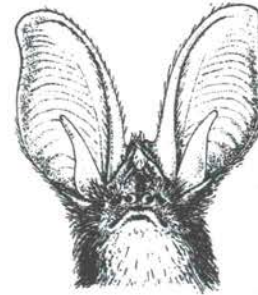
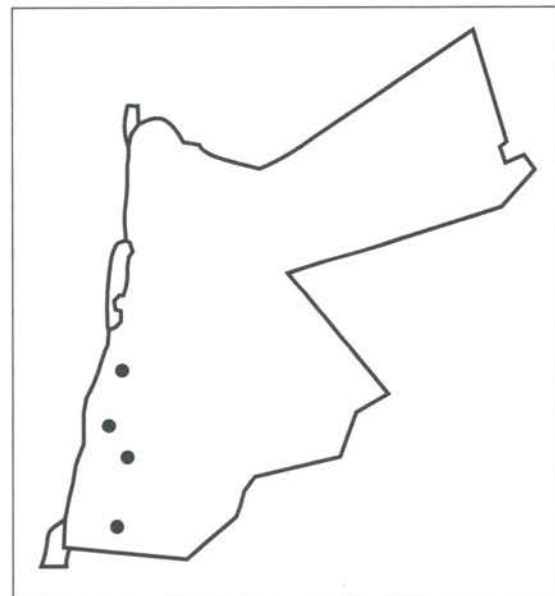


Fig. 15: *Plecotus austriacus*. After Harrison & Bates (1991).

"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 (Qumsiyeh *et al.*, 1998). Harrison (1964) observed a female with a single small fetus in March.



Map 29: Distribution of *Plecotus austriacus*.

Localities: Disah, Gharandal, Petra, Ras an Naqb.

Family Molossidae

The tail projects freely beyond the inter-femoral membrane. The tragus of the ear is

small and rudimentary, while the anti-tragus is very large.

Tadarida teniotis (Rafinesque, 1814)

Precis Som., p. 12.

Common name: European Free-tailed Bat.

Distribution: France, Portugal and Morocco to Japan, S China, and Taiwan; Madeira (Portugal) and Canary Isls (Spain).

Type Locality: Italy, Sicily.

Diagnosis: Large free-tailed bat. Forearm length 54-64 mm. Face characteristically wrinkled. Snout similar in shape to that of a

dog. Ears are very broadly rounded and point downwards towards the face. Tragus square-like, with rounded corners. Antitragus large. Fur colour dark blackish-grey dorsally, underside is lighter. Toes are covered with stiff hairs, and a pad is present on the soles. Tail projects beyond the interfemoral membrane. Skull is large and elongated. No sagittal crest. **Dental formula:** $i \ 1/2$ (or 3) $c \ 1/1$ $pm \ 2/2$ $m \ 3/3 = 30$ (or 32). **Remarks:** 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. It's ability to fly at high altitudes and for long distances are 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).

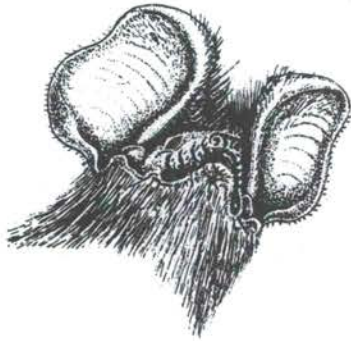
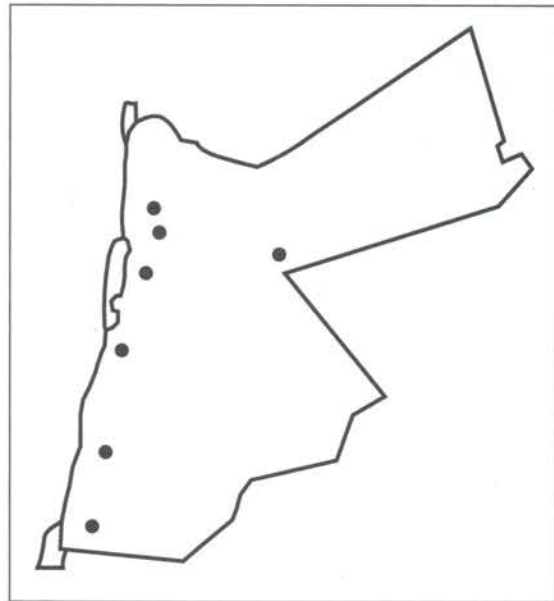


Fig. 16: *Tadarida teniotis*. After Harrison & Bates (1981).

dog. Ears are very broadly rounded and point downwards towards the face. Tragus square-like, with rounded corners. Antitragus large. Fur colour dark blackish-grey dorsally, underside is lighter. Toes are covered with stiff hairs, and a pad is present on the soles. Tail projects beyond the interfemoral membrane. Skull is large and elongated. No sagittal crest.

Dental formula: $i \ 1/2$ (or 3) $c \ 1/1$ $pm \ 2/2$ $m \ 3/3 = 30$ (or 32).

Remarks: The European Free-tailed Bat was



Map 30: Distribution of *Tadarida teniotis*.

Localities: Al Jubayha, Wadi al Mawjib, Faydat ad Dahikiyah, Ghawr as Safi, Jarash, Petra, Wadi Ramm.

Order Carnivora

The carnivores have a worldwide distribution and cover a wide range of habitats including dry, temperate, tropical and arctic regions. This order includes species that are adapted for terrestrial life (foxes, wolves and the mongoose), others can climb trees (martens and polecats), while otters are adapted to aquatic habitats. The diet of carnivores is not strictly flesh, some feed on nuts, vegetable matter, insects and others. 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.

pestidae and Mustelidae), with a total of 16 surviving species. In earlier papers, Amr & Disi (1988), Kock *et al.* (1993), Qumsiyeh *et al.* (1993) and Amr *et al.* (1996), 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). Also, many were indicated in the writings of early travelers in the Levant (Tristram, 1884).

The Carnivora of Jordan consists of five families (Canidae, Felidae, Hyaenidae, Her-

Key to Order Carnivora

- 1. Hind feet equipped with 5 digits 2
 Hind feet equipped with 4 digits 3
- 2. Fore feet with 4 digits. Dog-like Family Canidae
 Fore feet with 5 digits. Cat-like Family Felidae
- 3. Sagittal crest well developed Family Hyaenidae
 Sagittal crest not well developed 4
- 4. Tail length more than 2/3 of body length Family Herpestidae
 Tail length less than 2/3 of body length Family Mustelidae

**Family Canidae
 Jackals, Foxes and Wolves**

Originally, species of the order Canidae evolved in open, grassland habitats, however now they inhabit a wide range of environments. They are mainly dependent on flesh of other animals as a source of food. Foxes, on the other hand feed also on vegetable materials, small lizards and insects. Some premolars and molars are modified for flesh shearing

(Wozencraft, 1989).

Canids have long legs with four-toed feet, non-retractile claws, fused wrist bones that give their wrists unidirectional strength and locked front leg bones to prevent rotation. Such adaptations help the canids to run quickly after their prey (Wozencraft, 1989).

Key to Family Canidae

- 1. Large-sized, dog-like 2
 Small-sized, fox-like 3
- 2. Skull length 145-175 mm, cingulum well developed *Canis aureus*
 Skull length greater than 180 mm, cingulum on the outer edge of the first molar is small. *Canis lupus*
- 3. Back of the ears black or dark brown in colour *Vulpes vulpes*
 Back of the ears not as above 4
- 4. Tip of the tail black *Vulpus cana*
 Tip of the tail is not black *Vulpes rueppelli*

Canis aureus Linnaeus, 1758

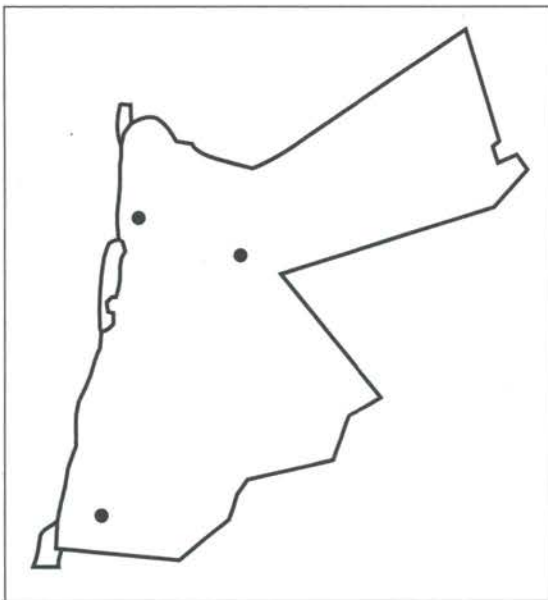
Syst. Nat., 10th ed., 1:40.

Common Name: Golden Jackal, Asiatic Jackal.

Distribution: N and E Africa, south to Senegal, Nigeria, and Tanzania; SW Asia; SE Europe; Transcaucasia; C Asia; Iran; Afghanistan; S Asia to Thailand, including Sri Lanka.

Type Locality: "oriente", restricted by Thomas (1911) to "Bennä Mts., Laristan, S. Persia" [Iran].

Diagnosis: Smaller than *C. lupus*. Skull length up to 175 mm. Head dog-like in shape. Tail short and with a black tip. Ears small, covered with long hair externally. Fur colour dorsally light brown, with a dark stripe running from the nose to the tip of the tail; ventral side lighter. Skull smaller than of *C. lupus*. Tympanic bullae large, rostrum elongated. Zygomatic arches moderately flared. Sagittal crest well developed. Skull hard to distinguish from the domestic dog. Last molar higher than other molars. Cingulum of



Map 31: Distribution of *Canis aureus*.

upper molars well developed.

Dental formula: i 3/3 c 1/1 pm 4/4 m 2/3 = 42.

Remarks: 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, 1884, 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 destruc-

tion and perhaps to competition with the Red Fox. Currently, population of the Jackal is confined to oasis, swamps and naturally protected areas such as the Azraq Nature Reserve, northern end of the Dead Sea and Wadi Ramm. This species prefers habitats with cover and avoids open areas. Such cover provides the animals with shelter. Jackals feed on several items of small animals (rodents, hares, birds etc.) as well as on vegetable matter. It is considered as an opportunistic omnivore. I personally observed a mother and three young Jackals in Azraq around the afternoon. It was seen and bone remains were collected from Wadi Ramm and Azraq (Mountford, 1965; Nelson, 1973; Amr & Disi, 1988).

Urgent measures should be implemented to save the scattered populations of this animal.

Localities: Azraq, Wadi Ramm.

Canis lupus Linnaeus, 1758

Syst. Nat., 10th ed., 1:39.

Common Name: Wolf.

Distribution: Throughout the N hemisphere: North America south to in Oaxaca (Mexico); Europe; Asia, including the Arabian Peninsula and Japan, excluding Indochina and S India. Extirpated from most of the continental USA, Europe, and SE China and Indochina.

Type Locality: "Europaelig sylvis, etjam frigidioribus", restricted by Thomas (1911) to "Sweden".

Diagnosis: Largest Canide. Similar to *C. aureus*, but larger, heavier build and with a more upright posture. Body robust and head large. Legs strong and long. Tail long and with a brush, pale yellowish in colour. Fur in general shorter than of *C. aureus*, with elongated hair on the mid dorsum forming a dark crest along the back. Hair on ears shorter than in *C. aureus*. Greatest length of skull exceeding 180 mm. Skull large, with well developed sagittal crest. Skull with abruptly elevated forehead. Tympanic bullae large. Mandible similar to *C. aureus*. Teeth well developed and more powerful than teeth of domestic dog and the Jackal. Cingulum of the upper molars small. Upper carnassial large and with a small lobe and with very ill defined cusps.

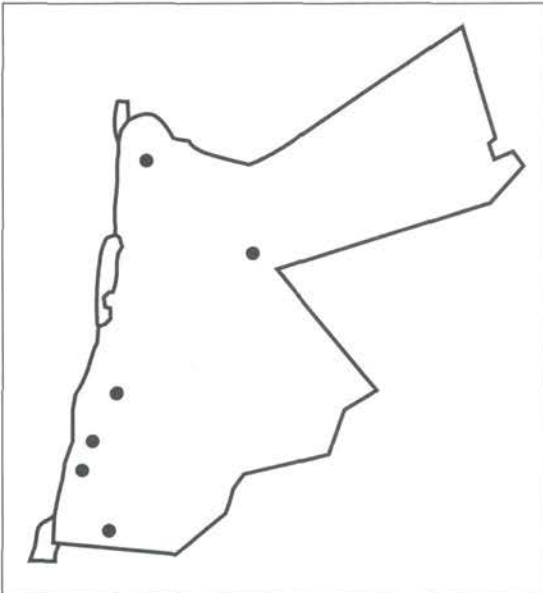
Dental formula: i 3/3 c 1/1 pm 4/4 m 2/3 = 42.

Remarks: Similar to the Jackal, the Wolf is a persecuted animal and is considered as an endangered species. The Wolf avoids extreme

desert habitats. The distribution map (Map 32) shows a distribution pattern along Wadi Arabah, southern Jordan, and Azraq area. 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.

Nelson (1973) reported several seen and or shot near Azraq. Specimens at the Jordan University Museum of Natural History (JUMNH) were obtained from Wadi Ramm in 1979, Wadi Faynan in 1981, and Rishah in 1986 (Amr & Disi, 1988). According to Clarke (1977) the Wolf is found in many localities in Jordan. Verbal recent records are from Ma'an, Abu Anseer (Amr & Disi, 1988) and Dana Nature Reserve.



Map 32: Distribution of *Canis lupus*.

Localities: Abu Anseer, Ajlun, Anaba, Azraq, Ma'an, Rishah, Wadi Faynan, Wadi Ramm.

***Vulpes cana* Blanford, 1877**

J. Asiat. Soc. Bengal, 2:321.

Common Name: Blanford's Fox .

Distribution: Turkmenistan, Afghanistan,

NE Iran, Pakistan.

Type Locality: "Gwadar, Baluchistan", [Pakistan].

Diagnosis: Ears large and hairy without black tips. Long white hair on the anterior border of ear and margins of ear. Muzzle with distinct black markings. The long and bushy tail terminates with a black tip. Weight 1 kg. Head and body length 434 mm. Tail 380 mm. Fore arm 158 mm. Ear 90 mm. Hind foot 98 mm. Hind foot pad 12 mm. Fore arm pad 14 mm. Footpads not covered by hair. Colour greyish. Skull with a narrow rostrum. Small tympanic bullae. Anterior border of coronoid process convexly curved. Dentition similar to *V. rueppelli*.

Dental formula: i 3/3 c 1/1 pm 4/4 m 2/3 = 42.

Remarks: Little is known on this handsome fox. Only recently it was recorded from the Dana area, near At Tafilah (Amr *et al.*, 1996). Blanford's Fox is one of the most rarest foxes in South West Asia. Its known distribution includes northern Iran, Afghanistan, Northwest Pakistan and southwestern Russia (Geffen *et al.*, 1993a). In the Middle East, it has been recorded from Palestine, Sinai, Oman and Arabia (Ilani, 1983; Harrison & Bates, 1989; Geffen *et al.*, 1993b).

Until recently, little information was known on the biology of this graceful fox. Geffen *et al.* (1992a, b & c, 1993a) reported on the diet, foraging behavior, habitat selection, and seasonal changes in body weight. Other reports described the physical characteristics and colouration patterns of Blanford's Fox collected from Iran, Afghanistan, Pakistan and Russia (Novikov, 1962; Roberts, 1977). This fox has a limited home range of 0.5-2 km² as reported by Geffen *et al.* (1992c).

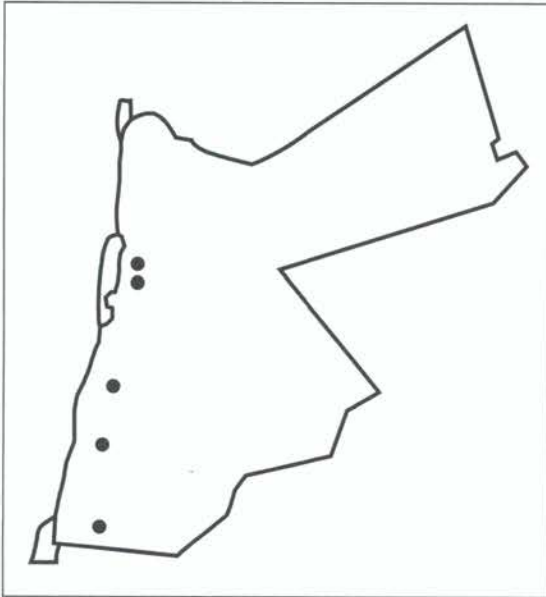
Blanford's Fox prefers rocky habitats. The rocky terrain of the Mediterranean part of Dana is mountainous with cliffs, crevices and caves that are scattered throughout the area. It is believed that the surviving populations in Oman, Rift Valley and the Negev desert are relicts (Mendelssohn *et al.*, 1987), and the desert extending across Iraq, Arabia and Jordan is a barrier that limited the distribution of *V. cana*.

Morphological characters of the 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.*, 1992a). *Vulpes cana* has an enormous jumping ability, this observation was documented by Mendelsohn *et al.* (1987).

The diet of this fox is mainly insectivorous as well as frugivorous (Geffen *et al.*, 1992b). The insects are mainly coleopterans, orthopterans, ants, wasps and isopterans. Further fecal analysis will be conducted to reveal its diet in the Dana Nature Reserve.

The unique habitat selection of the Blandford's Fox is very essential to implement protection strategies for this rare and beautiful fox. Fortunately, it was found in three Nature Reserves.



Map 33: Distribution of *Vulpes cana*.

Localities: Al Mawjib, Dana, Petra, Wadi Ramm.

***Vulpes rueppelli* (Schinz, 1825)**

In G. Cuvier, *Das Thierreich*, 4:508.

Common Name: Rüppell's Fox, Sand Fox.

Distribution: Arid areas of N Africa from Morocco to Somalia; Egypt; Sinai; Arabia; Iran; parts of Pakistan and Afghanistan.

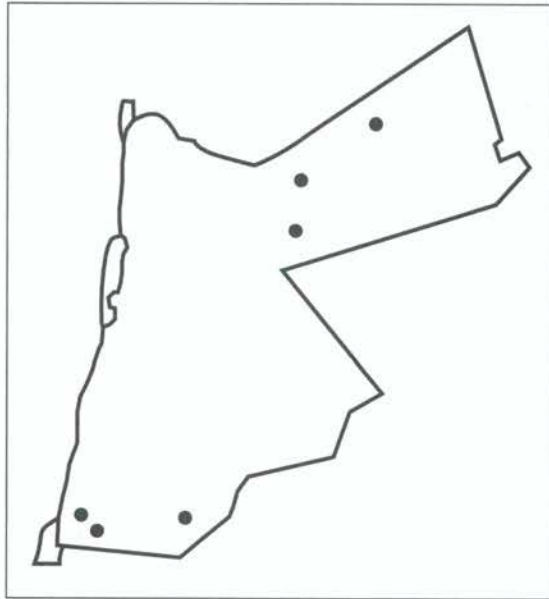
Type Locality: "Vatherland Dongola".

Diagnosis: The Rüppell's Fox has a long bushy tail, terminating with a white tip. Footpads covered with hair. Pale-brown to red-yellow, ventral side white. Face with distinct black markings between eye and muzzle.

Ears large. Back of the ear pale-brown. It is smaller than *V. vulpes* and slightly larger than *V. cana*. Skull small with large inflated bullae. Mandible less robust than that of *V. vulpes*. Dentition similar to *V. vulpes*, but more delicate.

Dental formula: i 3/3 c 1/1 pm 4/4 m 2/3 = 42.

Remarks: 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, arthropods and vegetable matter. Lindsay & Macdonald (1986) gave detailed descriptions on the behaviour and ecology of the Sand Fox. It is mostly nocturnal, but was also encountered during daytime.



Map 34: Distribution of *Vulpes rueppelli*.

Localities: Al Hazim, 2 km SE Aqabah, Er Ar Ruwayshid, Mushash Hodraj, Qasr Burqu'.

***Vulpes vulpes* (Linnaeus, 1758)**

Syst. Nat., 10th ed., 1:40.

Common Name: Red Fox .

Distribution: Europe and continental Asia except the tundra; N India and peninsular Indochina; Japan; Palearctic Africa; N America as far south as Texas and New Mexico (USA), but absent in part of the Central Plains and the Arctic. Introduced to Australia

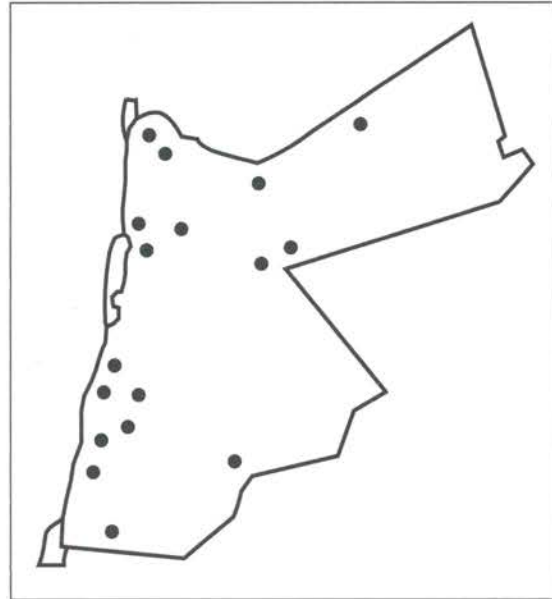
Type Locality: "Europa, Asia, Africa, antrafodiens," restricted by Thomas (1911), to "Sweden (Upsala)."

Diagnosis: Largest fox. Snout pointed with prominent large bluntly pointed ears. The tip

of each ear is brown, back of ear black or greyish black in colour. The anterior edge of the ear is covered by white hair that extend backwards. A black spot is usually located on each side of the muzzle. Tail tip usually white. Black mark on the fore leg. The Red Fox colouration varies from brown, light brown to red-yellow, with a very dark ventral side. Skull robust with a moderately elongated rostrum. Tympanic bullae less inflated. Posterior part of mandible high. Upper carnassial with a well formed inner lobe, and a distinct cup is present. Lower canine tall and strongly curved.

Dental formula: i 3/3 c 1/1 pm 4/4 m 2/3 = 42.

Remarks: 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. It is quite common in Wadi Arabah and Ar Ruwayshid. Packs of ten or more animals were spotted in north-eastern 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.



Map 35: Distribution of *Vulpes vulpes*.

Localities: Al Unab, Aqraba, Ash Shawbak, Azraq, Irbid, Jawa, Jordan Valley, Al Karak, Madaba, Wadi Arabah, Az Zarqa.

Family Felidae

Wild Cats, Lynx, Leopards and Cheetahs

Felids are strictly carnivorous and are specialized for catching, killing and devouring prey. Several adaptations made felines exquisite hunters, including the sharp light/dark vision, rounded ears that can unveil any vibrations, and carnassial modifications with a third premolar with an anterior cusp for crushing bones. Felid claws are retractable to provide

extra grip during its hunt (Wozencraft, 1989).

The surviving felines of Jordan are represented in two genera (*Felis* and *Caracal*) with four species. Unfortunately, several felines became extinct or endangered, as the Leopard. The status of these species is detailed in Chapter 5.

Key to Family Felidae

1. Small in size, greatest length of the skull less than 105 mm 2
 Large or medium in size, greatest length of the skull more than 105 mm 3
2. Black bars on the external part of the fore leg elbow are present, ears small.....*Felis silvestris*
 Black bars on the external part of the fore leg elbow are absent, ears large..... *Felis margarita*
3. Tufts on ears long, about 50 mm. Tail not ringed *Caracal caracal*
 Tuft on ears short, about 15 mm. Tail ringed *Felis chaus*

Caracal caracal (Schreber, 1776)

Die Säugethiere, 3(16):pl. 110[1776]; text 3 (24):413, 587[1777].

Common Name: Caracal.

Distribution: Aden, Afghanistan, Algeria, Angola, Arabia, Botswana, Egypt, Ethiopia, Gabon, India, Iran, Iraq, Palestine, Kenya, Kuwait, Libya, Malawi, Mauritania, Morocco, Mozambique, Namibia, Niger, Pakistan, Senegal, Somalia, South Africa, Sudan, Syria, Tanzania, Turkey, Turkmenistan, Uganda, Zaire, Zambia, Zimbabwe.

Type Locality: "Vorgebirge der guten Hoffnung", restricted by Allen (1924: 281) to "Table Mountain, near Cape Town, South Africa".

Diagnosis: Medium sized cat. Ear back is black; ears with long black tufts. Pupil of the eye is rounded. Face with black markings. Body colouration is reddish brown and sometimes creamy yellow, ventral side lighter. Except for a few spots on the chest and inner side of front legs there are no patterns on the body. Limbs are long and slender. Soles of feet hairy. Skull more robust than *Felis chaus*. Braincase narrow in front. The nasal branch of the premaxilla is long. Strong developed sagittal crest. Tympanic bullae strongly inflated. Inferior margin on the mandible straight. Posteropalatal notches small. Space between upper canine and premolar small. First upper premolar small and sometimes absent.

Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 2\ or\ 3/2\ m\ 1/1 = 28\ or\ 30$.

Remarks: 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. The Caracal is nocturnal as well as crepuscular. Gestation period lasts for about 82 days and females give birth to 1-3 new born. 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. Weisbein (1988) reports of a Caracal feeding on a donkey carcass, but they do not usually scavenge. Gazelles are usually killed by suffocation, following a brief chase of less than 50 meters. Caracals have also been reported to return to the same carcass for a second feed. They have also been known to

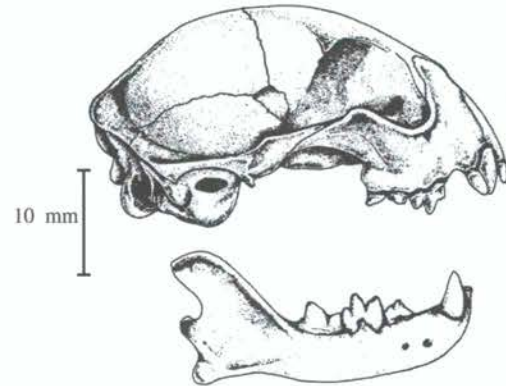
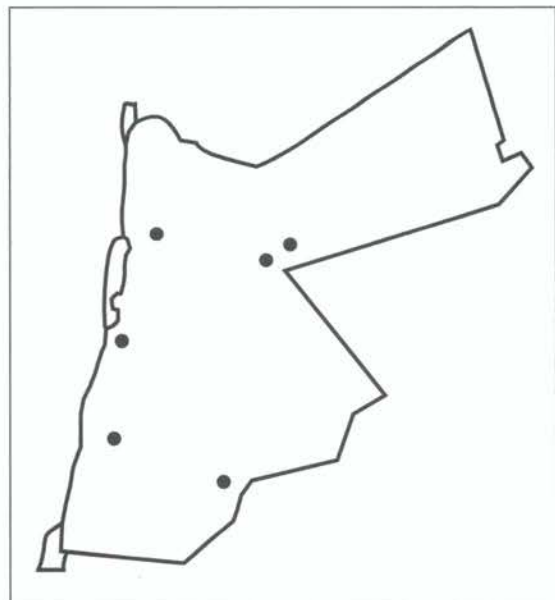


Fig. 17: Skull of *Caracal caracal*. After Osborn & Helmy (1980)

sometimes drag their killed prey up a tree. The diet of a Caracal in an irrigated agricultural area of Palestine was studied by Weisbein (1988), and had the following results: 63% mammals, 24% birds, 6.1% reptiles and 1.4% insects.

The conspicuous ears are believed to play a role in intraspecific communication (Corbet, 1978). They might also be a benefit to their kittens, allowing them to follow their mother as she stalks and catches her prey.

Males are territorial and their home ranges overlap those of at least one and usually two, or more, females. Ranges of their territory have been recorded from 4 to over 100 km². Weisbein (1988) recorded the home range for a female Caracal in Palestine to be



Map 36: Distribution of *Caracal caracal*.

34 km². Males travel an average of 10.4±5.2 km per 24-hour period, while females travel 6.6±4.1 km (Weisbein, 1989).

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

A specimen collected from Al Hazim area, was housed at Shawmari Wildlife Reserve, and subsequently released in 1985. One adult specimen was caught around the Amman area during 1965 and sent to the London Zoo. A male caracal was trapped in the Dana Nature Reserve with a body weight of 9.4 kg.

Localities: Al Hazim, Amman, Azraq, Dana Wildlife Reserve, Al Hasida, Petra.

***Felis chaus* Gldenstdt, 1776**

Nova Comm, Acad. Sci. Imp. Petropoli., 0;483.

Common Name: Jungle Cat.

Distribution: Afghanistan, Algeria, Arabia, Benin, Burma, China, Egypt, India, Iran, Iraq, Palestine, Kenya, Malawi, Morocco, Mozambique, Nepal, Pakistan, Sri Lanka, Syria, Thailand, republics of the former USSR, Vietnam, Yemen, Zambia, Zimbabwe.

Type Locality: Terek River N of Caucasus.

Diagnosis: Medium sized cat. Fur colour grizzled grey, ventral side white. Ears large with a black hair tuft that does not exceed 15 mm. Back of ears dark brown. Thin black stripe runs from anterior of eye towards the nasal. Tail short, less than 1/2 of head body length, with three black rings and a black tip. Limbs long and slender. Upper part of hind limbs with five or six dark bands, fore limbs with three black stripes on the inner side, and several black bands on the outer side. Large and elongated skull, with a long rostrum. Tympanic bullae moderately inflated. Postorbital swollen. Nasal branch of premaxilla broad. Upper canine with an antero external groove.

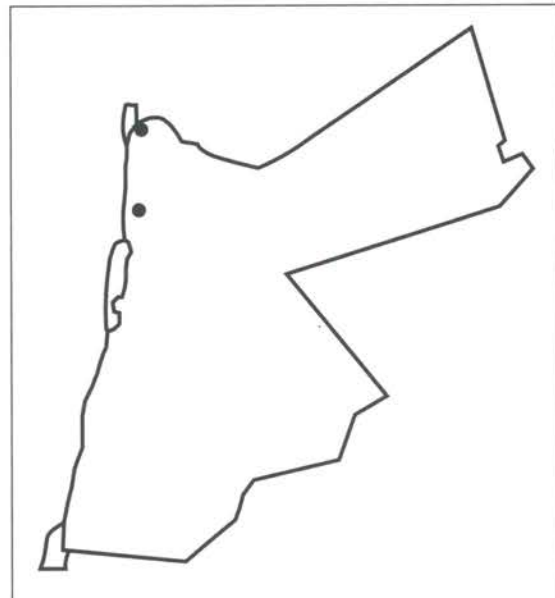
Dental formula: i 3/3 c 1/1 pm 3/2 m 1/1 = 30.

Remarks: 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. Gestation period lasts for about 68 days and the female gives birth to 1-6 kittens.

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.



Map 37: Distribution of *Felis chaus*.

Localities: Al Baqurah, Damiya.

***Felis margarita* Loche, 1858**

Rev. Mag. Zool. Paris, ser. 2, 10:49.

Common name: Sand Cat.

Distribution: Deserts in Algeria, Egypt, Iran, Libya, Morocco, Niger, Oman, Pakistan, Qatar, Saudi Arabia, Sudan, Tunisia, Turkmenistan, Uzbekistan, Yemen.

Type Locality: "environs de Ngonca (Sahara)" [Algeria].

Diagnosis: Small cat. Head flat with some very faint thin stripes. A reddish stripe extends from the anterior corner and the posterior corner of the eye towards the cheeks. Hind limbs with black bars. Eye with green-yellow

iris. Fur colour pale, with some black markings above the shoulder, ventral colour white. Elbow bars are black externally. Flanks with several reddish vertical stripes. Very large ears. Paws broad. A mat of long hair is present on the feet sole concealing the pads. Tail with black tip and with two or three black bars just before the tip. Skull small and with very strongly inflated tympanic bullae. Interorbital region broader than in *F. silvestris*. The nasal branch of premaxilla is broad. Upper and lower canines strong developed.

Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 3/2\ m\ 1/1 = 30$.

Remarks: The Sand Cat, *Felis margarita*, was recorded from Jordan based on an observation made by Mountfort (1965) in Wadi Ramm during the Second Jordan International Expedition. Later, its presence was substantiated in Wadi Ramm by finding a skull (Hemmer, 1978). The Sand Cat was observed in an area dominated by small shrubs near Qasr Burqu' (Bunian *et al.*, 1998).

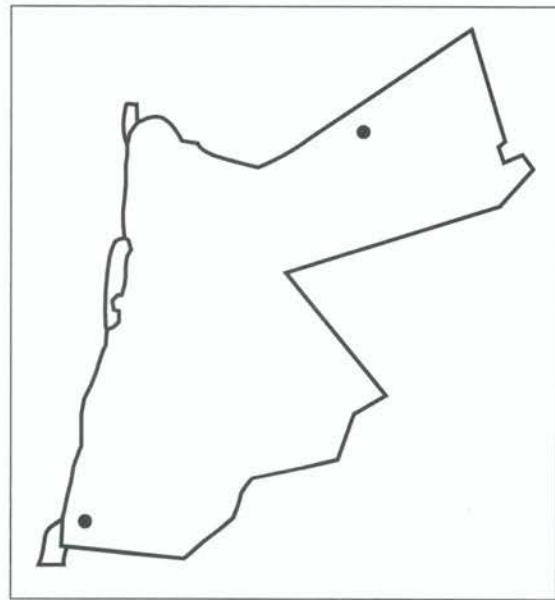
The Sand Cat has been recorded from southern Jordan, Saudi Arabia, South Yemen, Kuwait, Qatar and Oman (Hemmer 1978; Gasperetti *et al.*, 1985; Harrison & Bates, 1991). It is currently considered rare, probably due to its largely nocturnal lifestyle and secretive habits, however it may well be more widespread than records suggest. It is extremely sensitive to human disturbance, habitat encroachment and competition from larger predators. Other threats include poisoning and baiting.

Although Abbadi (1991) gave an extensive account on the behaviour, dispersal and biology of the Sand Cat in Wadi Arabah, our

survey failed to report or sight the cat in the Jordanian side of Wadi Arabah.

Acacia are its preferred habitats. Principal prey species are small desert rodents, to a lesser extent birds, reptiles and insects. Water requirements are sustained through absorption of moisture from prey kills. Individual Male/Female territories overlap and cover at most 16km² (Abbadi, 1991).

In Jordan, carnivores at large are under continuous attack by the locals. Practices as poisoning, shooting and trapping wild carnivores are used on a wide scale in farming and animal grazing areas, resulting in severe decline in the carnivore populations. This rare and beautiful species requires further studies to identify the major threats affecting its population, as well as to undertake necessary protective measures.



Map 38: Distribution of *Felis margarita*.

Localities: Qasr Burqu', Wadi Ramm.

***Felis silvestris* Schreber, 1775**

Die Säugethiere, 2(15):pl. 107[1775]; text 3 (23):397[1777].

Common Name: Common Wild Cat.

Distribution: Afghanistan, Algeria, Angola, Arabia, Botswana, Chad, China, Egypt, Ethiopia, France, Germany, Guinea, India, Iran, Iraq, Palestine, Italy, Kazakhstan, Libya, Malawi, Mali, Mauritania, Morocco, Mozambique, Namibia, Pakistan, Poland, Senegal, South Africa, Spain, Sudan, Syria, Tanzania,

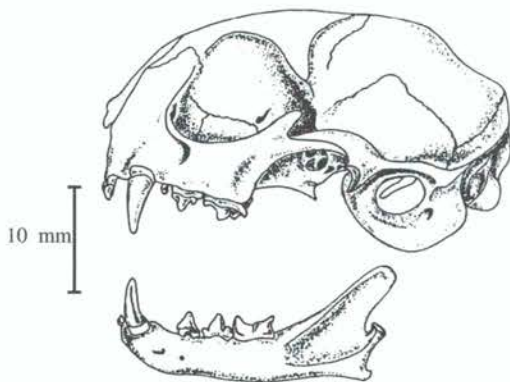


Fig. 18: Skull of *Felis margarita*. After Harrison (1981).

Tunisia, Turkistan, United Kingdom, Zambia, Zimbabwe. Introduced to: Australia, Brazil, Canada, and Madagascar.

Type Locality: Not given. Fixed by Haltenorth (1953) as "vielleicht Nordfrankreich". Listed by Pocock (1951) as "Germany".

Diagnosis: Small cat. Ears short, rusty brown on back. Elbows without black bars. Fur colour buff to olive brown with darker bands and spots, ventral side whitish. Long distinct stripes are present on the face. A distinct stripe on the cheek is present. Tail long, much larger than 1/2 of head body length. Soles of feet naked. Tail with several distinct black bars across and a black tip. Hind limbs with several dark bands across. Skull small, with a short rostrum. Sagittal crest very weak. Tympanic bullae moderately inflated. Mandible with an upturning anterior extremity. Postorbital not swollen. The nasal branch of premaxilla is broad. Upper incisors are small. Upper canine well developed and slender, first upper premolar very small. Lower incisors and canine weaker than upper ones.

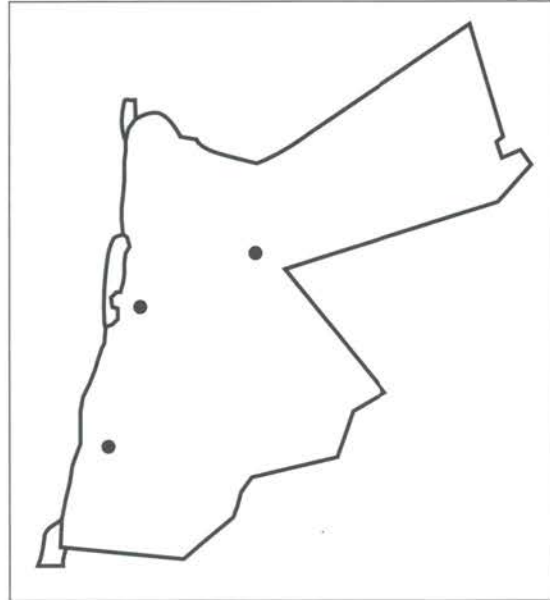
Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 3/2\ m\ 1/1 = 30$.

Remarks: 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).

Wild cats have a wide range of habitats ranging from densely forested areas to dry re-

gions with access to permanent water courses. This is true for localities in eastern Jordan.

Females give birth to 2-5 kittens after a gestation period that lasts for 63 days. The Wild Cat feeds on rodents, birds, reptiles, arachnids and insects (Nowell & Jackson, 1996). It is essentially nocturnal, especially in arid regions, however, it may appear during the early morning hours and late afternoon.



Map 39: Distribution of *Felis silvestris*.

Localities: Azraq ash Shishan, Dana Wildlife Reserve, Ghawr Seisaban, Mu'ab area Shawmari Wildlife Reserve.

Family Herpestidae

This family includes the mongooses. The head is pointed and long. The tail is long and bushy. This family is considered to have the slowest evolutionary rate among known carni-

vores, since it shows the most primitive skeletal features. They are omnivorous with a diet ranging from small mammals and birds to eggs and fruit (Wozencraft, 1989).

Herpestes ichneumon (Linnaeus, 1758)

Syst. Nat., 10th ed., 1:43.

Common Name: Egyptian Mongoose.

Distribution: Algeria, Angola, Botswana, Cameroon, Chad, Egypt, Ethiopia, Gambia, Ghana, Gibraltar, Guinea, Palestine, Italy, Ivory Coast, Jordan, Kenya, Lebanon, Liberia, Lybia, Malawi, Morocco, Mozambique, Niger, Portugal, Rwanda, Senegal, Sierra Leone, South Africa, Spain, Sudan, Syria, Tanzania, Togo, Tunisia, Turkey, Uganda, Zaire, Zambia.

Type Locality: "in AEliggypto ad ripas Nili, in India primario; mansuescit", restricted by Thomas (1911) to "Egypt".

Diagnosis: Body elongated, covered by grizzled blackish-brown hair. Face a bit darker in colour. Males are larger than females. Ears short and rounded, nearly completely covered by fur. Feet brown or black, palms and soles naked. Tail long with black terminal brush. Two pairs of mammae. Skull elongated, with a long palate. Sagittal and lambdoid crests

very well developed. Tympanic bullae with a distinct division between their two parts. Molars very sharp.

Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 4/4\ m\ 2/2 = 40$.

Remarks: 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 prey. This is a social animal living in family groups; usually the family consists of a male,

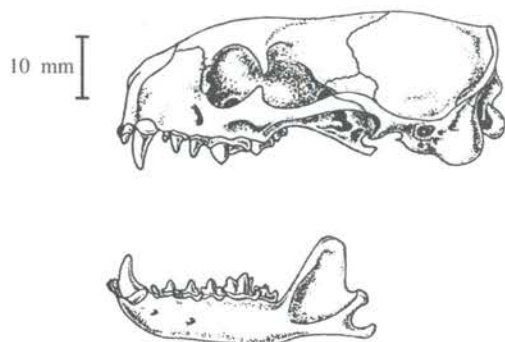


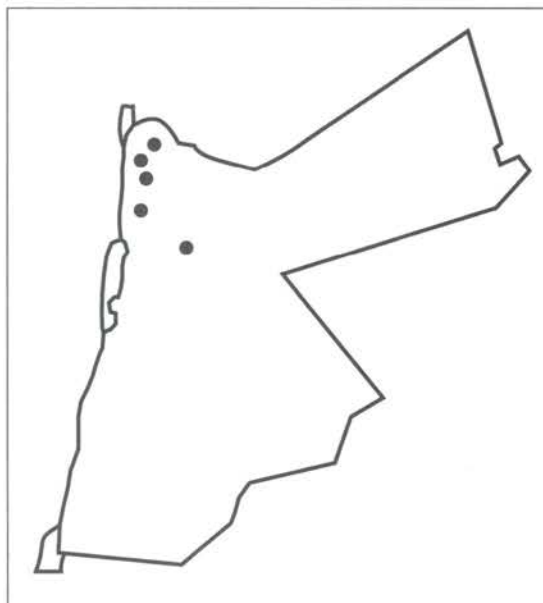
Fig. 19: Skull of *Herpestes ichneumon*. After Harrison (1981).

several females and cubs (Ben Yaacov, 1987). Gestation may last for about two months and 2-3 cubs are born. Families mark their territory using scat and scent.

The Mongoose feeds on a large food spectrum, including plant materials, snails, amphibians, fishes, rodents as well as turtle's

eggs. In northern Jordan, the Mongoose is called as "*Akel Al-Hahya-The Snake eater*". It lives in close proximity to chicken farms and cultivated areas in the Jordan Valley and northern Jordan.

It was collected from the Aqraba area and seen around the Maqarin Dam Station and North Shunah (Amr *et al.*, 1987).



Map 40: Distribution of *Herpestes ichneumon*.

Localities: Jordan Valley, Ayn Ghazal, Aqraba, Maqarin Dam Station, North Shunah.

Family Hyaenidae

Hyaenas have a robust skull with an extraordinary sagittal crest and strong musculature of the lower mandibles. Their teeth show specialized carnassial modifications special-

ized for ripping, shearing and crushing flesh and bones. Occasionally, they also feed on insects, vegetable matter, eggs and birds (Wozencraft, 1989).

Hyaena hyaena (Linnaeus, 1758)

Syst. Nat. 10th ed., 1:40.

Common Name: Striped Hyaena.

Distribution: Afghanistan, Algeria, Egypt, Ethiopia, India, Iran, Iraq, Palestine, Kenya, Libya, Mali, Morocco, Nepal, Nigeria, Pakistan, Saudi Arabia, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, republics of the former USSR, Yemen.

Type Locality: "India", restricted by Thomas (1911:134) to "Benna Mts., Laristan, S. Persia".

Diagnosis: This is the only hyaena in Jordan.

Body grey-whitish covered by black vertical stripes. Muzzle dark. Neck strong and thick. Ears large and rounded above. Dorsum with a long dark mane. Fore limbs longer and stronger than hind limbs. Claws short and non-retractile. Posture due to the less developed hind legs gives an impression of dragging its hind quarters. Two pairs of mammae. Skull large and robust and the braincase is characteristically depressed laterally, with extremely strong developed sagittal crest. Zygomatic arches very massiv. Mandibles short



Felis margarita (Photo: , courtesy of IUCN)



Felis chaus (Photo: D. Shafee)



Caracal caracal schmitzi (Photo: RSCN)



Vormela peregusna (Photo: D. Shafee)



Martes foina (Photo: D. Shafee)



Meles meles (Photo: D. Shafee)



Hyaena hyaena (Photo: D. Shafee)



Procavia capensis syriaca (Photo: L. Rifai)



Sciurus anomalus (Photo: A. Shihab)



Hystrix indica (Photo: D. Shafee)



Eliomys melanurus (Photo: D. Modry)



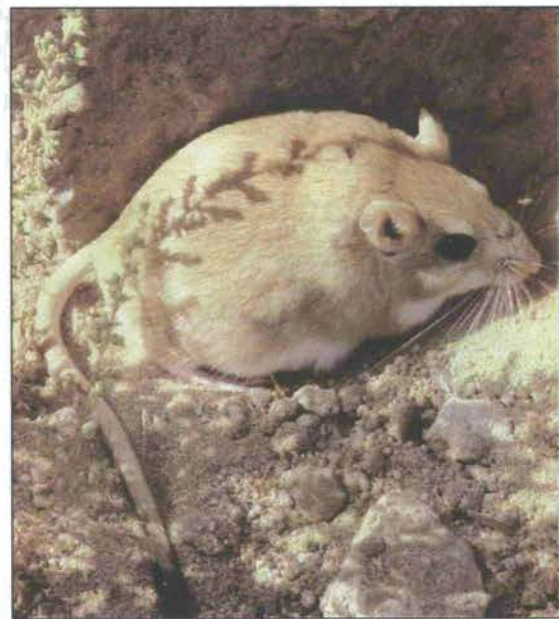
Jaculus jaculus (Photo: Kuwait Natural History)



Allactaga euphratica (Photo: A. Searight)



Nannospalax leucodon (Photo: M. Qumsiyeh)



Meriones libycus (Photo: Kuwait Natural History)

and massive. First upper premolar short and without function, lower first premolar absent. Carnassials set back for maximum efficiency, with upper ones extremely powerful.

Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 4/3\ m\ 1/1 = 34$.

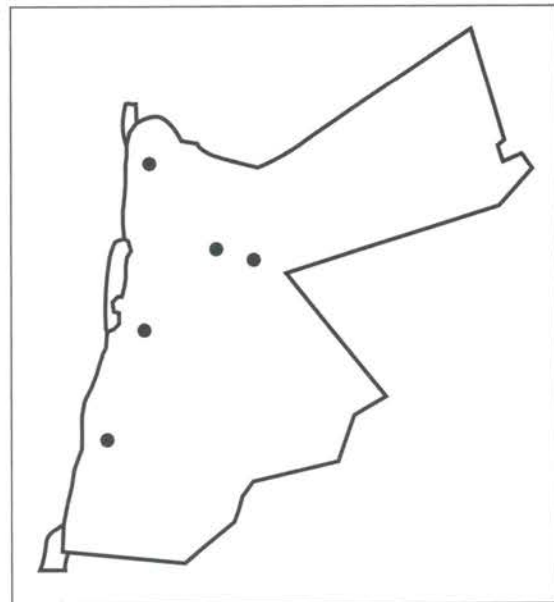
Remarks: The Striped Hyaena is known as a solitary carnivore and is rarely seen in groups, in contrast to the Spotted Hyaena. They could be found in all habitats of Jordan, with preference to dry deserts with caves. The home range may reach up to about 61 km² (Van Aarde *et al.*, 1988). The female hyaena may give birth to 1-5 pups. Sometimes she eats her young.

This is one of the most common carnivores in Jordan. Hyaenas 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.

I personally examined a den in Wadi Arabah. The den was located in a cave close to steep mountainous region. The cave had several tunnels with two exits. Skull remains of camels, donkeys, sheep, dogs and young ibexes were recovered. At this cave, a single hyaena was observed. Kerbis-Peterhans & Horwitz (1992) found that caprines, dogs, camels and donkeys were the most food item recovered from a hyaena's den respectively. He also recovered remains of several other mammals including a human. Macdonald (1978) gave an excellent account on the territorial behaviour and ecology of the Striped

Hyaena. Bouskila (1985) studied the social relations and behavioural patterns of the Striped Hyaena, including scent rubbing, gathering and transmitting information and aggression.

Many superstitions are associated with hyaenas. The locals strongly believe that hyaenas can hallucinate a person and then will guide the victim to its den and feast on him afterwards. Others believe that hyaenas can reverse sex after a certain age. More pressing is that eating parts of the hyaena will bring manhood and courage to men.



Map 41: Distribution of *Hyaena hyaena*.

Localities: Al Qatranah, Ash Shawmari, Azraq, Ishtafayna, Wadi edh Dhuleil, Wadi Fidan.

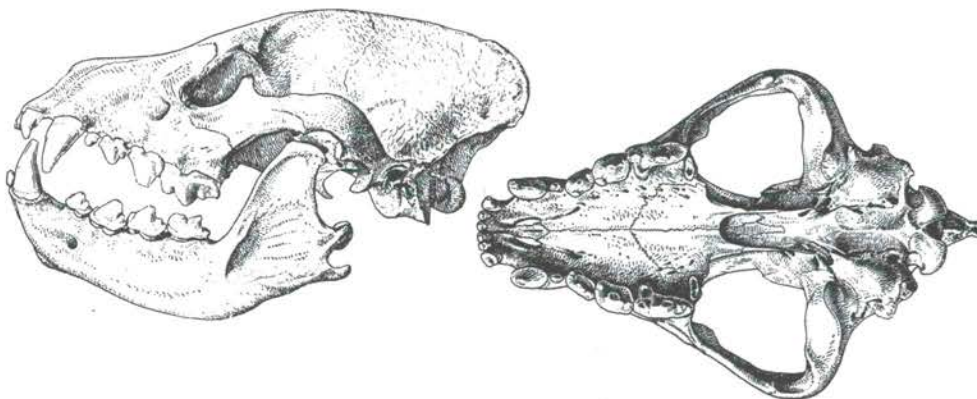


Fig. 20: Lateral and ventral views of *Hyaena hyaena* skull. After DeBlase & Martin (1974).

Family Mustelidae
Martens, Otters, Badgers Polecats and Weasels

Species of family Mustelidae are typically long, thin bodied carnivores. They are active hunters and spend much of their activity searching for food. Some mustelids developed an extraordinary reproductive strategy, where implantation is delayed until certain external environmental conditions are met.

Species of family Mustelidae are typically long, thin bodied carnivores. They are active hunters and spend much of their activity searching for food. Some mustelids developed an extraordinary reproductive strategy, where implantation is delayed until certain external environmental conditions are met.

Mustelids inhabits a wide variety of ter-

This family is represented in five species belonging to five different genera (*Lutra*, *Martes*, *Vormela*, *Mellivora*, and *Meles*).

Key to Family Mustelidae

- 1. Toes surrounded by web adapted for swimming *Lutra lutra*
Toes not surrounded by web 2
- 2. Small, body length not more than 350 mm 3
Large, body length more than 350 mm 4
- 3. Dorsum brown, head brown *Martes foina*
Dorsum brown with yellow spots, head with a white stripe *Vormela peregusna*
- 4. Face black, white hair extends from end of the head to tail *Mellivora capensis*
Face white with black around the eyes and ears, dorsum completely black *Meles meles*

***Lutra lutra* (Linnaeus, 1758)**

Syst. Nat., 10th ed., 1:45.

Common Name: European Otter.

Distribution: Eurasia (excl. tundra and desert): Afghanistan, Albania, Algeria, Austria, Bangladesh, Belgium, Bulgaria, China, Czechoslovakia, Denmark, England, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Iraq, Ireland, Palestine, Italy, Japan, Jordan, Korea, Laos, Lithuania, Malaysia, Mongolia, Morocco, Norway, Pakistan, Poland, Portugal, Scotland, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Tunisia, Turkey, republics of the former USSR, Vietnam, and the former Yugoslavia.

Type Locality: "Europaelig aquis dulcibus, fluviis, flagnis, piscinis," subsequently restricted by Thomas(1911) to "Upsala" [Sweden].

Diagnosis: Body slender and adapted to a semi-aquatic life style. Males are larger than females. Muzzle short and broad. Neck not very distinct. Ears very small. Claws are short and non-retractile. Limbs short with extensive webs in between digits. Palms and soles naked. Fur colour greyish brown to brown. Fur short and dense, with a water proof undercoat. Tail very muscular and thick at base and pointed towards end. Two pairs of mammae. Skull broad and flattened from above, with a

very depressed braincase. Tympanic bullae small and flattened. Mandible with wide condyles. Upper incisors in a straight row, third upper incisors very powerful. Upper canine very powerful, first upper premolar minute or missing. Lower canine short but powerful and curved.

Dental formula: i 3/3 c 1/1 pm 4/3 m 1/2 = 36.

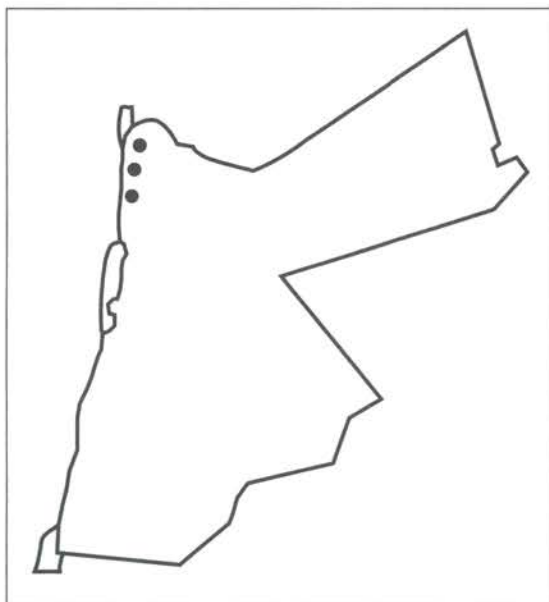
Remarks: The presence of otters is dependent on continuous flow of fresh water streams or rivers. Since permanent freshwater bodies are limited in Jordan, the otters have a very limited distribution along the Jordan and Yarmuk rivers. Associated vegetation close to their burrows, which are located on the bank of the river, includes *Arundo donax* and *Phragmites australis* (Macdonald *et al.*, 1986).

Otters are excellent swimmers and are adapted to live in aquatic environments. They use their vision during daytime to avoid obstacles and detect their way, while there are sensory structures at the base of their whiskers that help them to navigate during night time. Otters can breed throughout the year producing one litter. Cubs reach sexual maturity after one year. An otter's territory is defined by secretions from the anal glands on rocks or hard objects close to its habitat. The diet consists

of fish, water invertebrates and small mammals and birds (Yom-Tov, 1986).

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 Yarmuk rivers after Israel diverted the water courses of several side tributaries of the River Jordan, otter's population were reduced to the lowest level.

It was observed in the upper reaches of the River Jordan and the Yarmuk River. 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.



Map 42: Distribution of *Lutra lutra*.

Localities: Jordan and Yarmuk Rivers.

***Martes foina* (Erxleben, 1777)**

Syst. Regni Anim., 1:458.

Common Name: Stone Marten.

Distribution: Europe, Asia Minor, Iran and extends into northern India to China and Mongolia.

Type Locality: "Europa inque Persia", listed by Miller (1912) as "Germany."

Diagnosis: Slender and medium-sized mustelid. Ears large. Muzzle thin and pointed. Pads on palms naked, else haired. Fur colour brown except the whitish throat. Tail long, with bushy hair. Skull elongated and slender with weakly developed cranial ridges. Tym-

panic bullae moderately inflated. Upper incisors in a straight row. Upper canine very strong, with ridges anteriorly and posteriorly.

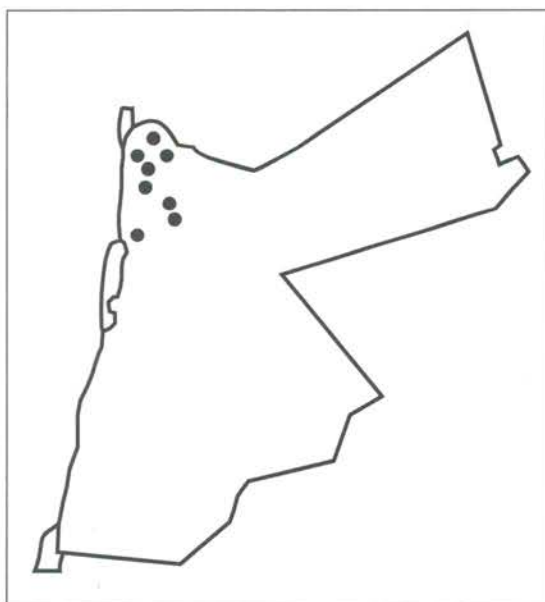
Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 4/4\ m\ 1/2 = 38$.

Remarks: The Stone Marten is a rare animal. It is mostly associated with fertile and wooded parts of the Mediterranean ecozone. 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 1950's.

It seems that in Jordan the animal's population is declining and restricted to the rocky mountains of the north. This is based on the lack of specimens or field observations from the Mediterranean mountains or plains near Wadi as Sir and its vicinity, from where Nehring (1902) described this subspecies.

Villagers consider the Stone Marten as a



Map 43: Distribution of *Martes foina*.

destructive animal that attacks chicken coops and is under continuous attack. Most of the collected specimens of *M. f. syriaca* at Jordan Natural History Museum (JNHM) were found either shot or poisoned. Two specimens from the Jarash area were found road-killed. 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. Perhaps the scattered pine and oak forests in Jarash and Ajlun represent the last refuge for this handsome animals (Al-Shafee *et al.*, 1997).

Localities: Ajlun, Al Mazar, Dayr Abu Sai'd, Bayt Yafa road, Jarash-Amman road, Juhfiyah, Kufr Kifiya, Thaghrat Asfour, Wadi Aqraba, Wadi as Sir, Wadi al Kafrayn.

***Meles meles* (Linnaeus, 1758)**

Syst. Nat., 10th ed., 1:48.

Common Name: Eurasian Badger.

Distribution: Scandinavia to S Siberia, south to Palestine; Iraq; China, Korea, and Japan; and on Ireland, Britain, Crete, and Rhodes.

Type Locality: "Europa inter rimas rupium et lapidum," restricted by Thomas (1911) to "Upsala" [Sweden].

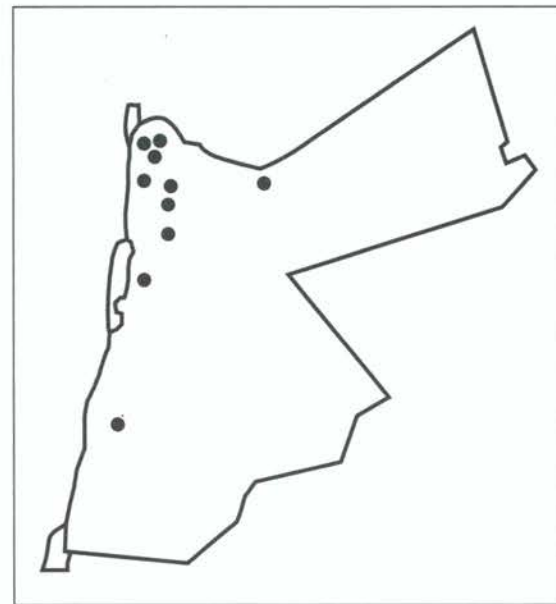
Diagnosis: Large, heavily build mustelid. Males are larger than females. Ears small. Face white with a black stripe through eyes and extending to ears. Fur coarse and long, colour brown to buff grey dorsally, ventral surface including feet black. Feet short and robust, with long claws. Tail very short, covered with hairs. Three pairs of mammae (2 abdominal, 1 inguinal). Skull large and elongated, with an elongated braincase. Zygomatic arches strong and massive. Sagittal crest very well developed. Lachrymal process well developed. Palate elongated and narrow. Tympanic bullae weakly inflated. Upper incisors form in a curved row. Upper canine with anterior and posterior ridges. First upper premolar minute, lying close between canine and second upper premolar. Lower incisors small. Lower canine with anterointernal ridge. First lower premolar minute.

Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 4/4\ m\ 1/2 = 38$.

Remarks: The Eurasian Badger prefers to colonize 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 metre under the surface. Badgers dig their burrows using

their strong claws leaving behind a large pile of excavated soil (Lewis *et al.*, 1968). Its diet includes rodents, reptiles and terrestrial arthropods as well as vegetable materials. Females produce 2-4 young.

This species was reported from Suwaylih area (Clarke, 1977), Aqraba (Amr *et al.*, 1987) and several localities in northern Jordan (Amr & Disi, 1988). Bodenheimer (1935) indicated its presence in the upper Jordan Valley. Jordan represents the southern limit of the badger.



Map 44: Distribution of *Meles meles*.

Localities: Wadi al Mawjib, Aqraba, Dana Nature Reserve, Harta, Irbid, Marw, Suwaylih.

***Mellivora capensis* (Schreber, 1776)**

Die Säugethiere, 3(18):pl. 125[1776]; text, 3(26):450[1777].

Common Name: Ratal, Honey Badger.

Distribution: Savanna and steppe from Nepal, E India and Turkmenistan west to Lebanon, south of the Mediterranean to South Africa.

Type Locality: "Vorgebirge der guten Hoffnung" [South Africa, Cape Prov., Cape of Good Hope].

Diagnosis: Large and robust mustelid. Males larger than females. Ears very short, almost completely covered by the fur. Fore limbs equipped with very strong digging claws. White hair across dorsal surface, ventral surface black, with a very well defined line of de-

marcation. Tail short, but longer than that of *Meles*. Two pairs of mammae (inguinal). Skull large, with a short and wide rostrum and a broad braincase. Lachrymal process not present. Zygomatic arches slender. Sagittal crest not very well developed. Palate short and broad. Tympanic bullae strongly inflated. Upper premolar powerful. Molar small.

Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 3/3\ m\ 1/1 = 32$.

Remarks: The Honey Badger inhabits a wide

the dead.

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

Localities: Aqraba, Azraq, Irbid, Jordan Valley, Mursi'.

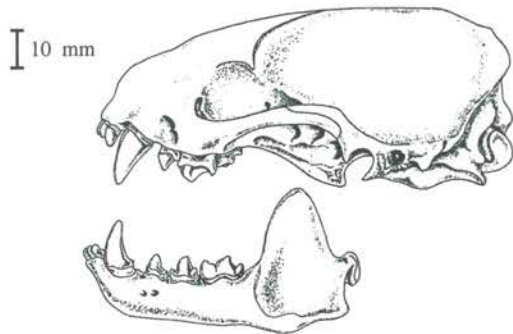
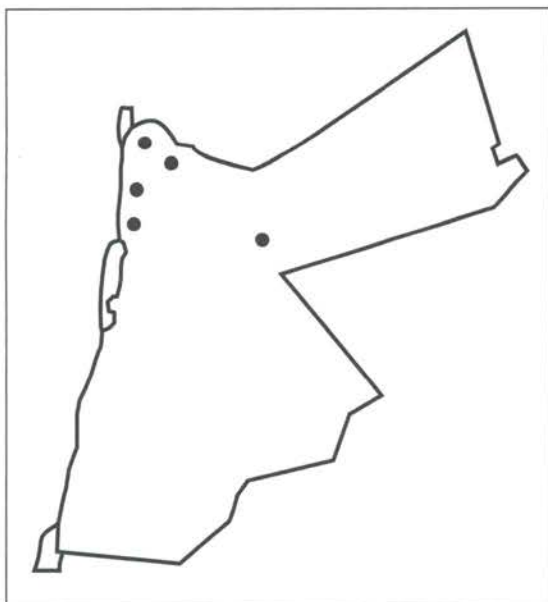


Fig. 21: *Mellivora capensis*. After Harrison (1981)

variety of environments including semi deserts, dry and Mediterranean habitats. It feeds on small mammals, reptiles, birds and arthropods (Gasperetti *et al.*, 1985).

The Bedouins believe that the "Siltah" is a dangerous animal that digs graves and drags



Map 45: Distribution of *Mellivora capensis*.

***Vormela peregusna* (Güldenstädt, 1770).**

Nova Comm. Imp. Acad. Sci. Petropoli, 14 (1):441.

Common Name: Marbled Polecat.

Distribution: Steppes and deserts of SE Europe, Caucasus, Kazakhstan, Middle Asia; SW Asia (excl. Arabia); N China and S Mongolia.

Type Locality: "habitat in campis apricis desertis Tanaicensibus".

Diagnosis: Small and slender mustelid. Head with a white stripe across, on top of eyes. Ears short and rounded, with hair on their upper margins. Back a mixture of dark brown, brown and yellow. Anal glands present. Tail thick and bushy, terminating with dark brown brush. Six pairs of mammae present (4 abdominal, 2 inguinal). Skull small with well developed cranial ridges. Rostrum short. Tympanic bullae placed distinctively far forward and well inflated. Palate short and broad. Sagittal crest well developed. Very powerful upper canines with a medial groove. A distinct metaconid is present on the lower carnassial.

Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 3/3\ m\ 1/2 = 34$.

Remarks: Harrison (1968) noted that a specimen was collected from As Salt, while Kock (1983) identified records of this species from Wadi Fauwar (Wadi al Jarrah), southeast the Dead Sea. Many villagers in the North especially around the Yarmuk River basin have indicated the presence of this species. 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 were it was observed. Kock (1983) discussed the distribution of the Marbled Polecat in the Middle East. Its distri-

bution extends from southern Turkey, across Syria and Lebanon, to southern Jordan and Palestine, and further east to Iraq and Iran.

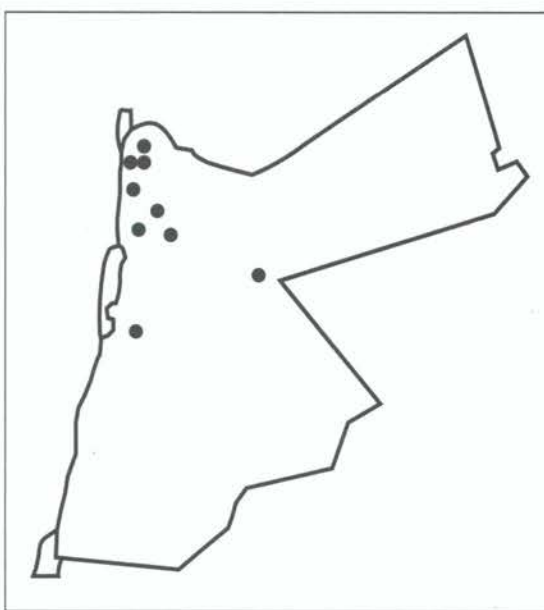
Despite the continuous changes in the natural habitats of Jordan, the distribution of the Marbled Polecat expanded. Perhaps extensive chicken farming country-wide and agricultural expansion allowed this mustelid to proliferate. As indicated from the localities, *V. peregusna* is distributed along the Mediterranean biotope and invaded parts of the Irano-Turanian steppes. We have verbal records and personal observations from Al Mafraq and Umm 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. A similar observation was reported in Wadi Arabah and An Naqb desert, where the Marbled Polecat expanded its range into desert habitats (Anon, 1986; 1991; Ilani, 1987).

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).

Little is known on the diet or the breeding season for this species. However, the lo-

calcs indicated that it feeds on small birds as well as rodents. In Pakistan, Roberts (1977) suggested that breeding occurs in spring, where 3-4 young are born in late March to early April. Our observations suggest that young are born in March through June, with a litter size reaching five.

The IUCN considered the Marbled Polecat as a vulnerable species. This indicates the urgent need to protect this animal. Such efforts should be implemented through law enforcement, since all carnivores in Jordan are considered locally threatened.



Map 46: Distribution of *Vormela peregusna*.

Localities: Al Barisah, Al Mafraq, At Tayyibah, Azraq, Baq'a, Kharja, Mutah, Qastal, Samma', Umm al Hiran, Umm al Jimal, Wadi as Sir, Waqqas.

Order Hyracoidea

This order is an ancient group and it is believed that it originated from a primitive ungulate stock (Harrison & Bates, 1991). This is an African group that extended into the

southern part of the Middle East. In Jordan, this order is represented by a single species, *Procavia capensis*, of the family Procaviidae.

Procavia capensis (Pallas, 1766)

Misc. Zool., p. 30.

Common Name: Common Rock Hyrax.

Distribution: Syria; Lebanon; Turkey; Palestine; Saudi Arabia; Yemen; NE Africa; Senegal to Somalia to N Tanzania; S Malawi to S Angola, Namibia and South Africa; isolated mountains in Algeria and Libya.

Type Locality: South Africa, Cape Prov., Cape of Good Hope.

Diagnosis: Fur dark brownish-yellow, with a distinct pale spot on the dorsum (surrounding the dorsal scent gland), which is characteristic for the subspecies. Neck short. Ears short. Hind foot with three toes, fore foot with four

It is associated with rocky areas with steep edges. Current populations are found in Wadi Ramm, Ghawr as Safi, and most common in Al Adasiyah, overlooking the Yarmuk River.

The Hyrax is a colonial animal. A large colony with over 50 individuals was monitored in Al Adasiyah. The Hyrax feeds on *Retama raetam*, *Aster subulatus*, *Ziziphus spina-christi*, and *Calycotome villosa*. Hyraxes are generalist herbivores and feed on leaves, or buds, stems and fruits. Two adults usually guard 5-6 young individuals. They are active during daytime, where they sit on stones in groups and get very close to the river to drink. Details on its behaviour, breeding and biology are summarized by Olds & Shoeshani (1982). This species was reported from the Mu'ab mountains by Hahn (1934). Gasperetti (1978) reported on the hyrax from Saudi Arabia and gave an account of its distribution and biology.

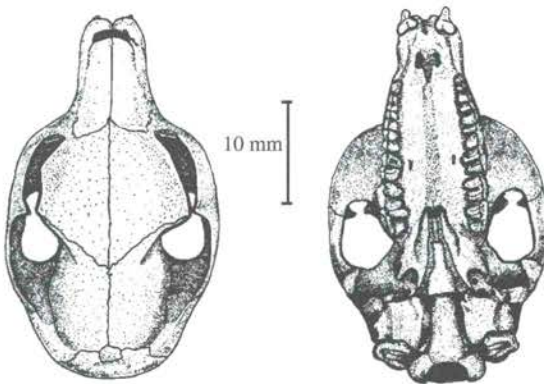
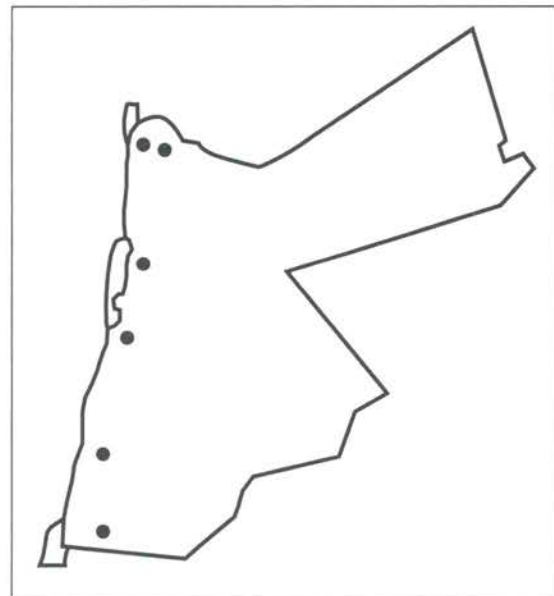


Fig. 22: Dorsal and ventral views of *Procavia capensis* skull. After Osborn & Helmy (1980)

toes, toes with black nails. Third internal digit on hind foot is equipped with a curved nail. Tail absent. Three pairs of mammae. Skull robust, with a flattened and wide interorbital region. Very weak developed sagittal crest. Tympanic bullae small. A very distinctive feature is the tusklike upper incisors (larger in males) and a unique wide mandible, greatly enlarged with plate-like angular regions. Upper incisors are pointed and triangular in cross section and far apart from the premolars. The upper premolars and molars are alined in a very tight row, increasing backwards slightly in size.

Dental formula: $i \ 1/2 \ c \ 0/0 \ pm \ 4/4 \ m \ 3/3 = 34$.

Remarks: The Hyrax is an agile rock climber.



Map 47: Distribution of *Procavia capensis*.

Localities: Al Adasiyah, Al Hammah, Dana Nature Reserve, Ghawr as Safi, Mu'ab mountains, Wadi Ramm.

Order Artiodactyla Even-toed Ungulates

This order includes either the two or four hoofed toes animals on each foot. In Jordan, the Even-toed Ungulates are grouped into two families (Suidae and Bovidae) based on teeth arrangements and structure, structure of the

stomach and feet, and the presence or absence of horns. Species of this order are strictly herbivores. They feed on a wide spectrum of vegetation. Upper canines and incisors are absent.

Family Suidae

Species of family Suidae have a simple stomach. The teeth are adapted for crushing, and the horns are absent. The Wild Boar is

the only species representing this family in the Middle East.

Sus scrofa Linnaeus, 1758

Syst. Nat., 10th ed., 1:49.

Common Name: Wild Boar.

Distribution: N Africa; Europe, S Russia and China south to Middle East, India, Sri Lanka, and Indonesia (Sumatra, Java east to Bali and Sumbawa Isls). Extinct in British Isles and Scandinavia.

Type Locality: Germany.

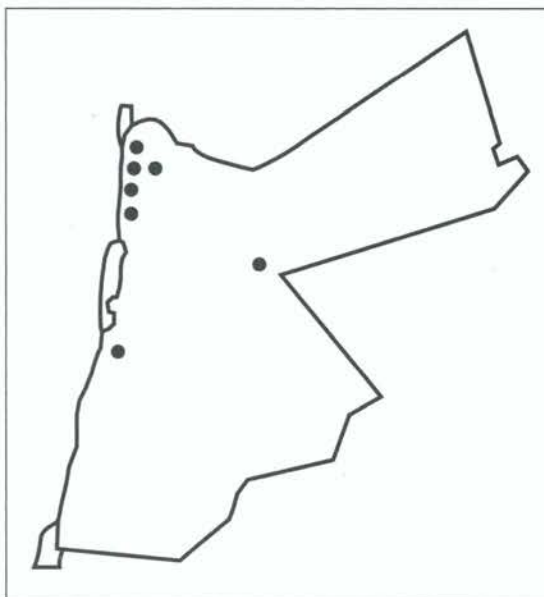
Diagnosis: Large, shoulder height up to 90 cm. Males larger than females. Forehead strong and elongated. Muzzle long and elongated, snout muscular, broad and flattened in front. Large ears covered with soft bushy hair. Tail short, covered with hairs. Feet with four well developed toes. Fur bristly and colour brown-greyish to blackish. Skull characteristically elongated and narrow. Braincase short. No sagittal crest. Canines long and continuously growing. Anterior part of mandible is extended, supporting the large canines. The upper canines form tusks curving outwards and upwards and are conspicuously larger in males. Lower canines also quite powerful in males, also curving upwards and outwards and a bit backwards at its tips. Large gap between the first premolar and molars in the mandible.

Dental formula: $i\ 3/3\ c\ 1/1\ pm\ 4/4\ m\ 3/3 = 44$.

Remarks: This is the only wild boar in Jordan. 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. It is a rather common species distributed through out the Jordan and Yarmuk Rivers basins. The Wild Bore is a pest in the citrus and vegetable farms of the Jordan Valley. It has been seen on many occasions around North Shunah and along the

Yarmuk River. During a survey conducted in 1982, 1193 wild boars attacked citrus farms along the Jordan Valley (Rahamat, 1982).

According to Meinertzhagen (1924) and Clarke (1977), *S. scrofa* was introduced and used to be common at Azraq, but disappeared recently. The Wild Boar was seen in Zubiya and Ba'un (Ajlun area), and along the Jordan



Map 48: Distribution of *Sus scrofa*.

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).

Localities: Azraq, Ba'un, Dayr Abu Sai'd, Jordan River, Jordan Valley, North Shunah, Yarmuk River, Zubiya.

Family Bovidae

Species of family Bovidae have rasping cheek teeth and the upper incisors are absent. Each foot has two or four hoofed toes. The stomach is complex and consists of several parts. Horns or antlers are present in most

species. This family is represented by five species belonging to three genera (*Capra*, *Gazella* and *Oryx*). In Jordan, all bovids are threatened and some are on the verge of extinction.

***Capra ibex nubiana* F. Cuvier 1825**

In E. Geoffroy and F. Cuvier, *Hist. Nat. Mam-mifères*, pt. 3, 6(50):2 pp.

Common name: Wild Goat, Nubian Ibex.

Distribution: Egypt east of the Nile, NE Sudan, and Syria south to Yemen and east to Oman.

Type Locality: Egypt, "Upper Egypt".

Diagnosis: Large goat-like animal, shoulder height up to 85 cm. Males with blackish beards and they are larger than females. Long, backwards hooked horns, with ridges across. Horns in females much smaller and smoother. Tail shorter than ear, with a black terminal tuft. Muzzle hairy. Fur colour dorsally brownish, with characteristic black and white markings on legs and white on ventral side. Skull robust, with a large and inflated braincase. Orbital region broad. Base of horn located above the orbits. Cross section of horns ovoid in shape and widest anteriorly.

Dental formula: $i\ 0/3\ c\ 0/1\ pm\ 3/3\ m\ 3/3 = 32$.

Remarks: 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. Specimens are available at the Jordan University Natural History Museum (JUMNH) collected from near Al Mazar in 1981, Ghawr al Mazra' in 1983, and a live specimen from At Tafilah was kept at Shawmari Wildlife Reserve (Amr & Disi, 1988). A specimen from the latter locality (collected in the late 1980's) is at the JNHM. Other sightings include Wadi Ben Hammad (Al Karak) and Wadi Rumm in 1992. Adult males were observed in the Dana Nature Reserve (Catullo *et al.*, 1996). Details on the Ibex population composition, various aspects of behaviour and conservation are given by Habibi (1994).

Localities: Al Mazar, At Tafilah, Dana, Ghawr al Mazra', Wadi Arabah, Wadi Ben Hammad, Wadi Ramm.

***Gazella dorcas* (Linnaeus, 1758)**

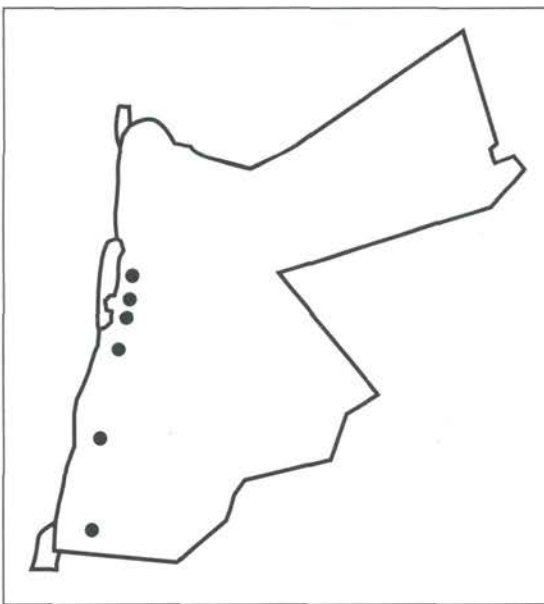
Syst. Nat., 10th ed., 1:69.

Common Name: Dorcas Gazelle.

Distribution: Morocco south to Mauritania (and formerly to Senegal) east to S Palestine and Egypt and from there south to Sudan, NE Ethiopia and N Somalia.

Type Locality: Lower Egypt.

Diagnosis: Small gazelle, shorter than the other gazelles. Males are larger than females. Horns of males are long and straight, but both sexes with well developed horns and annuli. Horns posteriorly with two grooves, in cross section ovoid in shape, and narrower anteriorly. Ears are very long, reach nostrils when laid forward. Posterior margin of nasals triangular in shape. Tail with dark streaks. Fur colour brownish red dorsally with facial markings, and white ventrally, flankstripes faint. Facial markings consist of dark stripes extending from the posterior mouth opening to the eye and a dark broad stripe extending from nasals to bases of horns, else facial colour whitish. Premaxillae long and in touch with

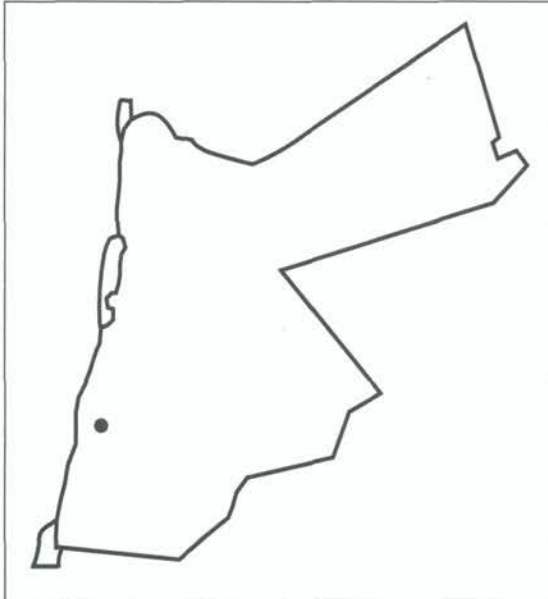


Map 49: Distribution of *Capra ibex nubiana*.

nasals, nasal bones narrow. Nasals widest anteriorly. Fenestrae of infraorbital fossa not present. Parietal ridges present.

Dental formula: $i\ 0/3\ c\ 0/1\ pm\ 3/3\ m\ 3/3 = 32$.

Remarks: Few specimens of this species were seen in the Wadi Arabah area. A male and female were found dead near Wadi Faynan during 1980-1981. The Dorcas Gazelle is includ-



Map 50: Distribution of *Gazella dorcas*.

ed in the list of protected species in Jordan.

Localities: Wadi Faynan.

***Gazella gazella* (Pallas, 1766)**

Misc. Zool., p. 7.

Common Name: Palastine Mountain or Common Arabian Gazelle.

Distribution: Syria, Palestine, Lebanon, Arabian Peninsula.

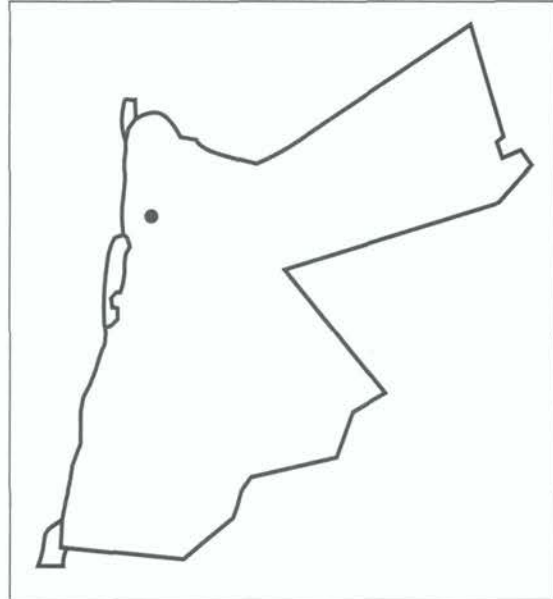
Type Locality: Syria.

Diagnosis: Larger gazelle, very slender. Horns short with a wide gap and strongly curved. Horns of females much shorter, very slender and with weak annulation markings. Anterior side of horns with a single groove. Ears short, by far not reaching nostril when laid forward. Height of shoulders more than 60 cm. Posterior margin of nasals round in shape. Small black hair tufts are present at anterior side of hooves. Tail short and black in colour. Fur colour pale reddish brown dorsally, ventral side pure white. Facial markings present, similar to that of *G. dorcas*. Premaxillae do not extend beyond the first upper pre-molar and are not in touch with the nasals. Nasals widest posteriorly. Fenestrae of infraorbital

fossa not present. Parietal ridges absent.

Dental formula: $i\ 0/3\ c\ 0/1\ pm\ 3/3\ m\ 3/3 = 32$.

Remarks: A specimen was killed in the Salt mountains in summer 1986. Tristram (1866) observed it in the forests of Gilead.



Map 51: Distribution of *Gazella gazella*.

Localities: Salt mountains.

***Gazela subgutturosa* (Güldenstädt, 1780)**

Acta Acad. Sci. Petropoli, for 1778, 1:251 [1780].

Common Name: Goitered or Arabian Sand Gazelle.

Distribution: Palestine; Jordan, C Arabia and E Caucasus through Iran; Afghanistan; WC Pakistan; Kazakhstan; Turmenistan; Uzbekistan; Mongolia; W China.

Type Locality: Azerbaijan, Steppes of E Transcaucasia.

Diagnosis: Large heavy build gazelle with a rather short black tail. Males with a conspicuous swelling around the throat. Ears short. Females either hornless or with very short, slender horns. Males with long annulated horns, lyrate and close together at base. Facial colour white, with a faint facial stripe going from the anterior of the eyes to the muzzle. Fur colour dorsally light clay brown, ventral white, with indistinct flank stripes. Skull robust, distinctively large in size and with a large orbital width. Nasals in contact with premaxillae.

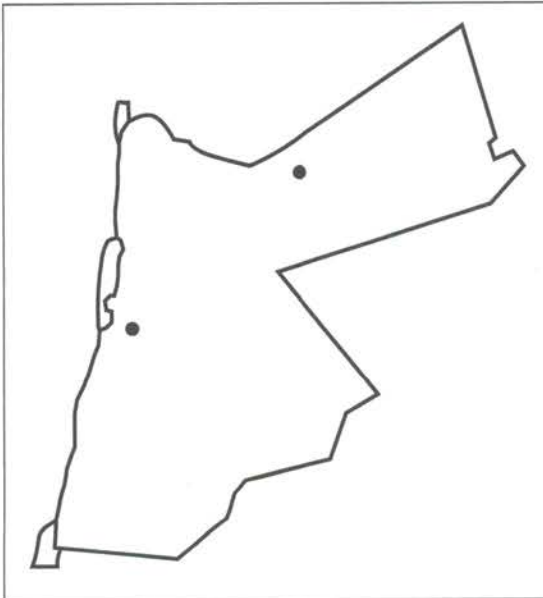
Dental formula: $i\ 0/3\ c\ 0/1\ pm\ 3/3\ m\ 3/3 = 32$.

Remarks: Goitered Gazelles inhabit all types of desert and arid habitats, including sand

dunes, however, they avoid rocky cliffs, thick vegetation and cultivated or grazed areas (Kingswood & Blank, 1996). This gazelle feeds on a wide variety of vegetation including *Alhaji*, *Astragalus*, *Nitraria*, *Tamarix* and many other grasses (Kingswood & Blank, 1996). Details on its population structure, behaviour and ecology are given by Kingswood & Blank (1996).

Male Goitered Gazelles are territorial during the reproductive season. At other times of the year, herds of 50-100 animals are the usual. Mating usually occurs around December and one or two young (occasionally three or four) are born (Kingswood & Blank, 1996).

A skull was collected from H-5 in 1950. Dr. Müller collected a skull from Qa' Dhuweila during September 1983. Clarke (1977) noted that a specimen was taken from Qatranah.



Map 52: Distribution of *Gazella subgutturosa*.

Localities: Qa' Duwaylah, Qatranah, Ar Ruwayshid.

***Oryx leucoryx* (Pallas, 1777)**

Spicil. Zool., 12:17.

Common Name: Arabian Oryx.

Distribution: SE Arabian Peninsula; formerly Iraq. Probably became extinct in the wild, but maintained in captivity, and recently reintroduced into Arabia.

Type Locality: Arabia.

Diagnosis: Body covered with white hair. Face with characteristic, black markings. Legs long and black with white patches just before the dark, broad hooves. Horns very long and thin and only very slightly curved, in both sexes. Horns rounded in cross section. Skull large and massive, with a distinctive short braincase and a long rostral region. Molars robust and hypsodont.

Dental formula: i 0/3 c 0/1 pm 3/3 m 3/3 = 32.

Remarks: Sometime between the first and second World Wars, the populations of the Oryx were decimated in the Arabian and Syrian deserts. This was accomplished by massive mechanized shooting especially near the newly discovered oil fields (Qumsiyeh *et al.*, 1996). The Oryx was observed in the 1930's from southern Jordan by Dollman & Burlace (1935). The Schmitz collection contains specimens from Jordan (Anon., 1946). 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 Qatranah in the 1920's. 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 end of 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 habitats included hameda deserts as well as wadis, sandy deserts, and plateaux (Qumsiyeh *et al.*, 1996). 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 Hatough & El-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 present. Hares are very common all throughout the world, especially species of the genus *Lepus*. They are exclusively herbivorous and can be found in varied habitats, including deserts, mountains as well as sandy deserts.

Lepus capensis Linnaeus, 1758.

Sys. Nat., 10th ed., 1:58.

Common Name: Cape Hare, Arabian Hare.

Distribution: Africa in two separate, non-forested areas: South Africa, Namibia, Botswana, Zimbabwe, S Angola, S Zambia (?), Mozambique; and to the north, Tanzania, Kenya, Somalia, Ethiopia, countries of the Sahel and Sahara, and N Africa; thence eastward through the Sinai to the Arabian Peninsula, Jordan, S Syria, S Palestine and W and S Iraq, west of the Euphrates River.

Type Locality : "ad Cap. b. Spei" [South Africa, Cape of Good Hope].

Diagnosis: Ears long with black tips. Feet covered with dense brushes of hair that nearly

nearly horizontal median parts. No sagittal crest. First upper incisor pro-odont with a deep groove anteriorly. Second upper incisor minute. Molars without roots.

Dental formula: $i\ 2/1\ c\ 0/0\ pm\ 3/2\ m\ 3/3 = 28$.

Remarks: Most of the previous collections of this species were made from the Jordanian desert (including Azraq and Al Jafr) (Atallah, 1967a, 1967b, Searight, 1987). This is a common desert species feeding on shrubs and vegetation. We encountered many road kills along the Amman-Aqabah highway and Al Mafraq.

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

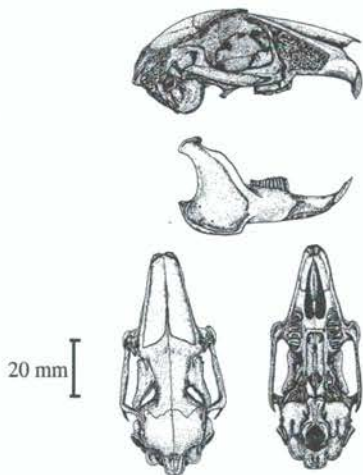
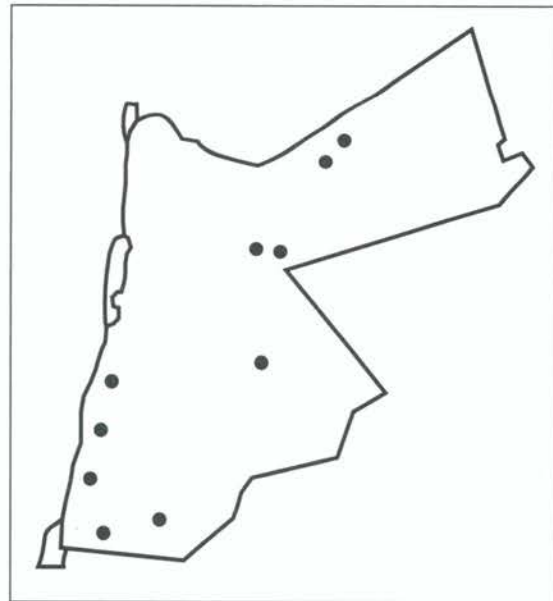


Fig. 23: Lateral, dorsal and ventral views of *Lepus capensis* skull. After Osborn & Helmy (1980).

cover the claws. Five digits on fore feet and four on hind feet. Tail short with tuft, colour dark dorsally and white ventrally. Hair around the eyes white. Body with dense and soft fur, colour grey to grey-brown, underside white, neck and chest ventrally with a wide brown band. Skull slender, with a small braincase. Zygomatic arches characteristically with



Map 53: Distribution of *Lepus capensis*.

Localities: Azraq, Ash Shawmari, Ba'r, Qasr Burqu, Safawi, Wadi Arabah, Wadi Ramm.

Order Rodentia

The original name of this order "Rodentia" is derived from the Latin, which means gnawing animals. Rodents are by far the largest mammalian order, including over 1700 species world-wide. The most unique feature of this order is the reduction of the incisors to one on each side in the upper and lower jaws, and the absence of canines.

Most of the Jordanian rodents are relatively small in size, with the exception of the Indian Crested Porcupine and the Persian Squirrel. The rodents of Jordan are represented in seven families (Spalacidae, Hystricidae, Sciuridae, Dipodidae, Gliridae, Cricetidae and Muridae) with 17 genera and 25 species.

Species of this order are diverse, inhabit-

ing a wide variety of habitats, ranging from extremely arid to mountainous and cold environments. The majority of rodents are nocturnal or crepuscular; however, some are strictly diurnal (e.g. squirrels). The diet of most rodents consists of vegetation, but a few species feed on insects or land snails. They have enormous reproductive abilities, expressed in the number of new borns, brief gestation periods and a short maturation age.

This order includes several species of economic importance, since they are considered as agricultural pests, inflicting severe damage to crops. It also includes species that are known to serve as reservoir hosts for zoonotic diseases (e.g. Leishmaniasis and Bubonic Plague).

Key to Order Rodentia

1. Eyes and ear's pinna absent Family Spalacidae
Eyes and ear's pinna present 2
2. Body covered with long spines (more than 150 mm). Large forms Family Hystricidae
Body not covered with long spines, small to medium sized forms 3
3. Tail very thick and bushy Family Sciuridae
Tail not as above 4
4. Hind foot long, about 60 mm in length Family Dipodidae
Hind foot not long, about 40 mm in length 5
5. Cheekteeth 4, black stripe passes through the eye Family Gliridae
Cheekteeth 3, no black stripe passes through the eye 6
6. Cheekteeth tuberculate in two longitudinal rows Family Cricetidae 7
Cheekteeth tuberculate in three longitudinal rows Family Muridae
7. Cheek pouches present. Tail not more than 40 mm in length Subfamily Cricetinae
Cheek pouches absent. Tail more than 60 mm in length 8
8. Ears short. Tail not more than 65 mm in length Subfamily Microtinae
Ears medium. Tail more than 100 mm in length Subfamily Gerbillinae

Family Sciuridae

About 250 species of squirrels have been described worldwide. Three basic types of squirrels are known according to their habitat; flying squirrels, tree squirrels and ground

squirrels. Squirrels are characterized by their flat and bushy tails. Their hind feet are equipped with five digits. This family is represented by one species in the Middle East.

***Sciurus anomalus* Gldenstdt, 1785**

In Schreber, Die Sugeth., 4:781.

Common Name: Persian Squirrel.

Distribution: Turkey, Transcaucasia (Armenia, Azerbaidzhan, Georgia), N and W Iran, Syria, Lebanon, Palestine.

Type Locality: Sabeka, 25 km SW of Kutais, Georgia.

Diagnosis: Tail thick, bushy and flattened in appearance. Ears with very short tufts. Muzzle short and blunt. Eyes surrounded by yellowish hair. Fur is coarse with soft underwool, colour on back brownish grey; ventral brownish yellow. Thumbs of forefeet vestigial. Hind feet with 5 digits. Dorsal side of tail is light red-brownish. Five pairs of mammae. Strong depression of the braincase posteriorly. Postorbital process of frontal present and distinctively sharp pointed. Low molar

crowns and square-like shaped.

Dental formula: i 1/1 c 0/0 pm 1 or 2/1 m 3/3 = 20 or 22.

Remarks: This is the only squirrel in Jordan. The Persian Squirrel is an arboreal and diurnal species. It is associated with thick pine and oak forests. It was observed in Dibbin Forests feeding on oak acorns and seeking shelter on trees. The Persian Squirrel is very uncommon in the mountains of Ajlun, Jarash and Ishtafayna, where pine and oak trees are abundant. Piles of eaten oak acorns found under trees are a typical sign for its occurrence.

Gavish (1993) recorded some aspects of the Persian Squirrel behaviours, including activity patterns, feeding and other behavioral descriptions.

It was reported from the Dibbin National Park, Kufrinjah and Ishtafayna (Atallah, 1977; Amr & Disi, 1988). Jordan represents the most southern distribution for the Persian Squirrel.

The Persian Squirrel is trapped and then

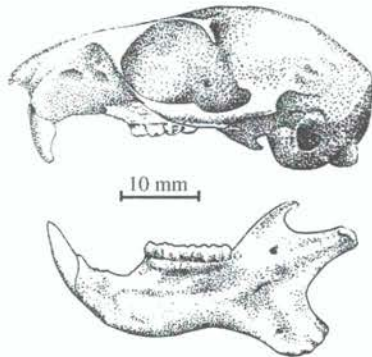


Fig. 24: Skull of *Sciurus anomalus*. (Scale bar 10 mm). Drawn by A. Shehab.

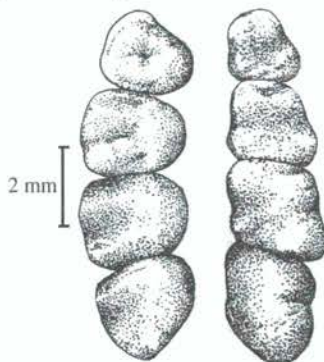
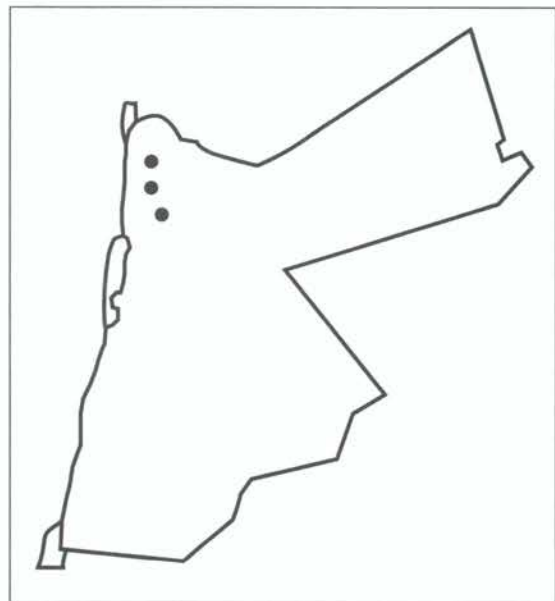


Fig. 25: Right upper and lower cheekteeth of *Sciurus anomalus*. (Scale bar 2 mm). Drawn by A. Shehab.



Map 54: Distribution of *Sciurus anomalus*.

sold as a pet animal in the streets of Amman. The present populations of this handsome species are declining due to trapping and expanding agriculture in its natural habitats. This

species is in need for protection and nature reserves or protected areas should be allocated to preserve its populations.

Localities: Dibbin, Kufrinjah, Ishtafayna.

Family Hystricidae

This family includes the Old World porcupines. The head and neck are covered with a crest of long bristles. The dorsal side is cov-

ered with spines of various sizes. Porcupines are nocturnal animals that feed entirely on roots, bulbs and other cultivated crops.

Hystrix indica Kerr, 1792

In Linnaeus, *Anim. Kingdom*, p. 213

Common Name: Indian Crested Porcupine.

Distribution: Transcaucasus; Asia Minor; Palestine; Arabia to S Kazakhstan and India; Sri Lanka; Tibet (China).

Type Locality: India.

Diagnosis: Largest rodent in Jordan. Can reach a length of up to 1m. Muzzle blunt, and covered with hair up to the lip. Eyes and ears small, ears round and covered by hair. Long and well developed vibrissae. Tail short. Body covered by long sharp spines (quills). Quills reach up to 400 mm in length on the posterior half of the back. They are creamy

white and banded with black (tip creamy white). Quills on base of tail and tail are completely white. Fur colour dark brown and blackish brown on the limbs. Forefeet with four digits, and a strong white claw; hindfeet with five digits. Palms and soles are naked. Three pairs of mammae. Skull large and robust with small tympanic bullae. Infraorbital foramen very massive. Frontal region of skull very broad. Cheekteeth are strongly hypsodont and complexly folded with flat crowns.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 1/1\ m\ 3/3=20$.

Remarks: 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. Also it feeds on 18 species of geophytes and hemicryptophytes (Aikon, 1999). They forage at night and can travel long distances away from their retreat.

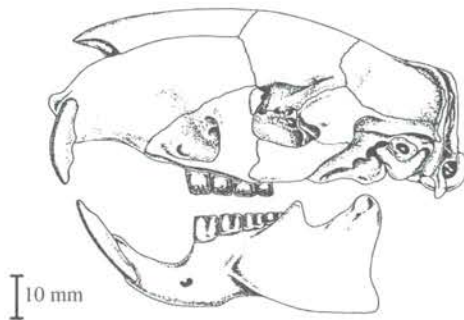


Fig. 26: Skull of *Hystrix indica*. (Scale bar 10 mm). After Harrison (1981).

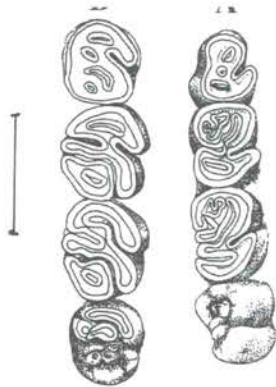


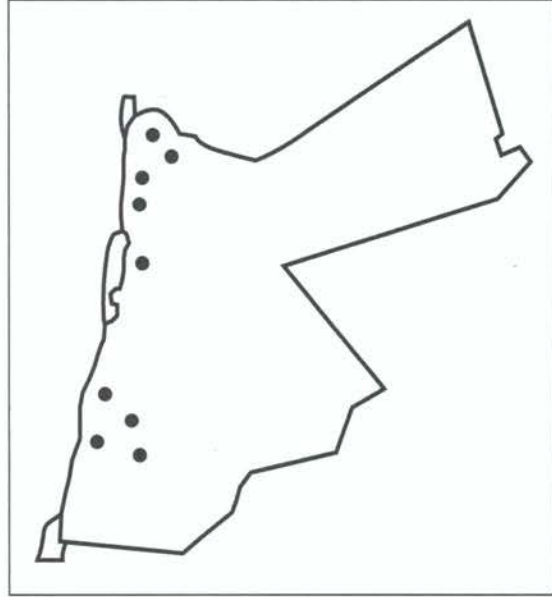
Fig. 27: Right upper and lower cheekteeth of *Hystrix indica*. (Scale bar 10 mm). Drawn by A. Shehab

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 proceptive 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 practiced 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).

Localities: Aqraba, Dana, Irbid, Jordan Valley, Petra, Wadi al Mawjib, Wadi Arabah.



Map 55: Distribution of *Hystrix indica*.

**Family Dipodidae
(Jerboas)**

The elongated hind limbs and short fore-arms characterize members of this family. This is an adaptation for saltatorial movement.

Two genera are recognized in Jordan, *Allactaga* and *Jaculus*. Both contain one species that are found in dry arid parts of the country.

Key to Family Dipodidae

- 1. Hind foot with 5 digits *Allactaga euphratica*
- Hind foot with 3 digits. *Jaculus jaculus*

***Allactaga euphratica* Thomas, 1881**

Ann. Mag. Nat. Hist., ser. 5, 8:15.

Common name: Five-toad Jerboa.

Distribution: Steppe and semi-desert from Turkey, Syria, E Jordan, east to N Saudi Arabia and Kuwait; north through Iraq to the Caucasus; N Iran; E Afghanistan.

Type Locality: Iraq.

Diagnosis: Ears distinctively long and narrow, more than one half of hindfoot length.

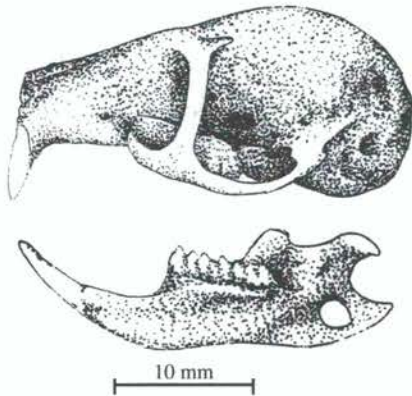
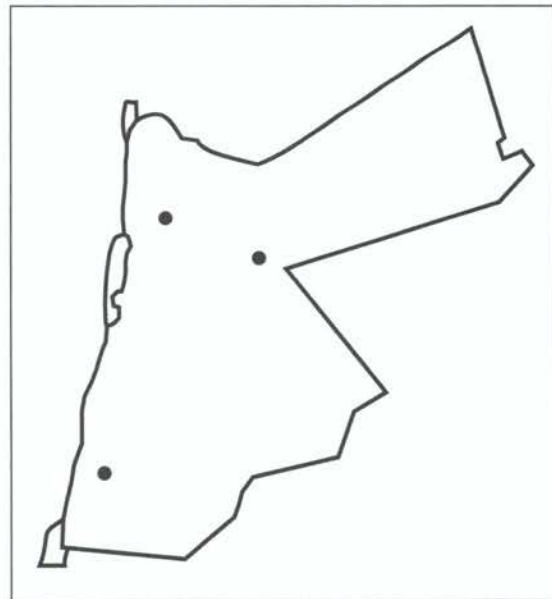


Fig. 28: Lateral view of *Allactaga euphratica* Skull. (Scale bar 10 mm). Drawn by A. Shehab.



Map 56: Distribution of *Allactaga euphratica*.



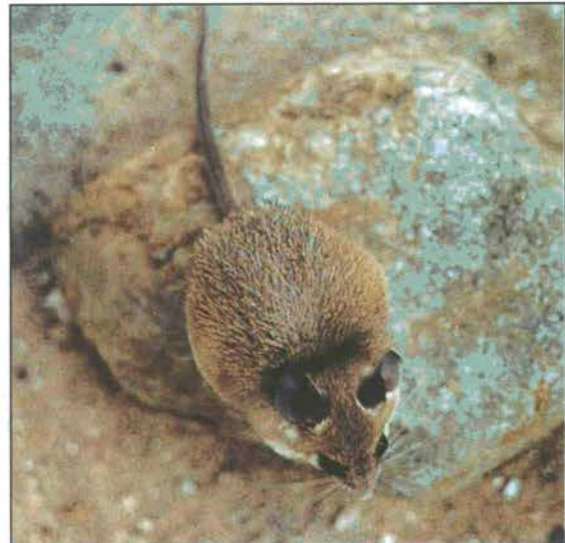
Acomys russatus (Photo: D. Modry)



Acomys russatus lewisi (Photo: M. Abu Baker)



Meriones crassus (Photo: A. Searight)



Acomys cahirinus (Photo: D. Shafee)



Gerbillus cheesmani (Photo: Kuwait Natural History)



Skeetamys calurus (Photo: M. Qumsiyeh)



Microtus guentheri (Photo: D. Shafie)



Psammomys obesus (Photo: A. Searight)



Sus scrofa libycus (Photo: M. Qumsiyeh)



Myocastor coypus (Photo: M. Qumsiyeh)



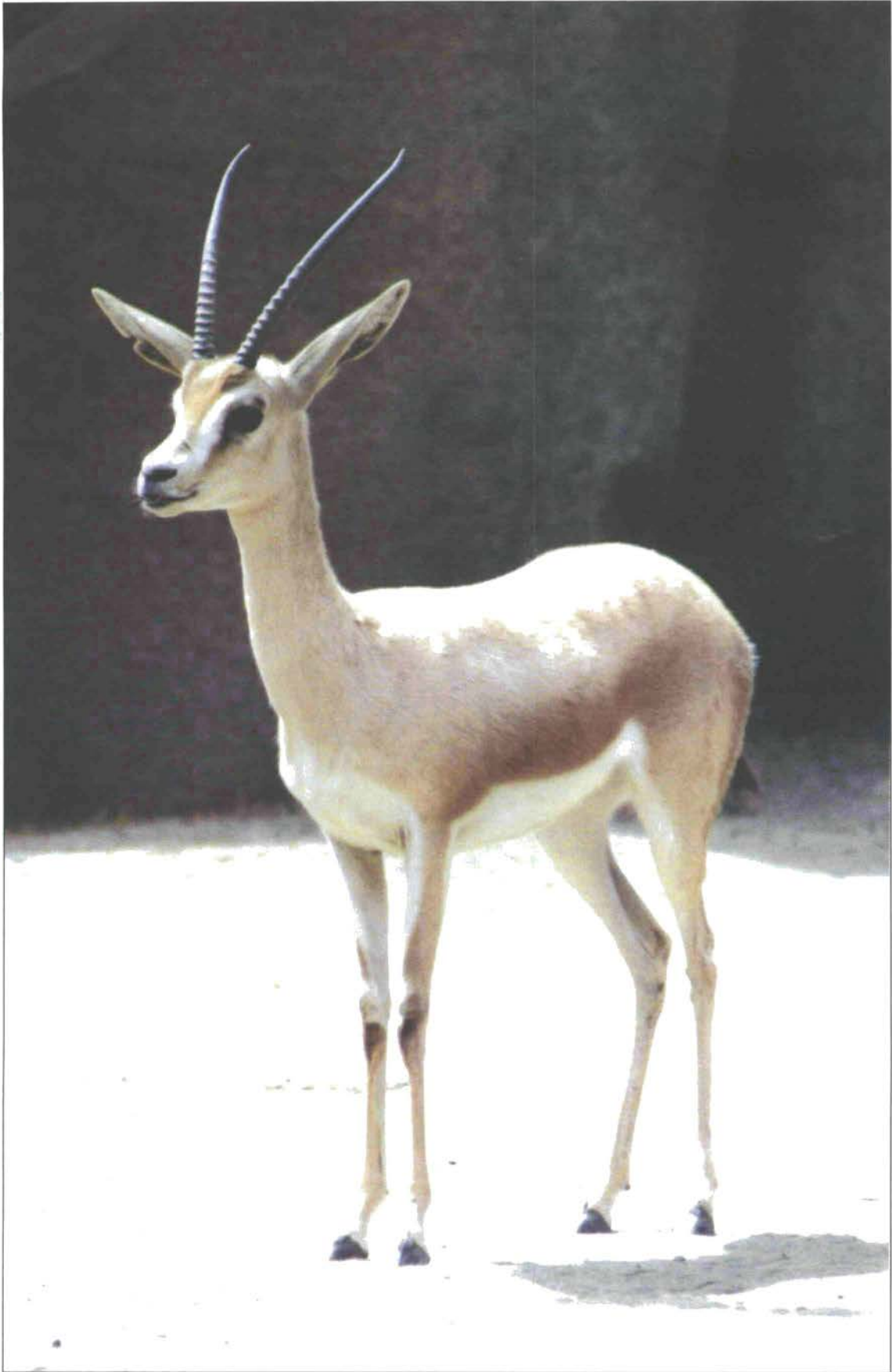
Apodemus mystacinus (Photo: M. Abu Baker)



Capra ibex nubiana (Photo: B. Huffman)



Gazella subgutturosa (Photo: B. Huffman)



Gazella dorcas (Photo: B. Huffman)

Dorsal brown, ventral white. Five digits on hindfeet, soles are naked. Hindfoot with three functional and two vestigial digits. Four pairs of mammae. Tail composed of three distinct bands; white anteriorly, brown medially and terminates with a white tip. Zygomatic arches widely flared posteriorly. Tympanic bullae small. Four upper cheekteeth, with a small first upper premolar. Angular process not perforated.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 1/0\ m\ 3/3 = 18$.

Remarks: The Five-toed 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 to up to nine young.

It was collected from Azraq, Ma'an, Amman, Mafraq, Qasr Amrah and Jawa (Amr & Disi, 1988, Searight, 1987).

Localities: Al Mafraq, Amman, Azraq, Jawa, Ma'an, Qasr Amrah, Wadi Arabah.

***Jaculus jaculus* (Linnaeus, 1758)**

Syst. Nat., 10th ed., 1:63.

Common name: Three-toed Jerboa.

Distribution: Africa, NE Nigeria and Niger, from SW Mauritania to Morocco, E through Algeria Tunisia and Libya to Egypt, Sudan,

and Somalia; throughout Arabia and to SW Iran.

Type Locality: Egypt, Giza Pyramids.

Diagnosis: Hind foot long and with three toes. The back feet also have large hair tufts. Central digit of the three toes is the longest. Tail long terminating with white brush. Fur long, colour dorsally reddish-brown, ventral colour white. Four pairs of mammae. Skull with very large, inflated bullae. 3 upper cheekteeth. Small first premolar missing. Angular process with perforation that has a sharp projection beneath it.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: 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 leveled, arid areas and may reach up to 120 cm deep. The entrance is plugged by sand during the daytime. Hatough-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. The 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 borns after a gestation period that lasts for about 25 days

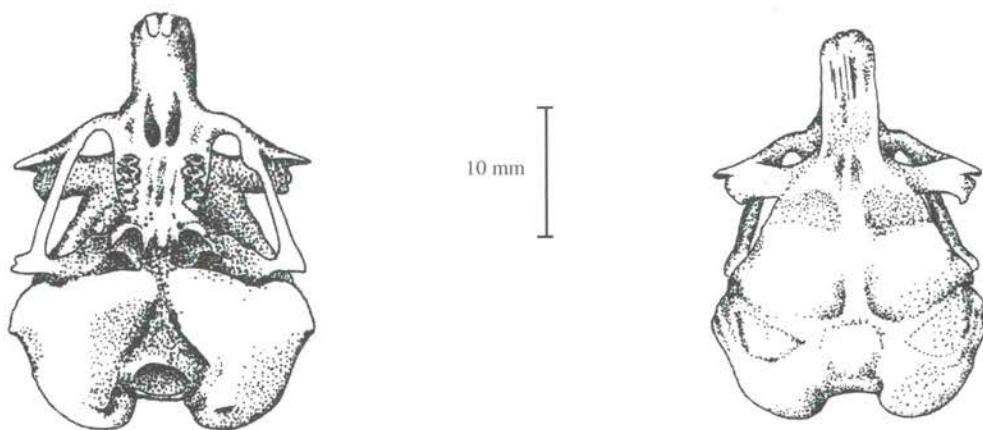


Fig. 29: Ventral and dorsal view of *Jaculus jaculus* skull. (Scale bar 10 mm). Drawn by A. Shehab.

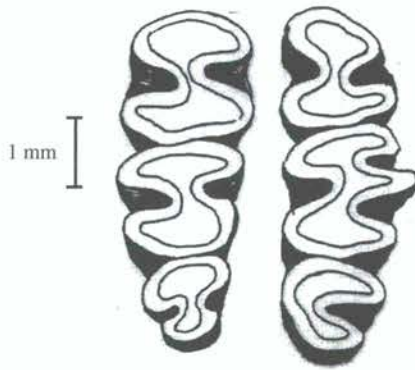
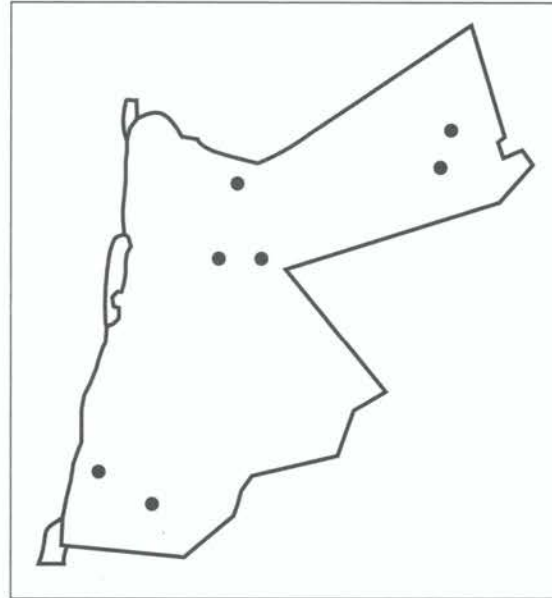


Fig. 30: Right upper and lower cheekteeth of *Jaculus jaculus* (Scale bar 1 mm). Drawn by A. Shehab.

(Lewis *et al.*, 1965; Kadhim *et al.*, 1979). The Three-toed Jerboa is a one of the major food items for desert owls; for example, it represented 2.1% of the Little Owl, *Athene noctua*, diet (Al-Melhim *et al.*, 1997), and was consumed readily by the Eagle Owl, *Bubo bubo*, (Amr *et al.*, 1997; Rifai *et al.*, in press).



Map 57: Distribution of *Jaculus jaculus*.

Localities: Al Jafr, Azraq, Jawa, Qasr Amrah, Rishah, Ar Ruwayshid, Wadi Fidan.

Family Gliridae

This family includes one species that occurs in Jordan. Members of this family are

known to have an arboreal life style.

Eliomys melanurus (Wagner, 1839)

Gelehrte Anz. I. K. Bayer. Akad. Wiss., München, 8(37):299.

Common name: Southwest Asian Garden Dormouse.

Distribution: S Turkey, Syria, Iraq, Jordan, Lebanon, Palestine, Saudi Arabia, the Sinai Peninsula, Egypt, Libya Tunisia, Algeria, Morocco.

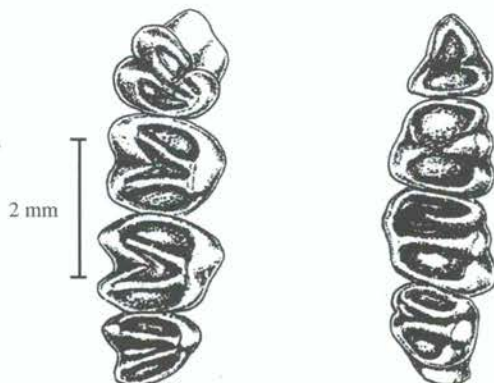


Fig. 31: Right cheekteeth *Eliomys melanurus*. (Scale bar 2 mm). After Harrison & Bates (1991).

Type Locality: Sinai.

Diagnosis: Eyes surrounded by black hair, black stripe extending from eyes backwards to the base of ears. Dorsal brown and ventral white, with a distinct line of demarcation. Forefeet have four digits, hindfeet five, the soles are naked. Tail terminates with bushy black hair, covering almost half of the tail length. Skull with very large tympanic bullae. Rostrum long. Zygomatic arches very delicate. Slender mandible with large perforations of the angular processes, having a distinctive secondary projection on the lower margin. Crowns of cheekteeth distinctively concave.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 1/1\ m\ 3/3 = 20$.

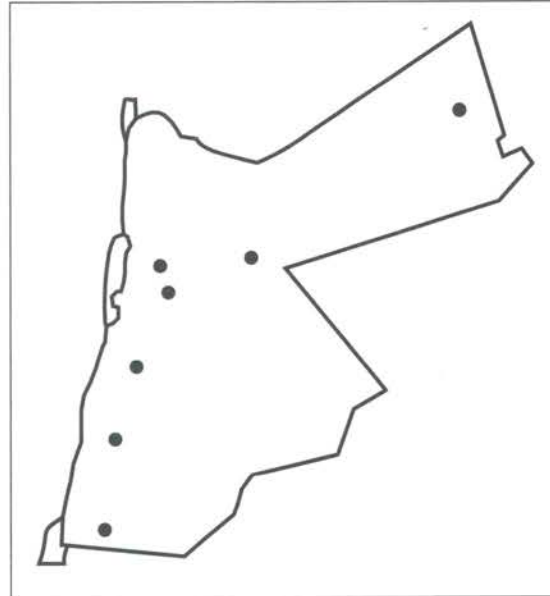
Remarks: This species has a remarkable distribution pattern, despite being originally an arboreal species. It occurs in very arid and densely vegetated habitats. As the distribution map shows, it was collected among black lava rocky habitats in the Eastern Desert and from rocky areas of the Dana Nature Reserve. The Southwest Asian Garden Dormouse be-

came 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).

The Garden Dormouse lives with other desert rodents, such as *G. dasyurus* and *Acomys* sp. (Atallah, 1978).

This species is considered common in the Jordan Valley, Um Rasas, and Azraq areas (Tristram 1866 & 1884; Allen, 1915, Atallah, 1966; Amr & Disi, 1988).

Localities: Azraq ad Duruz, Al Jizah, Al Wisad, Dab'ah, Dana Nature Reserve, Jordan Valley, Ar Ruwayshid, Umm Rasas, Wadi Ramm.



Map 58: Distribution of *Eliomys melanurus*.

Family Spalacidae

This family includes the mole rats. They live entirely in underground tunnels and are rarely seen on the surface. They feed on roots and bulbs. Their eyes and ears are vestigial

and the tail is very much reduced. Limbs are reduced and not adapted for digging. The large head and the long incisors perform the digging activities (Harrison & Bates, 1991).

***Nannospalax leucodon* (Nordmann, 1840)**
Demidoff Voy., 3:34.

Common name: Palestine Mole Rat.

Distribution: From Syria, Lebanon, Jordan, and Israel through N Egypt to N Libya, possibly SW Turkey.

Diagnosis: Body cylindrical in shape, with

very indistinct neck. The flat and broad snout is shovel-like in shape, with a large naked nose pad. Eyes, ears and tail absent. Fur is short, soft and nondirectional, colour of fur black to dark brown. Legs very short, soles of feet naked. Two pairs of mammae. Skull very robust. Long rostrum. Weak, but

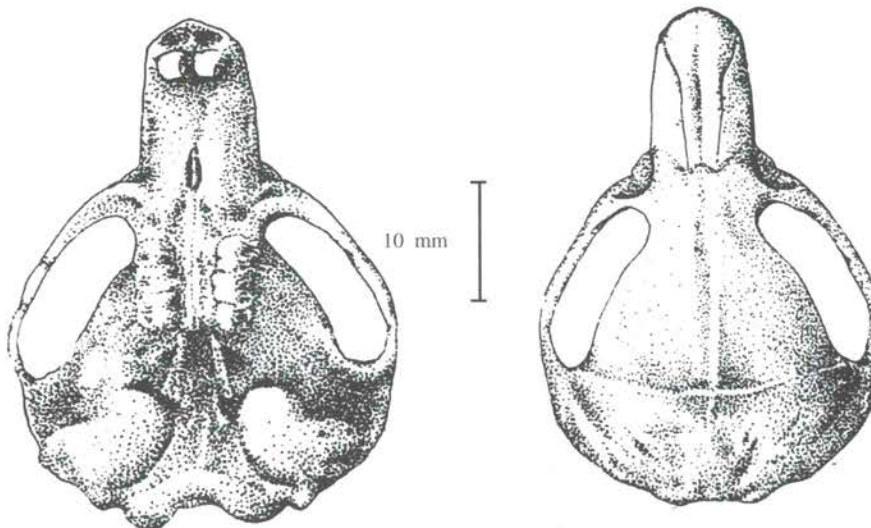


Fig. 32: Dorsal and ventral views of *Nannospalax leucodon*, Skull. (Scale bar 10 mm). Drawn by A. Shehab.

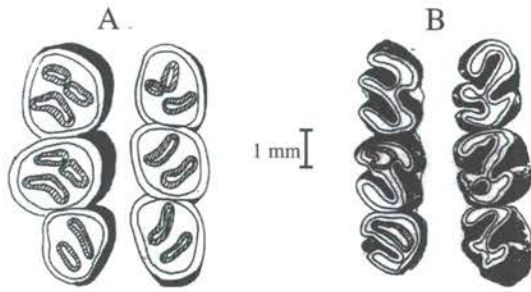


Fig. 33: Right cheekteeth *Nannospalax leucodon*. (Scale bar 1 mm). Drawn by A. Shehab. A. Young specimen. B. Old specimen.

strongly outward bowed zygomatic arches. Strong developed sagittal crest. Incisors are very conspicuous. Lower incisors very large in comparison to mandible.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

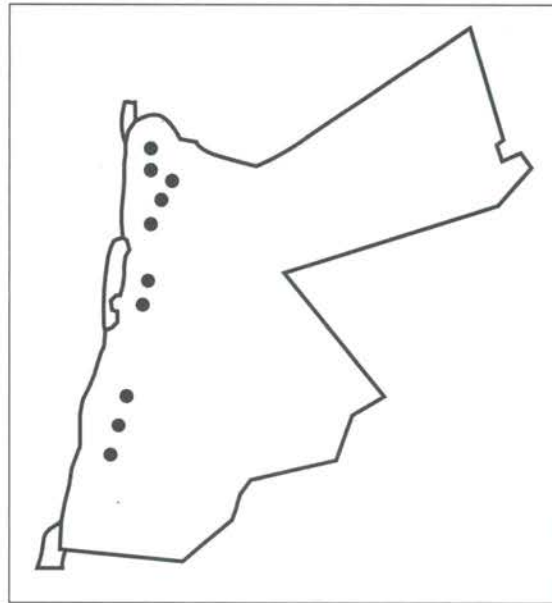
Remarks: The distribution of the Palestine Mole Rat is apparently associated with *terra rosa* soil, the abundant soil type covering the Mediterranean province of Jordan.

This mole is an aggressive fossorial solitary species. Its presence is immediately confirmed by the existence of the variously sized mounds that reflect 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 borns annually.

Farmers consider the Palestine Mole Rat as a serious pest. It causes damage to pota-

toes, summer crops and other bulbs. Surprisingly it avoids onion farms. This species has been reported from Ash Shawbak, Aqraba and other parts of the country (Ellerman, 1948, Mountfort, 1965; Amr *et al.*, 1987).

Harrison (1972) was unable to distinguish between *N. leucodon* and *Spalax ehrenbergi* on the characters proposed by Ellerman (1948). Also, Nevo (1969) reported on several chromosomal species in Palestine. The taxon *N. leucodon* is adopted herein.



Map 59: Distribution of *Nannospalax leucodon*.

Localities: Al Jubayhah, Ash Shawbak, Ar Ramtha, Busayra, between Jarash and Suf, Ibbin, Petra.

**Family Muridae
(Rats and Mice)**

This family includes generalized species that assume different life styles. It includes rats, mice and other forest inhabitants. Many species are considered serious pests of economic and health importance.

Key to Family Muridae

- 1. Dorsum is partially covered by spiny hair *Acomys* 2
 Dorsum is not partially covered by normal hair 4
- 2. Sole black. Ears with regular and spiny hair 3
 Sole pale. Ears without spiny hairs *Acomys cahirinus*
- 3. Body black *Acomys russatus lewisi*
 Body golden-yellow *Acomys russatus russatus*
- 4. Total body length more than 250 mm 5
 Total body length less than 250 mm 7
- 5. Ears do not exceed 20 mm in length *Nesokia indica*
 Ears exceed 20 mm in length *Rattus* 6
- 6. Tail longer than body length *Rattus rattus*
 Tail shorter than body length *Rattus norvegicus*
- 7. Palm with 5 rounded tubercles *Apodemus mystacinus*
 Palm with 3 rounded tubercles *Mus musculus*

Apodemus mystacinus (Danford & Alston, 1877)
Proc. Zool. Soc. Lond., 1877:279.

Common name: Broad-toothed Field Mouse.

Distribution: SE Europe, Palestine, Lebanon, Jordan, Iraq, Iraq, NW Iran, S Georgia in Caucasus, Rhodes, Crete, and other inshore Aegean isls, and N Arabia.

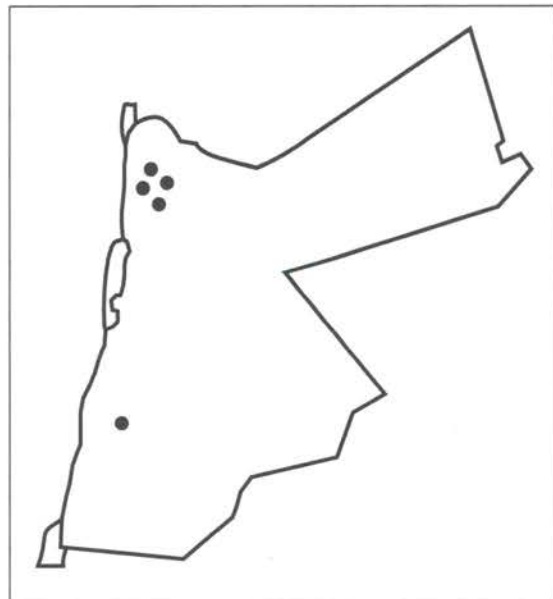
Type Locality: Turkey, Adana Prov., Bulgar Dagh Mt, Zebil.

Diagnosis: Ears large. Fur on dorsum greyish in adults, brownish-grey in younger individuals. Ventral buff white, sharp line of demarcation present. Thumb on fore feet vestigial. Soles of feet naked. Claws with white tip. Tail covered with short hairs. Three pairs of mammae. Upper incisor strongly curved.

Dental formula: i 1/1 c 0/0 pm 0/0 m 3/3 = 16.

Remarks: 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 stom-

ach of the Coined Snake, *Coluber nummifer*. Females give birth to 4-5 new born during April to October.



Map 60: Distribution of *Apodemus mystacinus*.

Localities: Ajlun, Dibbin, Dana Nature Reserve, Ibbin, Zubiya.

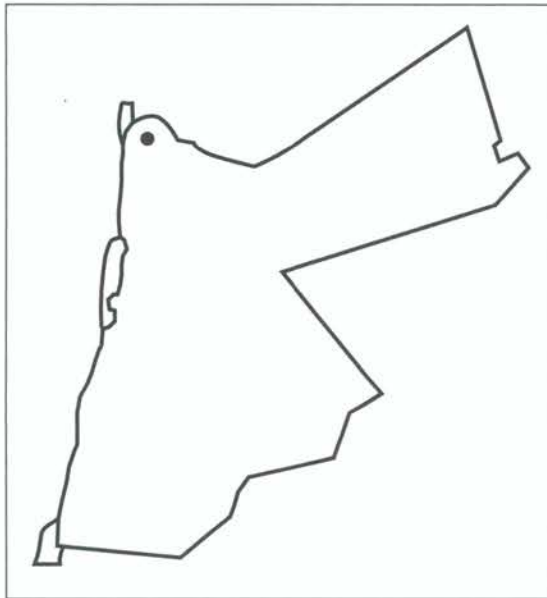
Apodemus hermonensis Filippucci et al. 1989
Boll. Zool., 56:374.

Distribution: Palestine, Syria ?, Lebanon and Jordan.

Type Locality: Mt Hermon, Palestine.

Remarks: This species was recently recorded from Jordan (Benda & Sadlová, 1999) from the Ajlun Mountains. This species was erected based on biometrical and electrophoretic studies of specimens originating from Palestine (Filippucci et al., 1989). In the forests of Palestine, Lebanon and probably Syria, *Apodemus falvicollis* and *Apodemus sylvaticus* are known to exist sympatrically (Harrison & Bates, 1991). Furthermore, studies in Asia Minor revealed that *A. sylvaticus* and *Apodemus hermonensis* are two separate species (Filippucci et al., 1996).

Ajlun mountain is a woodland dominated by oak with species of maquis (*Arbutus* sp. and *Ceratonia* sp.).



Map 61: Distribution of *Apodemus hermonensis*.

Localities: Ajlun.

***Rattus rattus* (Linnaeus, 1758)**

Syst. Nat., 10th ed., 1:61.

Common name: Black Rat.

Distribution: Native to Indian Peninsula, and introduced worldwide in the tropics and temperate zone.

Type Locality: Sweden, Uppsala County,

Uppsala.

Diagnosis: Head-body length up to 200 mm. Ears large and rounded. Fur colour very variable, ranging from blackish dorsally to greyish to brownish, with the underside being lighter. Tail longer than head and body length. Little and short hair on tail. Large

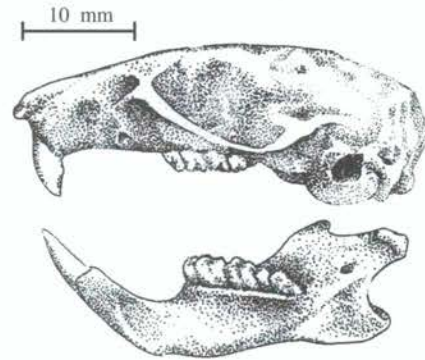


Fig. 34: Lateral view of *Rattus rattus* Skull. (Scale bar 10 mm). Drawn by A. Shehab.

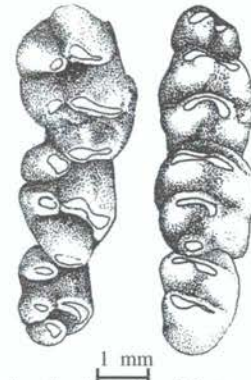


Fig. 35: Right cheekteeth of *Rattus rattus*. (Scale bar 1 mm). Drawn by A. Shehab.

and well inflated tympanic bullae. Skull elongated in shape, with laterally curved temporo-parietal ridges. Outer tubercles of upper molars well developed. First upper molar with anterolateral cusp.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: 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. We have witnessed severe loss in grain storage in northern Jordan. This species is capable of chewing electrical cables of 5 cm in diameter, causing extensive losses.

After the construction of the sewer system in Amman in 1979, the Black Rat became a serious problem for health and municipality officers. It was recovered from toilets in buildings in the second and third floor. The sewer system was a breeding shelter for the rats. It was found in large densities in open dumping sites near Az Zarqa and Irbid area. Currently, this pest is under control using various compounds of anticoagulants.

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 locals, it is also an important reservoir for zoonotic diseases such as *Leishmania* and Bubonic Plague. Historically, the Jordan Valley was an endemic foci for the Black Death, especially during the Islamic expansion from Arabia. In the eight century "Amwas Plague" took its toll among Muslim soldiers while in the Jordan Valley. Archeological surveys recovered thousands of skull for the Black Rat from that area.

Localities: Found in all cities, villages and agricultural areas.

***Rattus norvegicus* (Berkenhout, 1769)**

Outlines of the Natural History of Great Britain and Ireland, 1:5.

Common name: Norway Rat.

Distribution: Original distribution assumed to be SE Siberia and N China (Heilongjiang), but introduced worldwide where it is more common in colder climates of high latitudes; in warmer regions and tropics restricted to habitats highly modified by humans--sewers, buildings, wharves, and breakwaters, for example.

Type Locality: Great Britain.

Diagnosis: Larger more robust rat, head body length about 380 mm, and tail 175 mm. The colour is solid greyish brown above and below. Similar to *R. rattus*, but the tail is shorter than head and body length. Tail also with distinct epidermal scales. Six pairs of mammae. Large and very elongated skull, with parallel tempoparietal ridges. Tympanic bullae small and only little inflated. First upper molar

without an anterolateral cusp.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16.$

Remarks: It is not as common as *R. rattus* and did not establish itself very well in our area. The Norway Rat can live in close quarters with humans in buildings, trash filled streets, sewer systems, grain bins and stock

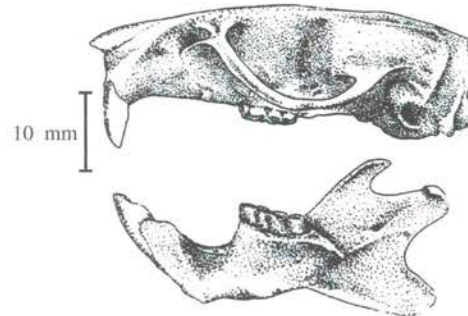


Fig. 36: Lateral view of *Rattus norvegicus* Skull. (Scale bar 10 mm). Drawn by A. Shehab.

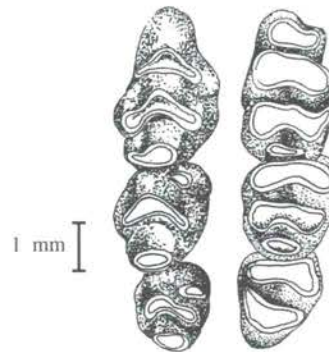


Fig. 37: Right cheekteeth *Rattus norvegicus*. (Scale bar 1 mm). Drawn by A. Shehab.

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.

Localities: Amman, Irbid, Jarash.

***Mus musculus* Linnaeus, 1758**

Syst. Nat., 10th ed., 1:62.

Common name: House Mouse.

Distribution: Spread throughout most of the world through its close association with humans; in some areas restricted to human dwellings and habitats maintained by human activity; sometimes feral where introduced.

Type Locality: Sweden, Uppsala County, Uppsala.

Diagnosis: Small mouse. Head body length up to 90 mm. Ears large and rounded at the edges. Fur colour brown to greyish dorsally,

ventrally usually lighter to white. Feet are white. Tail long and covered with hairs, but annulated. Five pairs of mammae. Skull very small, with a flattened braincase. Upper incisor with a distinctive notch. Crown area of the

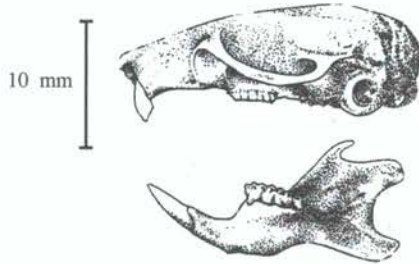


Fig. 38: Lateral view of *Mus musculus* Skull. (Scale bar mm). Drawn by A. Shehab.

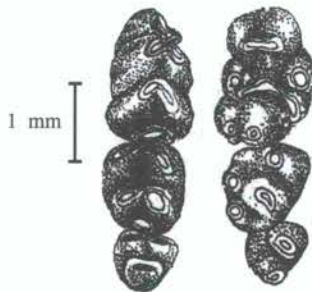


Fig. 39: Right cheekteeth of *Mus musculus*. (Scale bar 1 mm). Drawn by A. Shehab.

first upper molar very large in comparison to the second and third upper molars.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: The House Mouse is a very successful species that is found in all types of

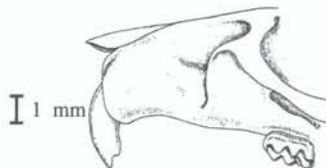


Fig. 40. Notch of the upper incisor of *Mus musculus*. After Harrison (1981).

habitats, including deserts. They breed about 12 times per year giving birth to about 5-8 new born each time. Within six weeks, the young's 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 and farms.

Localities: Common all over the country especially where ever there are human settlements.

***Acomys cahirinus* (Desmarest, 1819)**

Nouv. Dict. Hist. Nat., Nouv. ed., 29:70.

Common name: Cairo Spiny Mouse.

Distribution: W Sahara to Egypt (including Sinai), N Nigeria, N Ethiopia, N Sudan, Jor-

dan, Palestine, Lebanon, Syria, Yemen, Oman, Saudi Arabia, S Iraq, Iran, and Pakistan.

Type Locality: Egypt, Cairo.

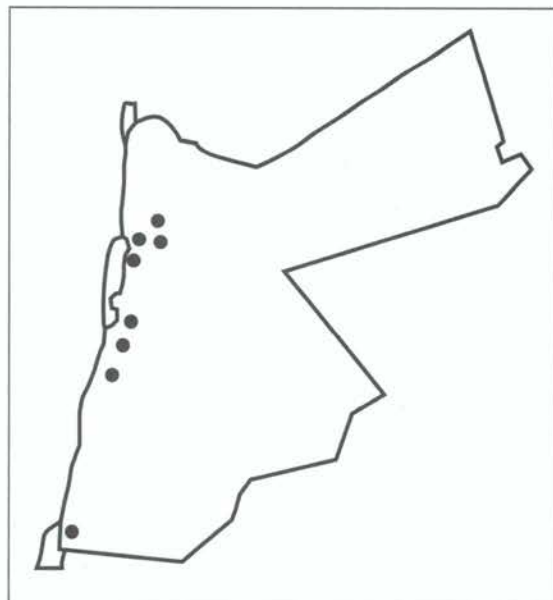
Diagnosis: Dorsum grey, ventral white to grey, with a very sharp line of demarcation. White patches present on the posterior side of the ear base. Fur spiny, with spines mostly on the back, not reaching back of the head. Ears without hair. Soles of hind feet yellow brown in colour. Tail with large and easy visible scales. Three pairs o mammae. Skull with a broad braincase. Median keel on palate present. Crown area of first upper molar very large.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: This is a pterophyles species associated with rocky terrains, in addition to steppe-desert habitats. Cairo 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 En Gedi, *A. cahirinus* and *A. russatus* were found to co-occur. The activity pattern of these two species suggests a compactive 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 bur-



Map 62: Distribution of *Acomys cahirinus*.

row 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.

Localities: Wadi al Mawjib, Al Aqabah, At Tafilah, Dibbin, Ghawr as Safi, Madaba, Petra, Suwaymah, Wadi al Haydan, Wadi al Karak, Wadi Ramm, Wadi Zarqa Main.

***Acomys russatus* (Wagner, 1840)**

Abh. Akad. Wiss. München, 3:195.

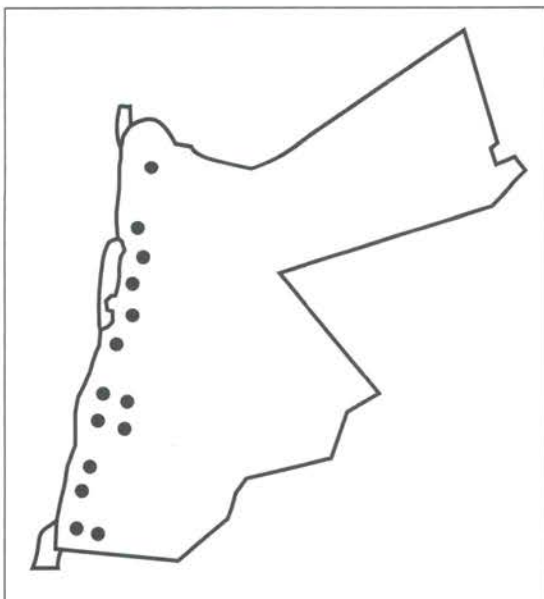
Common name: Golden Spiny Mouse.

Distribution: E Egypt, Sinai, Jordan, Palestine, and Saudi Arabia.

Type Locality: Egypt, Sinai.

Diagnosis: Dorsal area covered by golden yellow spiny hair. Spiny hair extend to the back of the head and the flanks. Line of demarcation indistinct on flanks. White patch behind ear. Palm and soles naked. Ears smaller than in *A. cahirinus*. Ventral side of feet, palm and tail black; tail shorter than body length. Skull with broad braincase. Median keel on palate absent.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16.$



Map 63: Distribution of *Acomys russatus*.

Remarks: Atallah (1978) stated that the Golden Spiny Mouse lives along with *A. cahirinus*; both species prefer rocky terrain. This species is common among rocky areas along Wadi Arabah and in some mesic habitats. It feeds on several halophytic plants such as *Anabasis articulata*, *Atriplex halimus* and *Hammada scorpioides* (Shkolnik & 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* (Shkolnik, 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).

Localities: Al Birkatayn (Jarash), Al Aqabah, At Tafilah, Azraq, Gharandal, Ghawr as Safi, Jawa, King Hussein Bridge area, Madaba, Petra, Rahmeh, Rishah, Wadi Fidan, Wadi al Karak, Wadi Ramm, Wadi Zarqa Ma'in.

***Nesokia indica* (Gray & Hardwicke, 1830)**

Illustr. Indian Zool., 1:pl. 11.

Common name: Short-tailed Bandicoot Rat.

Distribution: Modern range covers Bangladesh, NE India (Bihar), NW India (Kumaon and Rajputana), Pakistan, Afghanistan, Iran, Iraq, Syria, Saudi Arabia, Palestine, NE Egypt, NW China (Xinjiang), Turkmenistan, Uzbekistan, and Tadzhikistan. Late Pleistocene sites are beyond modern range in Egypt and in N Sudan.

Type Locality: India (uncertain).

Diagnosis: Rats-like in appearance. Total length ranges from 240-316 mm. Ears small. Dorsal fur colour brown, ventral lighter with a very weak line of demarcation. Tail without hair and markedly shorter than head and body length. Tail colour same ventrally and dorsally. Four pairs of mammae. Skull large and robust. Rostrum short. Upper incisors project beyond the anterior end of nasals. Upper molars broad and crowns without cusps in adults. Lower incisor large and powerful.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16.$

Remarks: 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 irri-

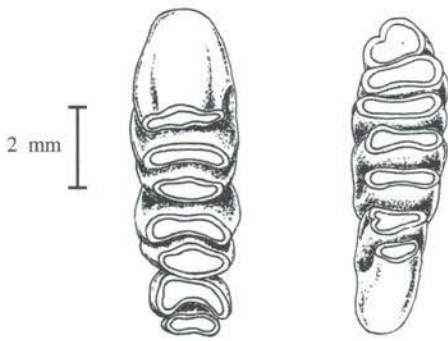
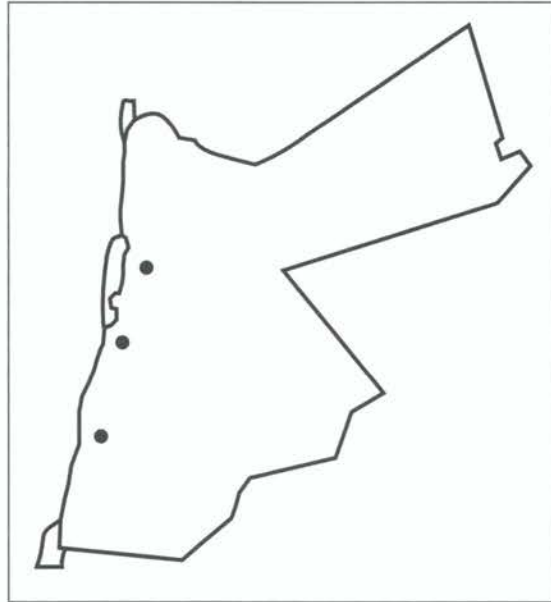


Fig. 41: Right cheekteeth *Nesokia indica*. (Scale bar 2 mm). After Harrison & Bates (1991)

gation 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 *Alhaji* sp. and *Typha* sp. (Osborn & Helmy, 1980).

The type specimen of this subspecies originated from "Ghor el Safieh" (=Ghawr as

Safi). It was also reported from Mu'ab (Aharoni, 1932), Wadi Fidan (Abu Dieyeh, 1988).



Map 64: Distribution of *Nesokia indica*.

Localities: Ghawr as Safi, Mu'ab, Wadi Fidan.

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 (Cor-

bet, 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.

Key to Subfamilies of Family Cricetidae

1. Cheek pouches present. Tail not more than 40 mm in length Subfamily Cricetinae
 Cheek pouches absent. Tail more than 60 mm in length 2
2. Ears short. Tail not more than 65 mm in length Subfamily Microtinae
 Ears medium. Tail more than 100 mm in length Subfamily Gerbillinae

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)**
Reise Prov. Russ. Reichs., 2:703.

Common name: Grey Hamster.

Distribution: S European Russia and SE Eu-

rope (Greece, Rumania, Bulgaria) through Kazakhstan to S Mongolia and N China, north nearly to Moscow, south to Palestine, Jordan, Lebanon, Iraq, Iran, Pakistan, Af-

ghanistan, and Turkey.

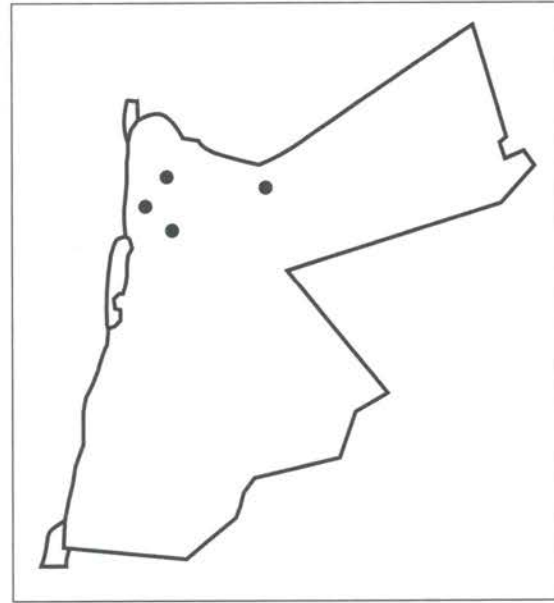
Type Locality: W Kazakhstan, lower Ural River.

Diagnosis: Cheek pouches present. Fur is soft and woolly, on th back grey to greyish-brown with a distinct dark stripe along the middle of the back. Ventral colour white, with a distinct line of demarcation. Tail is less than one-third of body length. Four pairs of mammae. Skull small, with small tympanic bullae. Very distinctive for this species is that the theeth consist of parallel rows of cusps.

Dental formula: i 1/1 c 0/0 pm 0/0 m 3/3 = 16.

Remarks: Apparently, Jordan represents the most southern distribution range for this species. It lives in diversed habitats including moderate and arid areas. It was collected from localities in northern Jordan and at high altitudes near Jawa (about 1100 m above sea level). The Grey 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 breeds all year round, where females give

birth to 2-11 young (Dahl, 1954).



Map 65: Distribution of *Cricetulus migratorius*.

Localities: Al Muwaqqar, As Sarih, Jawa, Wadi az Zarqa.

Subfamily Gerbillinae

This subfamily consitutes the largest group of rodents occuring in Jordan. It includes small-sized rodents adapted for arid and steppe areas. In Jordan, four genera are

represented (*Psammomys*, *Gerbillus*, *Sekeetamys*, and *Meriones*), with a total of 10 species.

Key to Subfamily Gerbillinae

1. Upper incisors with longitudinal groove2
 Upper incisors without longitudinal groove *Psammomys obesus*
2. Tail with a distinctive tuft extending about 1/2 to 2/3 of the tail, terminating with a white tip
 *Sekeetamys calurus*
 Tail without a distinctive tuft extending about 1/2 to 2/3 of the tail 3
3. Cheekteeth are hypsdont in adults *Meriones* 4
 Cheekteeth are not hypsdont. *Gerbillus* 6
4. Claws black *Meriones libycus*
 Claws not black 5
5. Ears small and not pigmented*Meriones crassus*
 Ears with pigmentation*Meriones tristrami*
6. Sole of the hind feet naked 7
 Sole of the hind feet hairy 8
7. Bulla large with mastid part projecting behinde occipital condyles.....*Gerbillus cheesmani*
 Bulla small with mastid part not projecting behinde occipital condyles.....*Gerbillus gerbillus*
8. Small form, hind feet does not exceed 20 mm*Gerbillus henleyi*
 Larger form, hind feet more than 20 mm.....9
9. Base of hair at rump greyish*Gerbillus dasyurus*
 Base of hair at rump white*Gerbillus nanus*

***Gerbillus dasyurus* (Wagner, 1842)**

Arch. Naturgesch., 8:20.

Common name: Wagner's Gerbil.

Distribution: Arabian Peninsula, Iraq, Syria, Lebanon, Palestine, Sinai.

Type Locality: Sinai.

Diagnosis: Dorsum brown grey, underside white, with a distinct line of demarcation. Distinct white patches behind ears and above eye present. Soles of hind feet devoid of hair. Bases of hair, above tail, greyish. Tail long, covered with hair and terminating with a pencil. Four pairs of mammae. Skull rounded posteriorly, with small tympanic bullae. Upper incisors grooved.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: Wagner's Gerbil has a wide range of habitats including basalt deserts, silt dunes and cultivated areas. This gerbil is a very common species in the Jordanian Desert. Furthermore, In the Negev, Shenbrot *et al.* (1997) reported that Wagner's Gerbil inhabits six different types of habitats including sand dunes, dry wadi beds, flat gravel plains, limestone cliffs and rocks and narrow wadis and hills. It was also collected from several localities along the eastern mountains. It was found to share burrows with *P. obesus* (Atallah, 1967b; Amr & Saliba, 1986). Hatough-Bouran (1990) studied the burrowing habits of Wagner's Gerbil in the Shawmari Wildlife Reserve near Azraq. The burrows are simple but deep. Burrows have 1-2 unplugged emergency exits.

Stored plants found includes *Anabasis articulata*, *Atriplex halimus* and *Artemisia herba-alba*. Reproduction occurs almost all year-round and pauses in December, Gestation lasts for 18-22 days with a litter size of 3-7 new born (Shenbrot *et al.*, 1997).

Localities: Al Hasa, Al Aqabah, Ash Shawmari, Ayn Musa, Azraq, Bir ed Doleh, Ghandal, Ghawr as Safi to Aqabah, Ghawr Nimrin, Al Jafr, Jarash, Mu'ab, Petra, Ra's an Naqb, Rishah, Wadi Fidan, Wadi Khinzirah.

***Gerbillus cheesmani* Thomas, 1919**

J. Bombay Nat. Hist. Soc., 26:748.

Common name: Cheesman's Gerbil.

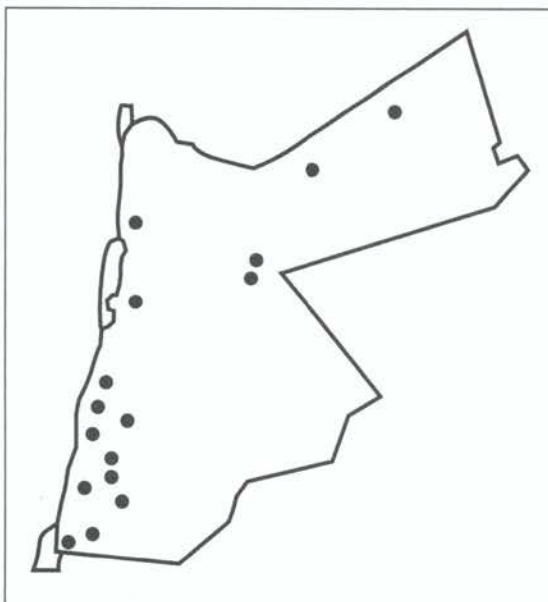
Distribution: SW Iran, C and S Iraq, Saudi Arabia, Oman, North Yemen, South Yemen, and Kuwait.

Type Locality: Iraq, Lower Euphrates, near Basra.

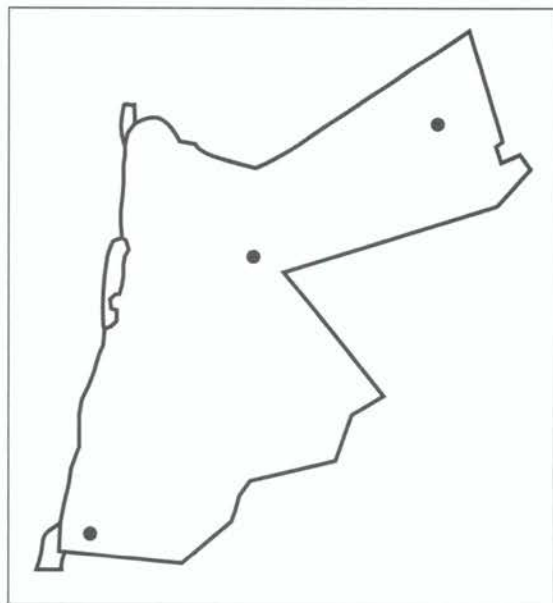
Diagnosis: White patches above eye and behind ear present. Fur colour sandy buff dorsally, without black speckling on rump, ventral site white with a distinct line of demarcation. Soles of hindfoot hairy. Tail very long, more than head body length. Terminal pencil scanty. Hair bases above base of tail white. Skull with large tympanic bullae extending beyond the supraoccipital. Dentition similar to *G. gerbillus*.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: The Cheesman's Gerbil inhabits extremely dry regions, and is adapted for



Map 66: Distribution of *Gerbillus dasyurus*.



Map 67: Distribution of *Gerbillus cheesmani*.

sandy deserts. Burrows were located in sand drifted areas. The burrow consists of 3-4 entrances, with a depth of 125 cm (Lewis *et al.*, 1965). Little is known about its biology.

Localities: Ar Ruwayshid, Azraq, Wadi Ramm.

***Gerbillus nanus* Blanford, 1875**

Ann. Mag. Nat. Hist., ser. 4, 16:312.

Common name: Baluchistan Gerbil.

Distribution: An extensive range from the Baluchistan region of NW India, Pakistan, S Afghanistan, and Iran through the Arabian Peninsula, Iraq, Jordan, Palestine, and North Africa to Morocco.

Type Locality: Pakistan, Gedrosia.

Diagnosis: Similar to *G. dasyurus*, but the osteology of the skull is different in that the zygomatic arches touch the auditory meatus and with well inflated bullae. Another distinguishing character is that the base of hairs above the tail are white. Dentition indistinguishable from *G. dasyurus*.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16.$

Remarks: This is another desert inhabitant that prefers hammada and habitats with loose soil texture. The Baluchistan Gerbil was trapped near burrows of *M. crassus* and *M. libycus*, suggesting a commensal relationship with these species (Lewis *et al.*, 1965). Burrows were constructed in salt flats with halophytic vegetation of *Nitraria retusa* (Zahavi & Wahrman, 1957). Furthermore, Abu Dieyeh (1988) found that burrows of this ger-

bil were constructed in both hard and loose soil in Wadi Arabah. Activity is at its maximum two hours after dusk (Lewis *et al.*, 1965)

The distribution of *G. n. arabium* is restricted to southern Jordan. Many reports indicated the presence of this species in Wadi Arabah and Aqabah.

Localities: Al Aqabah, Azraq, Petra, Wadi Arabah, Wadi Khinzirah, Wadi Ramm.

***Gerbillus henleyi* (De Winton, 1903)**

Novit. Zool., 10:284.

Common name: Pygmy Gerbil.

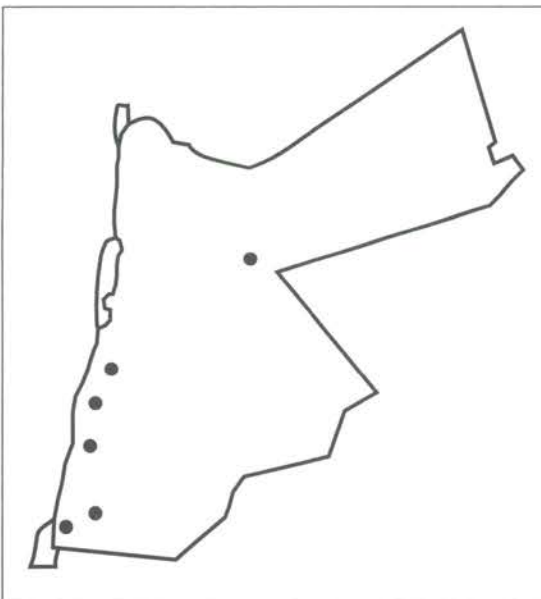
Distribution: From Algeria through N Africa to Palestine and Jordan, W Saudia Arabia, N Yemen, and Oman.

Type Locality: Egypt, Wadi Natron, Zaghigh.

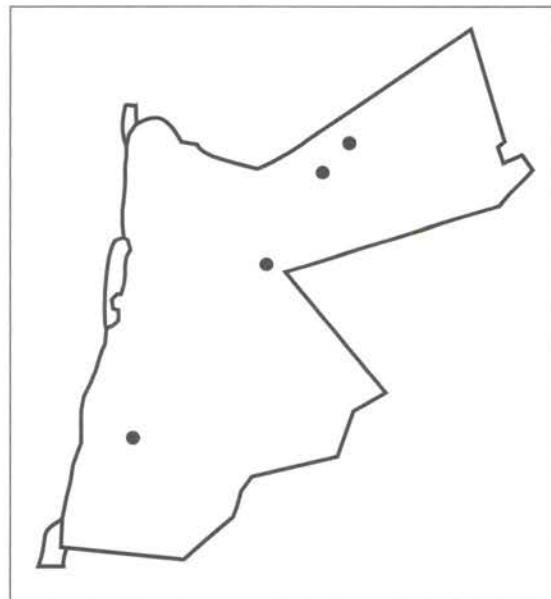
Diagnosis: Very small gerbil with small ears. White patches above eye and behind ear. Dorsal colour buffy brown, underparts are white, with a distinct line of demarcation. Soles of hindfeet naked. Skull small and delicate, with strongly inflated bullae. Braincase very broad, with short rostrum. Teeth very small and delicate.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16.$

Remarks: Collected from Al Jafr area around cultivated fields (Atallah, 1978). This species prefers stony, gravelly wadis with ample vegetation. Its burrow is characterized by its small diameter (1-2 cm). A female was found



Map 68: Distribution of *Gerbillus nanus*.



Map 69: Distribution of *Gerbillus henleyi*.

to have six embryos (Atallah, 1967b). In the Negev, two distinct breeding periods were observed, one in the spring and the second in late summer. In comparison with other species of the genus *Gerbillus*, *G. henleyi* is more a seed eater, more mobile with a less stable home range than *G. dasyurus*. This suggests that *G. henleyi* is more adapted to xeric habitats than other gerbils (Shenbrot *et al.*, 1994).

Localities: Al Jafr, Azraq, Faydat ed Dahiyah, Burqu', Ar Ruwyshid, Wadi Ramm.

***Gerbillus gerbillus* (Olivier, 1801)**

Bull. Sci. Soc. Philom. Paris, 2:121.

Common name: Egyptian Gerbil.

Distribution: From Palestine through Egypt and N Sudan to Morocco; also N Mali, N Niger, and N Chad.

Type Locality: Egypt, Giza Prov.

Diagnosis: Medium-sized gerbil. Ears small, sandy buff in colour and pigmented. Fur colour pale sandy buff dorsally with a pinkish tinge, white ventrally, with distinct line of demarcation. White patch behind ear and above eye and rump distinct. Feet with fringes of hair. Soles not pigmented. Tail covered with short hair, moderate terminal pencil present. Skull with flat and broad braincase. Posterior margin of nasals rounded. Upper incisor very narrow. First lower molar with distinct cusps.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: This is a sand dune inhabitant gerbil. It prefers sandy areas and salt flats. It was

collected from several localities in Wadi Arabah area, Wadi Ramm, where sand prevails (Allen, 1915).

Localities: Al Aqabah, Petra, Wadi Arabah, Wadi Ramm.

***Sekeetamys calurus* (Thomas, 1892)**

Ann. Mag. Nat. Hist., ser. 6, 9:76.

Common name: Bushy-tailed Jird.

Distribution: From E Egypt through Sinai, S Palestine and Jordan into Central Saudi Arabia.

Type Locality: Egypt, Sinai, near Tor.

Diagnosis: Fur fine and dense, colour brown-yellowish dorsally, ventrally pure white. White patches behind ears distinct, while the white patches above the eye are quite indistinct. Palms and soles are naked. Tail with black bushy hair for more than half of its

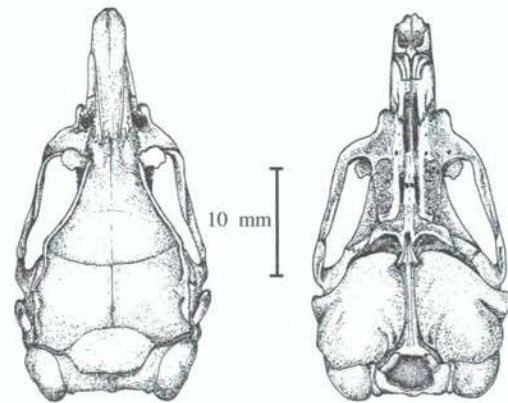
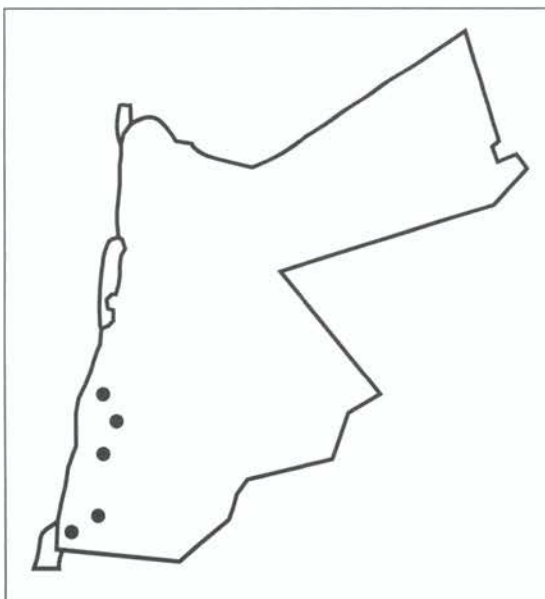
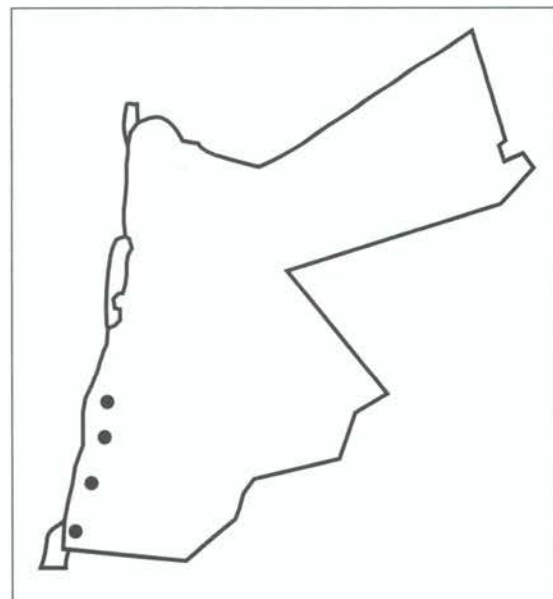


Fig. 42: Dorsal and ventral view of *Sekeetamys calurus* skull. After Osborn & Helmy (1980).



Map 70: Distribution of *Gerbillus gerbillus*.



Map 71: Distribution of *Sekeetamys calurus*.

length, with a white tip. Four pairs of mammae. Skull with very large tympanic bullae, and with a broad braincase. Upper incisor with single groove anteriorly. Molars not cuspidate.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: 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. Osborn & Helmy (1980) included many desert plants as part of its diet (*Zilla spinosa*, *Citrullus colocynthis* etc.)

Localities: Al Aqabah, Rishah, Rahmeh, Wadi Faynan.

***Meriones tristrami* Thomas, 1892**

Ann. Mag. Nat. Hist., ser. 6, 9:148.

Common name: Tristram's Jird.

Distribution: From Palestine, Lebanon, and Jordan to E Turkey, Syria, N Iraq, NW Iran, and Transcaucasia.

Type Locality: Palestine, Dead Sea region.

Diagnosis: Dorsal fur colour brownish grizzled with black, ventral colour pure white, line of demarcation distinct. White patches above eye and behind ear. Ears with pigmentation. Sole partially covered with hair. Tail longer than head body length with a small

black brush. Claws pale in colour. Four pairs of mammae. Skull small with small tympanic bullae, the posterior part of the bullae do not extend beyond the paraoccipital. Braincase rounded at posterior end. Suprameatal triangle of bullae completely closed. Upper incisors with anterior median groove.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: This is a rather common species in Jordan. It inhabits the Mediterranean and steppe areas. The burrows system of Tristram's 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 gives birth to 6-9 young (Atallah, 1978).

The distribution of this species is important, since the Tristram's Jird plays a role as a reservoir host for *Leishmania tropica*, the etiologic agent of the oriental sore.

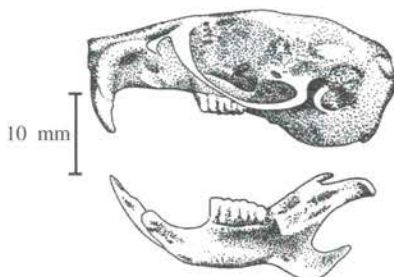


Fig. 43: Lateral view of *Meriones tristrami* skull. (Scale bar 10 mm). Drawn by A. Shehab.

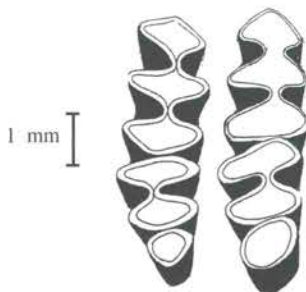
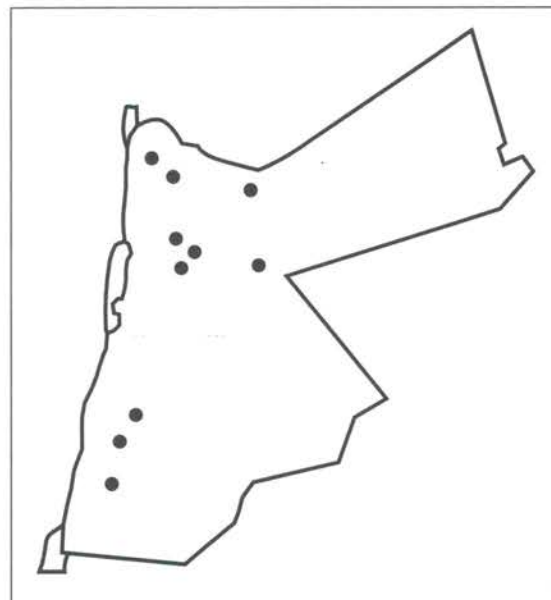


Fig. 44: Right cheekteeth of *Meriones tristrami*. (Scale bar 1 mm). Drawn by A. Shehab.



Map 72: Distribution of *Meriones tristrami*.

Localities: Al Muwaqqar, Amman, Ash Shawbak, At Tafila. Azraq, Ghazalah, Irbid, Jawa, Ra's an Naqb.

***Meriones libycus* Lichtenstein, 1823**

Verz. Doublet. Zool. Mus. Univ. Berlin, p. 5.

Common name: Libyan Jird.

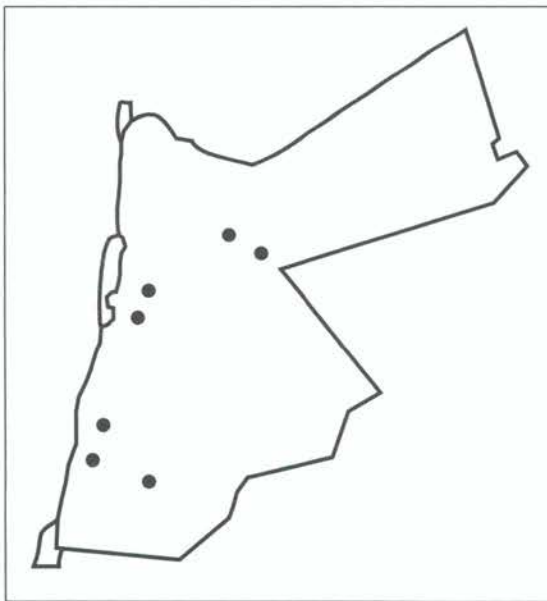
Distribution: North Africa from Western Sahara (Rio de Oro) to Egypt, through Saudi Arabia, Jordan, Iraq, Syria, Iran, Afghanistan, and into S Turkestan to W China.

Type Locality: Egypt, near Alexandria.

Diagnosis: Fur colour brown yellowish dorsally with some black speckling, ventral colour white. Ears are not pigmented. Claws black. Hindfeet with partially hairy soles. Tail reddish terminating with a thick black brush. Tympanic bullae large, extending beyond supraoccipital, accessory tympanum present. Form of the suprimeatal triangle of bullae distinguishes this species from *M. crassus*, in being smaller and nearly closed at its posterior end. Upper incisors with anterior median groove.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: 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 colocyntis*, a common desert annual plant. This is a nocturnal species, however, it may appear during daytime (Personal observations). Females give birth to 2-4 young (Osborn & Helmy, 1980).



Map 73: Distribution of *Meriones libycus*.

Localities: Al Jafr, Al Qatranah, Azraq, Al Lajjun, Qasr al Hallabat, Wadi Arabah.

***Meriones crassus* Sundevall, 1842**

K. Svenska Vet. Akad., Ser. 3, p. 233.

Common name: Sundevall's Jird, Sand Jird, Silk Jird.

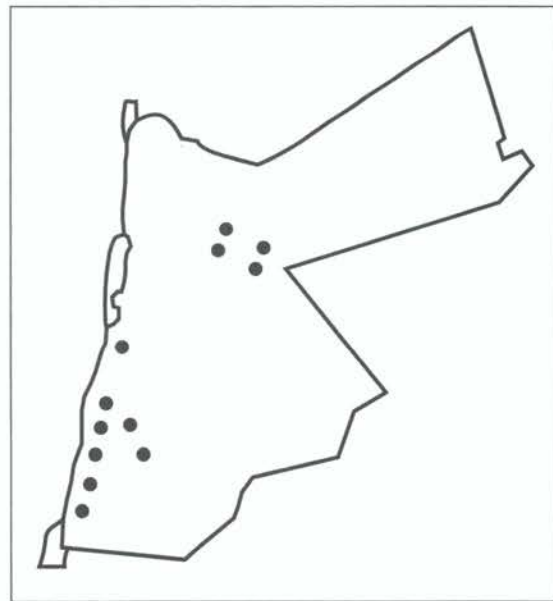
Distribution: Across North Africa from Morocco through Niger, Sudan, and Egypt to Palestine, Jordan, Syria, Saudi Arabia, Iraq, Iran, and Afghanistan.

Type Locality: Egypt, Sinai, Fount of Moses (Ain Musa).

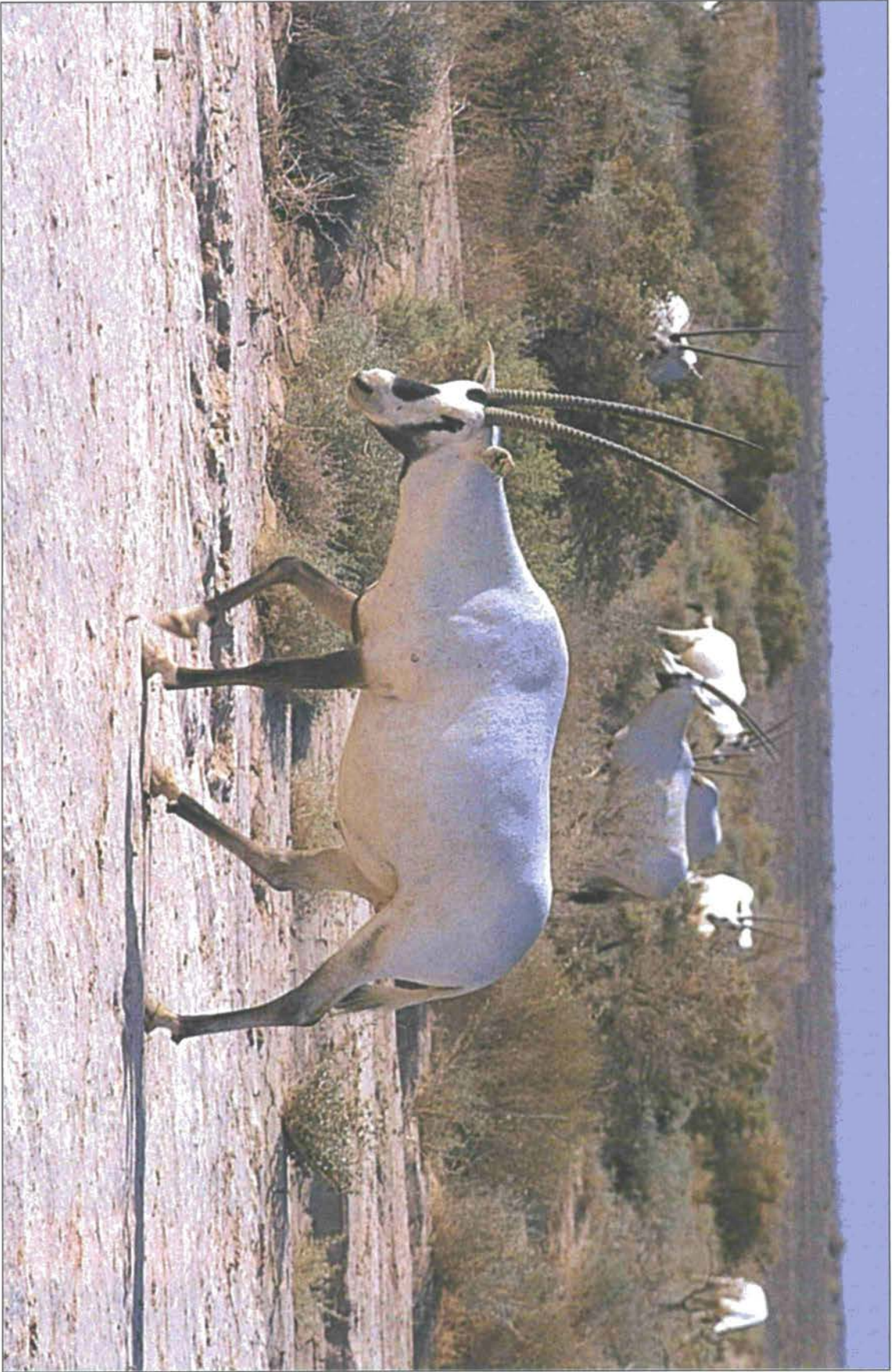
Diagnosis: Fur colour pale sandy dorsally, underside pure white, line of demarcation not very distinct. Ears small and not pigmented, claws white. Hind feet covered with white hair. Tail terminates with a black brush (not as well developed as in *M. libycus*). Tail length is about equal to head body length. Skull robust, with extremely large bullae that extend quite beyond the supraoccipital. Braincase broad. The suprimeatal triangle of bullae large and widely open at its posterior end. Upper incisors with anterior median groove.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: This is one of the most common jirds inhabiting the dry and arid habitats of Jordan. 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



Map 74: Distribution of *Meriones crassus*.



The Arabian Oryx at Shawmari Wildlife Reserve (Photo: Z. Amr)



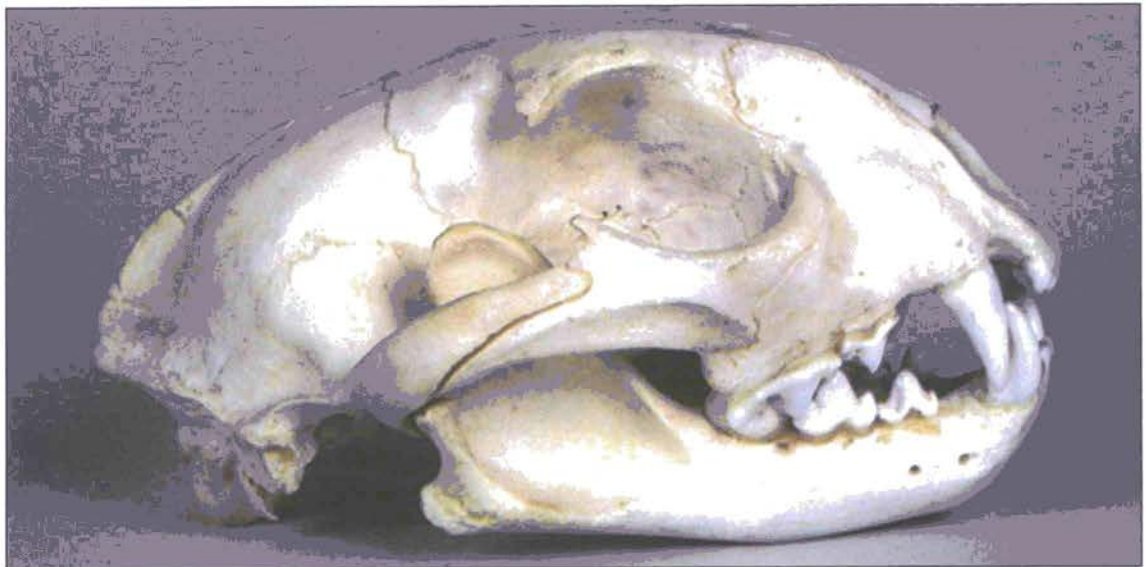
Gazella dorcas in Wadi Araba (Photo: RSCN)



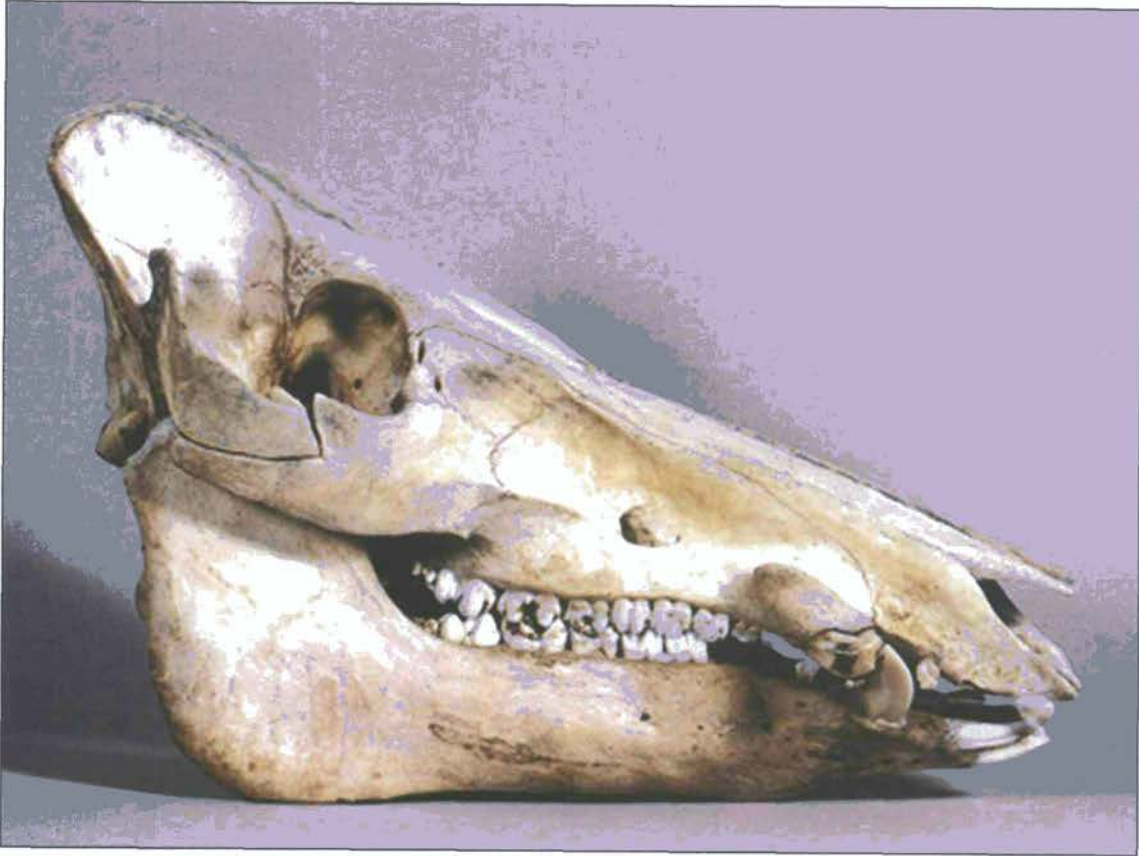
Vulpes vulpes (Photo: W. Higgs)



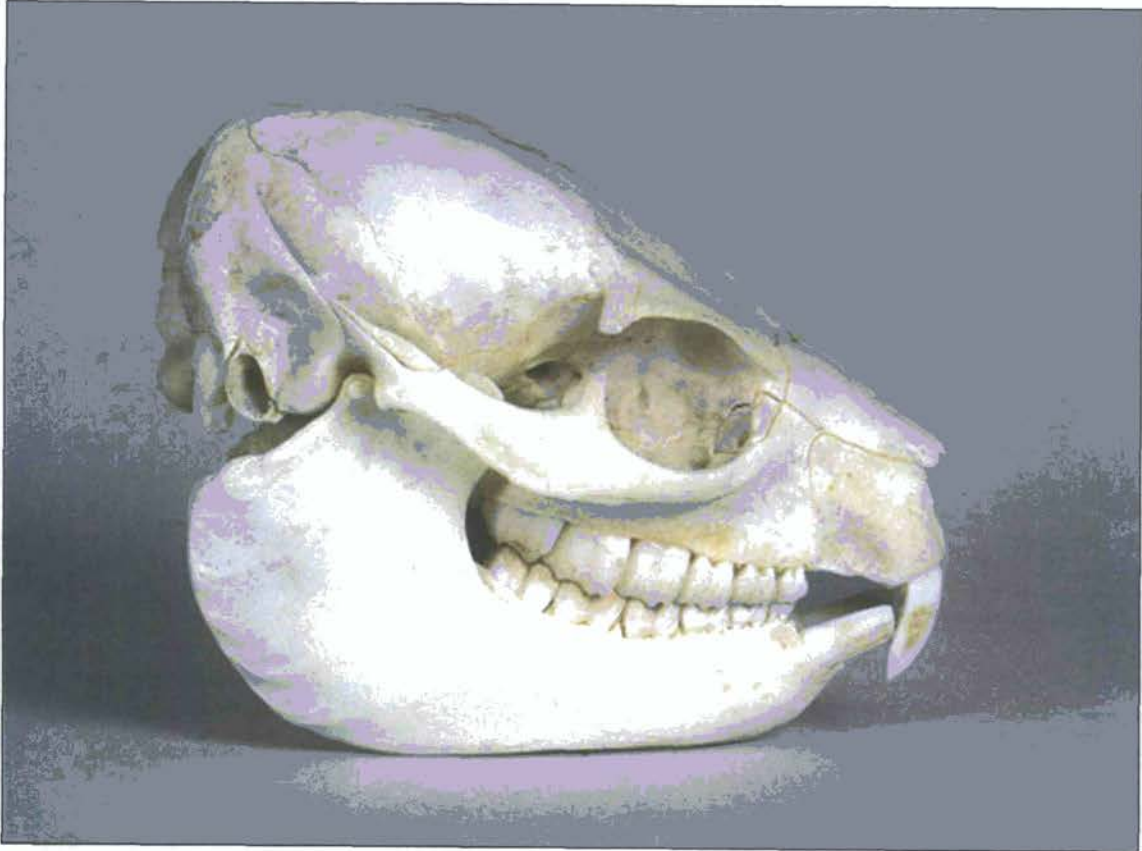
Lutra lutra (Photo: W. Higgs)



Caracal caracal (Photo: W. Higgs)



Sus scrofa (Photo: W. Higgs)



Procapra capensis (Photo: W. Higgs)

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 out during daytime to feed on barely and other vegetable matters.

Localities: Al Jafr, Al Muwaqqar, Al Aqabah, Ash Shawmari, Azraq, Bi'r Madhkur, Ghawr as Safi, Qasr Amrah, Quwayrah, Rishah, Wadi Fidan, Wadi Khinzirah.

***Psammomys obesus* Cretzschmar, 1828**

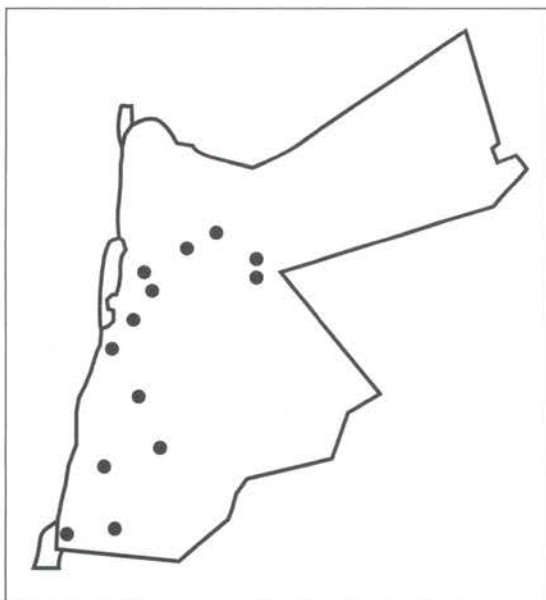
In Rüppell, *Atlas Reise Nordl. Afr., Zool., Säugeth.*, p. 58, pl. 22.

Common name: Fat Sand Rat.

Distribution: In North Africa from Algeria through Tunisia and coastal region of Egypt into Syria, Jordan, Palestine, and parts of Arabia, also on the coast of Sudan.

Type Locality: Egypt, Alexandria.

Diagnosis: Large rodent. Fur dorsally reddish to yellowish in colour, ventral side greyish white, line of demarcation not very distinct. No white patches behind ears or above eyes. Ears densely haired and short. Feet with black claws. Long hair on hindfeet soles, with naked heel. Tail short and thick terminating with a black tuft. Skull robust and very angular with well developed ridges. Upper incisors without grooves, else the crown structure of molars very similar to *Meriones*.



Map 75: Distribution of *Psammomys obesus*.

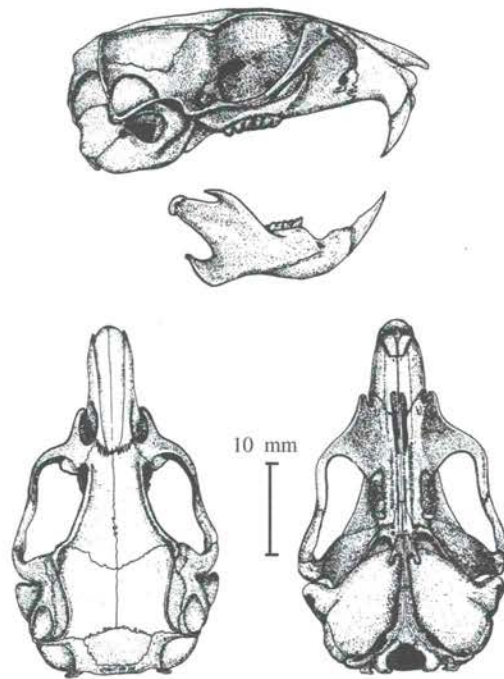


Fig. 45: Lateral, dorsal and ventral view of *Psammomys obesus* skull. After Osborn & Helmy (1980).

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16$.

Remarks: 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 colonized by this jird. The Fat Sand Jird is a colonial species forming large colonies constructed close to *Anabasis* sp. shrubs. It was found to share burrows with the Grey 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, it disappeared entirely, whereas new colonies are established in new areas away from the original foci. Gestation period may last for 23-25 days, and females give birth to 2-8 young (Osborn & Helmy, 1980).

Localities: 60 Km S Amman, Al Hasa, Al Jafr, Al Muwaqqar, Al Qatranah, Al Aqabah, Ash Shawmari, Azraq, Ma'an, Qasr al-Hallabat, Umm Rasas, Wadi Ramm.

Subfamily Microtinae

***Microtus guentheri* (Danford & Alston, 1880)**
Proc. Zool. Soc. London, 1880:62.

Common name: Levant Vole.

Distribution: S Bulgaria, S Yugoslavia, E Greece, and W Turkey

Type Locality: Turkey, Maras Prov., Taurus Mtns, near Maras (= Marash).

Diagnosis: Fur colour of dorsum reddish brown, greyish ventrally, weak line of demarcation. Ears and tail are very short. Hindfeet with

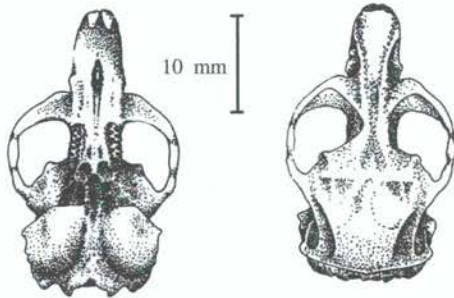


Fig. 46: Dorsal and ventral views of *Microtus guentheri* skull. (Scale bar 10 mm). Drawn by A. Shehab.

five tubercles on soles. Soles of hindfeet densely haired posteriorly. Tail less than one third of head body length. Four pairs of mammae. Third upper molar with three re-entering folds.

Dental formula: $i\ 1/1\ c\ 0/0\ pm\ 0/0\ m\ 3/3 = 16.$

Remarks: The Levant Vole is 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 Gray Hamster (*Cricetulus migratorius*) and Tristram's Jird (*Meriones tristrami*). The Barn Owl (*Tyto alba*) feeds readily on the Levant Vole (Dor, 1947; Rifai *et al.*, 1998).

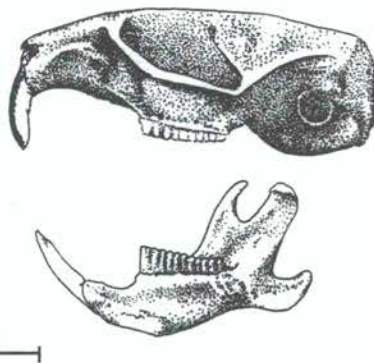
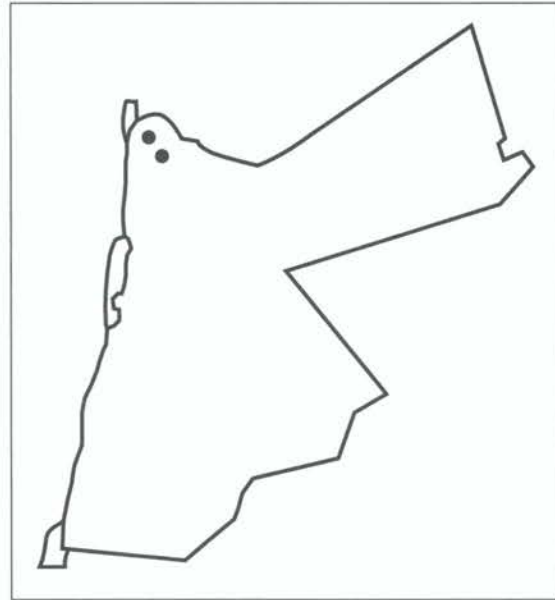


Fig. 47: Lateral view of *Microtus guentheri* skull. (Scale bar 10 mm). Drawn by A. Shehab.

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 (Personal observations).

This rodent is a very important agricultural pest. Its populations may increase suddenly inflicting severe damage to crops. In 1992, northern Jordan was plagued with a population explosion of the Levant Vole. This was manifested in severe damage of wheat fields, all summer crops (squash, watermelon, etc.) and destruction of stems of newly planted fruit trees. In the following years the populations of this vole ceased and are now under control.



Map 76: Distribution of *Microtus guentheri*.

Localities: Ibeen, Sareeh.

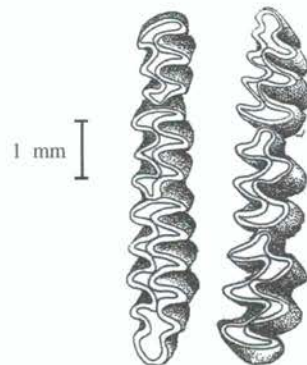


Fig. 48: Uper and lower cheel-teeth of *Microtus guentheri* skull. (Scale bar 1 mm). Drawn by A. Shehab.

CHAPTER 5

THE STATUS OF MAMMALS IN JORDAN

Species that constitute the base of biodiversity in Jordan can be divided into the following categories. **Common species:** these are species that are not threatened by human activities and environmental changes since they are not in demand or used in any form. Also, common species have innate or behavioral capacities that allow them to accommodate quickly to new surroundings. They are usually abundant and are not prone to extinction. **Threatened species:** these are species that are still abundant in parts of their territorial range, are declining significantly in total numbers and may be on the verge of extinction in certain regions or localities. **Endangered species:** these species are considered in imminent danger of extinction. **Relict species:** these are species isolated from the general range of their current distribution and still exist in areas out of their natural range of distribution, with delicate and fragile environment conditions which their ancestors used to live under. **Endemic species:** These are species that are unique to a certain geographical area, and are not found in any other areas. **Introduced or exotic species:** These are not originally known to occur in the area, and are brought from distant origins for a variety of reasons. **Re-introduced species:** These species were locally extinct, and then re-introduced to Jordan into their previous habitats.

In this account we are going to classify the current status of the Jordanian mammals based on recent studies.

1. Common Species:

Perhaps rodents are the most common species known to occur in Jordan. More than 18 species are considered common. They are: Family Cricetidae: *Gerbillus dasyurus*, *Gerbillus nanus*, *Gerbillus henleyi*, *Gerbillus gerbillus*, *Meriones tristrami*, *Meriones libycus*, *Meriones crassus*, *Psammomys obesus*, *Micro-*

tus guentheri, Family Spalacidae: *Nannospalax leucodon*, Family Muridae: *Apodemus mystacinus*, *Rattus rattus*, *Rattus norvegicus*, *Mus musculus*, *Acomys cahirinus*, *Acomys russatus*, and Family Dipodidae: *Jaculus jaculus*, *Allactaga euphratica*.

Other species as hedgehogs (Family Erinaceidae: *Erinaceus concolor*, *Hemiechinus auritus*, and *Paraechinus aethiopicus*) are still common despite the heavy death tolls especially on highways and small roads.

Among the carnivores, the Red Fox (*Vulpes vulpes*) is the only species that is not affected by human activities. This fox seems to be adapted to all types of habitats in Jordan, given its wide range of distribution.

In order Artiodactyla, the Wild Boar, *Sus scrofa*, is the only common species. This animal is considered dirty and its meat is forbidden among the Muslim's majority inhabitants of Jordan. It is quite common along the Jordan and Yarmuk Rivers in the Jordan Valley.

This is due to the fact that these animals are not under direct threat by human activities and have a high reproductive potential. Additionally, the natural habitats for these species is away from human settlements and subsequently are not under direct threat impacts of man-made changes. Some species, however, are associated with urban habitats (i.e. *R. rattus*, *R. norvegicus* and *M. musculus*).

2. Threatened Species:

From the beginning of this century and continuing to the present day, very rapid changes have occurred in the Middle East and particularly in Jordan. These changes include the introduction of machine guns and vehicles

that invaded the deserts and all types of habitats, as well as continuous population growth and mass emigration from Palestine into Jordan during the 1948 and 1967 wars. These changes had a tremendous impact on the wildlife in many aspects, and land use for agriculture and development took its toll at the expense of wildlife habitats (Qumsiyeh *et al.*, 1996).

Additionally, unlawful hunting based on wrong attitudes towards some species caused a severe decline in their populations. Artiodactyls are the most affected mammals, such as the Nubian Ibex, *Capra ibex nubiana*, and the gazelles, *Gazella dorcas* and *Gazella subgutturosa*.

Most species of the order Carnivora were drastically affected, and some were actually extinct. Of those that are considered threatened: Family Canidae: *Canis lupus*, *Canis aureus syriacus*, *Vulpes rueppelli*, *Vulpes cana*, Family Mustelidae: *Vormela peregusna*, *Martes foina syriaca*, *Meles meles*, *Mellivora*

capensis, *Lutra lutra*, Family Herpestidae: *Herpestes ichneumon*, Family Hyaenidae: *Hyaena hyaena*, Family Felidae: *Felis silvestris*, *Felis margarita*, *Felis chaus* and *Caracal caracal*.

Two species of the order Rodentia, the Persian Squirrel, *Sciurus anomalus*, and the Indian Crested Porcupine, *Hystrix indica*, are considered as threatened. This is largely based on the consumption of the porcupine flesh for medicinal purposes by the locals and the agricultural expansion and deforestation of pine and oak forests, the perfect habitats for the Persian Squirrel.

The Cape Hare, *Lepus capensis*, is under continuous threat in the Jordanian desert. In our field trips we noticed a sharp decline in its populations due to the extensive all-year round hunting. On the other hand, the Rock Hyrax, *Procavia capensis*, has a restricted distribution in relatively fragile habitats, placing this little known animal under threat.

Table (1)
Summary for the status of Artiodactyla in Jordan

Species	Current Status	IUCN global threat Category	Approximate Population Size	Approximate date of extinction
<i>Sus scrofa</i>	Common	V	high	
<i>Bos primigenius</i>	Extinct	?	--	1200
<i>Addax nasomaculatus</i>	Extinct	C	--	1800
<i>Capra ibex</i>	Endangered and Re-introduced	V	700	
<i>Oryx leucoryx</i>	Re-introduced	E	176	1920
<i>Gazella gazella</i>	Rare	R	?	
<i>Gazella dorcas</i>	Vulnerable	V	300	
<i>Gazella subgutturosa</i>	Endangered	E	<100	
<i>Cervus elaphus</i>	Extinct	?	--	1500
<i>Capreolus capreolus</i>	Re-introduced	O	12	1700
<i>Dama mesopotamica</i>	Extinct	C	--	1900

C: Critical, V: Vulnerable, R: Rare, O: out of danger, E: Endangered

3. Extinct Species

Several species of medium and large-sized mammals became extinct from the Jordanian ecosystems as well as from the surrounding countries. Some of these animals vanished about 500 years ago as the lion. By the turn of this century several even-toed ungulates and carnivores became very rare and are now considered extinct.

Qumsiyeh *et al.* (1993 & 1996) gave a detailed treatment for the status of the extinct carnivores and artiodactyls. Of the carnivores, the lion, *Panthera leo*, became extinct from our area around the time of the crusaders according to Tristram (1884). The Leopard, *Panthera pardus*, is perhaps still surviving in the southern mountains of Jordan and around the mountains of the Dead Sea. Records from Zarqa Ma'in indicated that a male was killed in 1965. Clarke (1977) listed the following localities for the leopard in Jordan based on earlier records: Petra, Wadi az Zarqa, Ayn el Tabah, Ayun Buweirdah, and Ma'an. Amr & Disi (1988) reported that one was seen by shepherds in the At Tafilah area where it attacked and killed two sheep.

The Cheetah, *Acinonyx jubatus*, was reported from several localities during 1866-1935. This animal must have been common in the Middle Ages because it is mentioned frequently in the writings of the Arabian travelers and by European explorers. By the time of Tristram, it was very scarce and only located in wooded hills of the Galilee and near Tabor in Palestine and in the Ajlun mountains in Jordan (Tristram, 1876 & 1885). The Cheetah probably became extinct in Palestine in the last half of the 19th century with remnant populations in Jordan left around Mu'ab until 1900-1912, where Schmitz collected a specimen and discussed its presence. Aharoni (1930) mentions that the Bedouins reported seeing animals in the southern region of the country early in this century. The Cheetah is probably extinct in Palestine and Jordan. However, a record from northern Saudi Arabia in 1950 (Morrison-Scott, 1951) suggests that there may be a remnant population surviving in the Northern Arabian deserts.

Many of our artiodactyls became extinct due to extensive hunting. Bone remains were

excavated from early human settlements as Ayn Ghazal, Azraq, Wadi al Hasa, Wadi Jilat and Tel Hesban (Boessneck & Von den Driesch 1978; Garrard *et al.*, 1988; Kohler-Rollefson *et al.*, 1988). The Wild Ox, *Bos primigenius*, was extirpated around the 13th century. The Addax, *Addax nasomaculatus*, survived during the Roman period and became extinct by the 19th century. Remains of *Cervus elaphus*, the Red Deer, were excavated from Tel Hesban in strata the dates back to the 12th to the 15th century AD (Boessneck & Von den Driesch, 1978). The Roe deer, *Capreolus capreolus*, perhaps disappeared during the beginning of this century. Carruthers (1909) reported that the Roe Deer existed around the forested regions in the north of the Jordan Valley and in the hills of northern Palestine. Severe deforestation in Jordan as well as extensive hunting are the main reasons for the extermination of this forest adapted species. The Mesopotamian Fallow Deer, *Dama mesopotamica*, was common in Jordan during the 7th to the 6th century BC. Bone remains were excavated from Tel Hesban and Al Hammah (Boessneck & Von den Driesch 1978; Edwards *et al.*, 1988). Bodenheimer (1958) gave a record of antlers saying that they originated from Jarash. It is estimated that the Mesopotamian Fallow Deer became extinct around the beginning of this century.

4. Re-introduced Species

Three species of artiodactyls were successfully reintroduced in three wildlife reserves managed by the Royal Society for the Conservation of Nature (RSCN). The Oryx have been reintroduced to Jordan in 1978 in the Shawmari Wildlife Reserve (Fitter, 1984; Lamb, 1984; Nelson, 1985; Hatough & El-Eisawi, 1988). In 1995, the herd numbered about 176 heads and was held within a 20 km² enclosure. The present Oryx herd at Shawmari Wildlife Reserve originated from stock received from the San Diego Wild Animal Park during 1978-1979 and Qatar. In 1984 a herd of the Oryx was released in the Jordanian desert (Fitter, 1984; Nelson, 1985).

In 1988, two males and two females of *Capreolus capreolus* from the Turkish-Bulgarian border were donated by the Turkish Government to the RSCN. This species was reintroduced to the Zubiya Nature Reserve,

situated near Ajlun. It occupies 11 km². It lies within the Mediterranean biotope dominated by open woodland of *Quercus calliprion* and *Pistacia palaestina*. By 1995, 12 individuals were surviving in this reserve.

In 1989, 20 Nubian Ibexes, *Capra ibex*, were donated from the San Diego Zoo and placed at Al Mawjib Nature Reserve. This reserve occupies 212 km² over-looking the Dead Sea. Two local animals collected from Karak were mated with the herd. Now, the herd consists of 68 heads kept in an enclosure of 20,000 m². The RSCN is in the process of releasing the ibex in some selected habitats (Qumsiyeh *et al.*, 1996).

5. Exotic Species

The Coypu, *Myocator coypus*, was in-

troduced to Jordan in 1940's by the British Mandate authorities to encourage fur production. Also, it was introduced by Israeli settlers (Bodenheimer, 1958). This is a New World rodent species that proliferated along the Jordan and Yarmuk Rivers. Now it is considered as an agricultural pest for farmers along the Jordan River. I saw a colony of the Coypu near the banks of Yarmuk River. A specimen of this rodent was found in Sil Jaraash (Qumsiyeh, 1996).

The Rabbit, *Oryctolagus porcellus*, is currently progressing in some parts of the country. The Rabbit was introduced from many origins as a source of meat. Several rabbit's farms are producing rabbit meat at a commercial scale. Perhaps some animals strayed and formed wild colonies.

Table (3)
Local, IUCN, and CITES status of some mammals in Jordan

Species	Local Status	IUCN Status	CITES Status
<i>Erinaceus concolor</i>	Common		
<i>Hemiechinus auritus</i>	Vulnerable		
<i>Paraechinus aethiopicus</i>	Vulnerable		
<i>Crocidura suaveolens</i>	Rare		
<i>Suncus etruscus</i>	Rare		
<i>Rousettus aegyptiacus</i>	Common		
<i>Rhinopoma hardwickei</i>	Vulnerable		
<i>Rhinopoma microphyllum</i>	Vulnerable		
<i>Taphozous perforatus</i>	Vulnerable		
<i>Taphozous nudiventris</i>	Vulnerable		
<i>Eptesicus bottae</i>	Vulnerable		
<i>Miniopterus schreibersi</i>	Vulnerable	Lower risk nt	
<i>Myotis emarginatus</i>	Vulnerable	Vulnerable	
<i>Myotis capaccinii</i>	Vulnerable	Vulnerable	
<i>Myotis nattereri hovei</i>	Vulnerable		
<i>Otonycteris hemprichi</i>	Vulnerable		
<i>Pipistrellus ariel</i>	Rare		
<i>Pipistrellus bodenheimeri</i>	Vulnerable		
<i>Pipistrellus kuhli</i>	Common		
<i>Plecotus austriacus</i>	Vulnerable		
<i>Tadarida teniotis</i>	Vulnerable		
<i>Sciurus anomalus syriacus</i>	Endangered	Lower risk nt	
<i>Hystrix indica</i>	Vulnerable		
<i>Allactaga euphratica</i>	Common	Lower risk nt	
<i>Jaculus jaculus</i>	Common		
<i>Eliomys melanurus</i>	Vulnerable		
<i>Spalax leucodon</i>	Vulnerable		
<i>Canis aureus</i>	Endangered		
<i>Canis lupus</i>	Endangered		
<i>Vulpus cana</i>	Vulnerable	Insufficiently known	Appendix II
<i>Vulpes rueppelli</i>	Endangered	Insufficiently known	
<i>Vulpes vulpes</i>	Common		
<i>Acinonyx jubatus</i>	Rare or extinct	Vulnerable	
<i>Caracal caracal</i>	Endangered	Rare	Appendix I
<i>Felis chaus</i>	Endangered		Appendix II
<i>Felis margarita</i>	Endangered	Endangered	Appendix II
<i>Felis silvestris</i>	Vulnerable		Appendix II
<i>Panthera pardus</i>	Extinct		
<i>Procavia capensis syriaca</i>	Vulnerable		
<i>Hyaena hyaena</i>	Vulnerable		
<i>Herpestes ichneumon</i>	Vulnerable		
<i>Lutra lutra</i>	Vulnerable	Vulnerable	Appendix I
<i>Martes foina syriaca</i>	Rare and vulnerable		Appendix III
<i>Meles meles</i>	Vulnerable		
<i>Mellivora capensis</i>	Endangered		Appendix III
<i>Vormela peregusna syriaca</i>	Rare and vulnerable	Vulnerable	
<i>Sus scrofa</i>	Common		
<i>Gazella gazella</i>	Vulnerable		
<i>Gazella subgutturosa</i>	Endangered		
<i>Gazella dorcas</i>	Vulnerable		Appendix III
<i>Oryx leucoryx</i>		Endangered	Appendix I

CHAPTER 6

MAMMALS OF ECONOMIC AND HEALTH IMPORTANCE

1. Mammals of Economic Importance

Several species of mammals occurring in Jordan are considered as agricultural pests. Some can inflict damages to crops and cereals in various parts of the country. The majority of these mammals are rodents. Of the known 25 species of rodents, only six species are considered of economic importance.

The Levant Vole, *Microtus guentheri*, is notorious for its serious damage to wheat fields and summer crops as well as to bark of newly planted fruit trees (i.e. squash, cucumber, water melon etc.). This species is widely distributed in northern Jordan (Irbid Governorate). In 1992, an outbreak of the Levant Vole was recorded near As Sarih area, and caused devastation among farmers. In the following years further outbreaks were reported. The Ministry of Agriculture in participation with the Jordan University of Science and Technology and the National Centre for Agriculture and Technology Transfer (NCARTT) instituted continuous program for rodent control.

The Mole Rat, *Nannospalax leucodon*, is common in the mountainous regions of Jordan. It lives underground and make tunnels while moving from one place to the other. The Mole Rat feeds primarily on bulbs and roots. Its characterized mounds of red soil are the signs for its presence.

Other pests include the Libyan Jird, *Meriones libycus*. This species feeds on grains and green leaves of crops. It is considered as a pest in farms established in the eastern desert.

Three murids, the Black Rat (*Rattus rattus*), the Brown Rat (*Rattus norvegicus*), and the House Mouse (*Mus musculus*) are also considered to be of economic importance.

They damage stored serials, food items as well as animal feed. These three species are associated with urban habitats and found in farms in remote areas.

As for the other rodents, the majority are not considered as major agricultural pest, since they do not cause severe damages to the different crops.

The Wild Boar, *Sus scrofa*, is widely distributed along the Jordan Valley, and the mountains of Ajlun. They attack orange grooves and fruit gardens. This species is not under protection and farmers use all kinds of control including poisoning and shooting.

The Egyptian Fruit Bat, *Rousettus aegyptiacus*, causes marginal damages to fruit trees in the upper Jordan Valley and some areas in the Karak Governorate. However, this bat is under severe stress due to habitat modifications and is considered as a threatened species.

Some carnivores occasionally attack chicken farms such as the Red Fox (*Vulpes vulpes*). However, the loss is not evident to consider this fox as serious pests. Some species as the Stone Marten (*Martes foina*) and the Marbled Polecat (*Vormela peregusna syriaca*) are suffering from poisoning (Rifai *et al.*, 1998).

2. Mammals of Health Importance

Several mammals serve as reservoir hosts for different zoonotic diseases. These are the diseases that are transmitted between man and wild animals.

Leishmaniasis

Leishmaniasis, an endemic disease to Jordan, and is caused by at least two proto-

zoan parasites of the genus *Leishmania*. *Leishmania major*, the causative agent for zoonotic Cutaneous Leishmaniasis, was isolated from the Sand Fat Jird, *Psammomys obesus* (Saliba *et al.*, 1988; Saliba *et al.*, 1994; Saliba & Oumeish, 1999). 23% of 170 fat sand jirds were positive for the *Leishmania* amastigote in their ears (Saliba *et al.*, 1994). This rodent is widely distributed in arid and semi-arid environments with Chenopod vegetation (*Anabasis* sp.). In Jordan, other rodents including *Meriones libycus*, *Meriones tristrami*, *Meriones crassus* and *Allactaga euphratica* and other gerbils were not infected by the parasite (Saliba *et al.*, 1994). In the Middle East, known reservoir hosts includes *Meriones crassus*, *Meriones libycus* and *Gerbillus pyramidum*, from which *L. major* was isolated.

On the other hand, the natural reservoir for *L. tropica* is not yet fully known in affected areas, it is speculated that dogs, hyraxes (*Procavia capensis*) or other wild animals may serve as reservoirs. Kamhawi *et al.* (1995) suggested an anthroponotic transmission, as it is the case in other endemic areas. Near Jerusalem, Klaus *et al.* (1994) implied that hyraxes close to human dwellings are involved in the transmission of both *L. tropica* and *L. major*, where both forms of cutaneous leishmaniasis occur.

Hydatid Cyst

Hydatidosis is another zoonotic disease endemic to Jordan and other Mediterranean countries. This disease is caused by the Dog Tapeworm, *Echinococcus granulosus*. Domestic animals such as sheep, goats, camels, donkeys and cattle are the primary hosts for the immature stage of the worm, while canines, particularly dogs and foxes are the hosts for the mature stage.

Plague

Historically, Jordan as well as many other Middle Eastern countries was known as an endemic foci for Bubonic Plague. In the Jordan Valley, the "Omwas" plague took its toll during the early period of the newly established *Al-Rashedeen Khalifs*. However, since the foundation of the modern state of Jordan, plague has never been reported. Gratz (1973) reviewed the status of plague in the Middle East.

In 1997, oro-pharyngeal plague occurred among 12 inhabitants of Azarq ad Duruze village, northeastern Jordan (Arbaji *et al.*, in preparation). Oro-pharyngeal plague due to consumption of plague infested animals has been reported in Libya (Christie, 1980; Christie *et al.*, 1980). Camels and goats are the major red meat source in nomadic areas, and could acquire the causative agent for plague, *Yersinia pestis*, while foraging in deserts. It is believed that domestic animals become infected through feeding on rodent's faeces contaminated forage, or biting by infested fleas

Rabies

Little is known about the status of rabies in Jordan. However, canids are most likely to be the major source of this deadly viral infection. Scattered reports indicated that the wolf (*Canis lupus*) is the major reservoir for rabies. In the 1996 report for the WHO, a total of 24 animal cases were confirmed in the laboratory or clinically. Four dogs, one cat, nine ruminants, one equine, and three foxes were among the infected animals. Yet, more studies should focus on the role of wild animals in the epidemiology of this serious disease.

3. Ectoparasites Associated with Mammals in Jordan

3.1 Siphonaptera

Few studies focused on the Siphonaptera associated with mammals in Jordan. Burt (1970) and Saliba & Amr (1985) studied the fleas of Jordan. These fleas are represented in five families (Ceratophyllidae, Hystrichopsyllidae, Leptopsyllidae, Pulicidae and Vermipsyllidae), with a total of 23 species taken from wild animals, including insectivores, rodents and carnivores. Table (4) summarizes all fleas species and their mammalian hosts.

3.2. Acarina (Hard and soft ticks)

So far, a total of 20 species and subspecies of ixodid ticks represented in five genera (*Boophilus*, *Haemaphysalis*, *Hyalomma*, *Ixodes* and *Rhipicephalus*) were recorded from Jordan (Hoogstraal & Kaiser, 1959 & 1960; Rabi *et al.*, 1990; Saliba *et al.*, 1990). Five argasid ticks belonging to two genera (*Argas* and *Ornithodoros*) were taken from domestic mammals and bats.

All species recovered were associated

Table (4)
Fleas and their mammalian hosts reported from Jordan

Families and Species	Host
Family Ceratophyllidae	
<i>Nosopsyllus geneatus</i>	<i>Acomys russatus</i>
<i>Nosopsyllus heneleyi</i>	<i>Psammomys obesus</i>
<i>Nosopsyllus iranus</i>	<i>Gerbillus dasyurus</i> , <i>Meriones tristrami</i> , <i>Psammomys obesus</i>
<i>Nosopsyllus pumilionis</i>	<i>Gerbillus dasyurus</i> , <i>Meriones tristrami</i>
<i>Nosopsyllus pringlei</i>	<i>Gerbillus dasyurus</i>
<i>Nosopsyllus sincerus</i>	<i>Gerbillus dasyurus</i> <i>Microtus guentheri</i>
Family Hystrihopsyllidae	
<i>Stenoponia tripectinata</i> spp.	<i>Gerbillus dasyurus</i> , <i>Meriones tristrami</i>
Family Leptopyllidae	
<i>Leptopsylla algira</i>	<i>Gerbillus dasyurus</i> , <i>Mus musculus</i> , <i>Meriones</i> sp.
<i>Leptopsylla segnis</i>	<i>Acomys cahirinus</i> , <i>Apodemus mystacinus</i>
<i>Ophthalmopsylla volgensis</i>	<i>Alactaga euphratica</i> , <i>Jaculus jaculus</i>
Family Pulicidae	
<i>Ctenocephalides canis</i>	Domestic cat, domestic dog
<i>Ctenocephalides felis</i>	Domestic cat, domestic dog, <i>Rattus rattus</i> , <i>Herpestes ichneumon</i>
<i>Parapulex chephrenis</i>	<i>Acomys cahirinus</i> , <i>Acomys russatus</i>
<i>Pulex irritans</i>	Man, domestic dog, <i>Vulpes vulpes</i>
<i>Synosternus cleopatrae</i>	<i>Meriones crassus</i> , <i>Meriones tristrami</i>
<i>Synosternus pallidus</i>	<i>Hemiechinus auratus</i> , <i>Vulpes vulpes</i>
<i>Xenopsylla cheopis</i>	<i>Acomys cahirinus</i> , <i>Rattus rattus</i> , <i>Rattus norvegicus</i> , domestic dog
<i>Xenopsylla conformis</i>	<i>Gerbillus dasyurus</i> , <i>Jaculus jaculus</i> , <i>Meriones crassus</i> , <i>Meriones libycus</i> , <i>Meriones tristrami</i> , <i>Psammomys obesus</i>
<i>Xenopsylla dipodilli</i>	<i>Gerbillus dasyurus</i> , <i>Meriones tristrami</i>
<i>Xenopsylla nubica</i>	<i>Allactaga euphratica</i> , <i>Jaculus jaculus</i>
<i>Xenopsylla ramesis</i>	<i>Gerbillus dasyurus</i> , <i>Meriones crassus</i> , <i>Meriones tristrami</i> , <i>Mus musculus</i> , <i>Psammomys obesus</i>
Family Vermipsyllidae	
<i>Chaetopsylla joannae</i>	<i>Meriones tristrami</i> , <i>Gerbillus dasyurus</i>
<i>Chaetopsylla globiceps</i>	<i>Vulpes vulpes</i>

with domestic animals, birds, reptiles and other wild mammals. Table (5 and 6) gives a summary for hosts associated with each species.

3.3. Streblidae and Nycteribiidae

The bat flies of Jordan are still poorly studied. Four species belonging to two fami-

lies were recorded from three bat species (Amr & Qumsiyeh, 1993). Table (7) summarizes bat flies associated with bats in Jordan.

Table (5)
Hard ticks in Jordan and their respective Mammalian hosts

Species	Host(s)
<i>Hyalomma marginatum marginatum</i>	Goats and cattle
<i>Hyalomma marginatum turanicum</i>	Sheep
<i>Hyalomma anatolicum anatolicum</i>	Sheep
<i>Hyalomma anatolicum excavatum</i>	Sheep and cattle
<i>Hyalomma dromedarii</i>	Camel
<i>Hyalomma impeltatum</i>	Camel, cattle
<i>Hyalomma schulzei</i>	Domestic cow, camel
<i>Hyalomma detritum</i>	Domestic cattle, camel, domestic cow
<i>Rhipicephalus sanguineus</i>	Dog, <i>Vulpes vulpes</i> , <i>Hemiechinus arutus</i> , cat, sheep, goat
<i>Rhipicephalus turanicus</i>	Domestic sheep, <i>Meriones tristrami</i> , <i>Vulpes vulpes</i> , <i>Acomys cahirinus</i> , <i>Sekeetamys calurus</i> , domestic ox
<i>Rhipicephalus camicasi</i>	<i>Lepus capensis</i> , domestic goat
<i>Rhipicephalus bursa</i>	Sheep and goat
<i>Haemaphysalis erinacei taurica</i>	<i>Meriones tristrami</i> , <i>Paraechinus aethiopicus</i> , <i>Vulpes vulpes</i>
<i>Haemaphysalis sulcata</i>	Cattle
<i>Haemaphysalis otophila</i>	Sheep and goats
<i>Haemaphysalis parva</i>	Goat and sheep
<i>Boophilus annulatus</i>	Sheep, goat and cattle
<i>Boophilus kohlsi</i>	Domestic cow, domestic horse, domestic cattle, and domestic buffalo
<i>Ixodes sp.</i>	<i>Herpestes ichneumon</i>

Table (6)
Soft ticks in Jordan and their respective hosts

Species	Host (s)
<i>Argas vespertilionis</i>	<i>Myotis nattereri</i>
<i>Ornithodoros coniceps</i>	Domestic sheep
<i>Ornithodoros erraticus</i>	<i>Meriones libycus</i>
<i>Ornithodoros salahi</i>	<i>Myotis sp.</i> and <i>Rousettus aegyptiacus</i>
<i>Ornithodoros lahorensis</i>	Domestic sheep and camel

Table (7)
Bat flies associated with bats in Jordan

Species	Host (s)
Family Streblidae	
<i>Brachytarsina falvipennis</i>	<i>Rhinolophus blasii</i>
Family Nycteribiidae	
<i>Stylidia biarticulata</i>	<i>Rhinolophus blasii</i>
<i>Stylidia integra</i>	<i>Rhinolophus hipposideros</i>
<i>Basilina nana</i>	<i>Myotis nattereri</i>

References

- Abbadi, M. 1991. Israel's elusive feline: Sand Cats. *Israel Land & Nature*, 16(3):11-115.
- Abed, A. 1982. *Geology of Jordan*. Al-Nahada Al-Islamia. Amman.
- Abu Dieyeh, M. H. 1988. The ecology of some rodents in Wadi Araba with special reference to *Acomys cahirinus*. M. S. Thesis. Jordan University. 216 pp.
- Aharoni, B. 1932. Muriden von Palestina und Syrien. *Zeitschrift für Säugetierkunde*, 7:166-240.
- Aharoni, J. 1930. Die Säugetiere Palästinas. *Zeitschrift für Säugetierkunde*, 5:327-343.
- Aikon, P. U. 1999. Microhabitat to landscape impacts: crested porcupine digs in the Negev desert highlands. *Journal of Arid Environments*, 41:183-202.
- Al-Eisawi, D. 1985. Vegetation in Jordan. In: Hadidi, A. (ed.): *Studies in the History and Archeology of Jordan*, Vol. 1. Amman (Department of Antiquities): 45-57.
- Allen, G. M. 1915. Mammals obtained by the Phillips Palestine Expedition. *Bulletin of the Museum of Comparative Zoology of Harvard University*, 59:3-14.
- Al-Melhim, W., Amr, Z. S., Disi, A. & Katbeh-Bader, A. 1997. On the diet of the Little Owl, *Athene noctua*, from Safawi Area. *Zoology in the Middle East*, 15:19-28.
- Al-Robaae, K. 1966. Untersuchungen der Lebensweise irakischer Feldermäuse. *Säugetierkundliche Mitteilungen*, 14:177-211.
- Al-Robaae, K. 1968. Notes on the biology of the tomb bat, *Taphozous nudiventris magnus* v. Wettstein 1913, in Iraq. *Säugetierkundliche Mitteilungen*, 16:21-26.
- Al-Shafee, D. M., Yuosef, M., Al-Melhim, W. N. & Amr, Z. S. 1997. The status of the Stone Marten, *Martes foina syriaca* (Nehring, 1902), in Jordan. *Zoology in the Middle East*, 15:5-8.
- Amr, Z. S. & Disi, A. 1988. *Jordanian Mammals acquired by the Jordan University Natural History Museum*. Publication of the University of Jordan. 32 pp.
- Amr, Z. S. & Disi, A. M. 1998. Diet of some snakes from Jordan. *Amphibia-Reptilia*, 19:436-439.
- Amr, Z. S. & Qumsiyeh, M. 1993. Records of bats flies from Jordan, Libya and Algeria *Entomological News*, 104:43-46.
- Amr, Z. S. & Saliba, E. K. 1986. Ecological observations on the Fat Jird, *Psammomys obesus diana*, in the Mowaqqar area of Jordan. *Dirasat*, 13(7):155-161.
- Amr, Z. S., Al-Melhim, W. & Yousef, M. A. 1997. Mammal remains from pellets of the Eagle Owl, *Bubo bubo*, from Azraq Nature Reserve. *Zoology in the Middle East*, 14:5-10.
- Amr, Z. S., Kalishaw, G., Yosef, M., Chilcot, B. J. & Al-Budari, A. 1996. Carnivores of Dana Nature Reserve (Carnivora: Canidae, Hyainidae and Felidae), Jordan. *Zoology in the Middle East*, 13:5-16.
- Amr, Z. S., Woodbury, S. & Disi, A. 1987. On a collection of mammals from Jordan. *Dirasat*, 14(7):131-136.
- Anon. 1946. The Schmitz collection of mammals. *Bulletin of Jerusalem Naturalist Club*, 23:1-2.
- Anon. 1986. Polecats all over. *Israel Land & Nature*, 11 (3):148.
- Anon. 1990. Jordan. Official Standard Names Gazetteer. Washington, D.C. (United States Board on Geographic Names).
- Anon. 1991. Marbeled Polecat in the Arava. *Israel Land & Nature*, 17 (1):94.
- Atallah, S. I. 1966. Mammals. In: Boyd, J. M. International Jordan Expedition 1966. *Nature (London)*, 212:664.
- Atallah, S. I. 1967a. A new species of spiny mouse (*Acomys*) from Jordan. *Journal of Mammalogy*, 48:255-261.
- Atallah, S. I. 1967b. A collection of mammals from El-Jafr., southern Jordan. *Säugetierkundliche Mitteilungen*, 32:307-309.
- Atallah, S. I. 1970. Bats of the genus *Myotis* (Family Vespertilionidae) from Lebanon. *University of Connecticut Occasional Papers*, 1:205-212.
- Atallah, S. I. 1977. Mammals of the Eastern Mediterranean: their ecology, systematics and zoogeographical relationships. *Säugetierkundliche Mitteilungen*, 25:241-320.
- Atallah, S. I. 1978. Mammals of the Eastern Mediterranean: their ecology, systematics and zoogeographical relationships. *Säugetierkundliche Mitteilungen*, 26:1-50.
- Bates, P. 1994. The distribution of *Acomys* (Rodentia: Muridae) in Africa and Asia. *Israel Journal of Zoology*, 40:199-214.
- Bates, P. 1995. Arabia's Hedgehogs: primitive but successful. *Arabian Wildlife*, 2(1): 18-19.
- Bates, P. 1996. Desert Specialists: Arabia's elegant mice. *Arabian Wildlife*, 2 (3): 26-27.
- Bates, P. J. & Harrison, D. 1989. New records of small mammals from Jordan. *Bonner Zoologische Beiträge*, 40:223-226.
- Belon, P. 1588. *Les observations de plusieurs singularitez et choses memorables, trouvees en Grece, Asie, Iudje, Egypte, Arabie & autres pays estranges, rediges en trois liures*. Paris, H. de Marnef.
- Benda, P. & Sadlová, J. 1999. New records of small mammals (Insectivora, Chiroptera, Rodentia, Hyracoidea) from Jordan. *Casopis Národního muzea, Rada prirodovedná*, 166:25-56.
- Bender, F. 1974. *Geology of Jordan*. Beiträge zur regionalen Geologie der Erde, 7. Supplement. Berlin, Stuttgart.

REFERENCES

- Ben-Yaacov, R. 1987. Mongooses-the creeping trackers. *Israel Land & Nature*, 12(2):50-55.
- Bodenheimer, F. S. 1935. *Animal Life in Palestine*. L. Mayer, Jerusalem, 507 pp.
- Bodenheimer, F. S. 1958. The present taxonomic status of the terrestrial mammals of Palestine. *Bulletin of the Research Council of Israel*, 7B:165-189.
- Boessneck, J. & Von den Driesch, A. 1978. Preliminary analysis of the animal bones from Tel Hesban. Andrews University Monographs, *Studies in Religion*, 10:259-87.
- Bouskila, Y. 1985. A closer look at the striped hyena. *Israel Land & Nature*, 10:50-56.
- Bunaian, F., Mashaqbeh, S., Yousef, M., Budairi, A. & Amr, Z. 1998. A new record of the Sand Cat, *Felis margarita* Loche, 1858 from Jordan. *Zoology in the Middle East*, 16:5-7.
- Burt, P. M. 1970. Fleas (Siphonaptera) of Israel and Jordan. M. S. thesis. Iowa State University.
- Carruthers, D. 1909. Big Game of Syria, Palestine and Sinai. *Field, London*, 114:1135.
- Carruthers, D. 1935. *Arabian Adventure*. H. F. & G. Witherby Pub., London. 200 pp.
- Catullo, G., Ciucci, P., Disi, A. M. & Boitani, L. 1996. Nubian Ibex in southwestern Jordan (Dana Nature Reserve). *Oryx*, 30:222-224.
- Christie, A. B., Chen, T.H. & Elberg, S. S. 1980. Plague in camels and goats: their role in human epidemics. *Journal of Infectious Diseases*, 141(6):724-726.
- Clarke, J. E. 1977. A Preliminary List of Jordan's Mammals. The Royal Society of the Conservation of Nature. Amman. 16 pp.
- Corbet, G. B. 1978. *The Mammals of the Palaearctic Region: a Taxonomic Review*. British Museum (Natural History). Cornell University Press. London. 314 pp.
- Dahl, S. K. 1954. *The Animal World of the Armenian S. S. R. Vol. 1. Vertebrates. Pt ii. Mammals*. Zoological Institute of Yerevan Pub. 415 pp.
- Darweesh, N., Al-Melhim, W. N., Disi, A. M. & Amr, Z. S. 1997. First record of the Naked Bellied Tomb Bat, *Taphozous nudiventris* Cretzschmar 1830, from Jordan. *Zoology in the Middle East*, 15: 13-14.
- De Blase, A. F. & Martin, R. E. 1974. *A Manual of Mammalogy with Keys to Families of the World*. W.M.C. Brown Co. 329 pp.
- De Blase, A. F. 1972. *Rhinolophus euryale* and *R. mehelyi* (Chiroptera, Rhinolophidae) in Egypt and southwest Asia. *Israel Journal of Zoology*, 21:1-12.
- Disi, A. M. & Hatough-Bouran, A. 1999. Biodiversity of the terrestrial vertebrate fauna of Petra (Jordan). *Casopis Národního muzea, Rada prirodovedná*, 166:83-98.
- Disi, A. M. & Z. S. Amr 1998. Distribution and ecology of lizards in Jordan (Reptilia: Sauria). *Faun. Abh. Mus. Tierkd. Dresden*, 21 (Suppl. [in: Fritz, U., F. J. Obst & B. Andreas (eds.): Contribution to a "Herpetologia arabica"]), Nr. 6: 43-66.
- Dollman, G. & Burlace, J. B. 1935. *Rowland Ward's records of Big Game. African and Asiatic Sections*. 10th. ed. Rowland Ward Pub., London. 433 pp.
- Dor, M. 1947. Observations sur les micromammifères trouvés dans les pelotes de la chouette effraye (*Tyto alba*), en Palestine. *Mammalia*, 11:49-54.
- Edwards, P. C., Bourke, S. J., Colledge, S. M., J. Head, & Macumber, P. G. 1988. Late Pleistocene Prehistory in the Wadi al-Hammeh, Jordan Valley. *The Prehistory of Jordan*, 396:525-565.
- Ellerman, J. R. 1948. Key to the rodents of south-west Asia in the British Museum collection. *Proceedings of the Zoological Society of London*, 118:765-816.
- El-Shehabi, F., Abdel-Hafez, S. K. & Kamhawi, S. A. 1999. Prevalence of intestinal helminthes of dogs and foxes from Jordan. *Parasitology Research*, 85:928-934.
- Feinbrun, N. & Zohary, M. 1955. A geobotanical survey of Transjordan. *Bulletin of the Research Council of Israel*, 5(D): 5-28.
- Felten, H. 1956. Fledermäuse fressen Skorpione. *Nat. Volk.* (Frankfurt), 86:53-57.
- Felten, H., Spitzenberger, F. & Storch, G. 1973. Zur Kleinsäugerfauna West-Anatoliens. Teil II. *Senckenbergiana Biologica*, 54(4/6): 227-290.
- Filippucci, M. G., Storch, G., Macholán, M. 1996. Taxonomy of the genus *Sylvaemus* in western Anatolia- morphological and electrophoretic evidence (Mammalia: Rodentia: Muridae). *Senckenbergiana biologica*, 75:1-14.
- Filippucci, M. G., Simson, S. & Nevo, E. 1989. Evolutionary biology of the genus *Apodemus* Kaup, 1829 in Israel: allozymic and biometric analyses with description of a new species: *Apodemus hermonensis* new species (Rodentia; Muridae). *Bollettino di Zoologia*, 56:361-376.
- Firenze, F. 1983. *Nomadi del Deserto*. Center Studi Per Lecologia del Quaternario.
- Fitter, R. 1984. Operating Oryx-the success continues. *Oryx*, 18:136.
- Garrard, A. N., College, S., Hunt, C. & Montague, R. 1988. *Environment, settlement and subsistence during the late Pleistocene and early Holocene in the Azraq Basin*. Colloque International CNRS, Prehistorik du Levant. 2.
- Gasperetti, J. 1978. Notes on Wild Goats and Sheep in Arabia. *Journal of the Saudi Arabian Natural History Society*, 23: 10-18.
- Gasperetti, J., Harrison, D. & Buttiker, W. 1985. The Carnivora of Arabia. *Fauna of Saudi Arabia*, 7:397-461.
- Gavish, L. 1993. Preliminary observations on the behavior and ecology of free-living populations of the subspecies *Sciurus anomallus syriacus* (Golden Squirrel) on Mount Hermon, Israel. *Israel Journal of Zoology*, 39:275-280.
- Geffen, E. & Macdonald, D. W. 1993a. Activity and movement patterns of Blanford's foxes.

- Journal of Mammology*, 74:455-463.
- Geffen, E., Hefner, R., Macdonald, D. W. & Ucko, M. 1993b. Biotope and distribution of Blanford's fox. *Oryx*, 27:104-108.
- Geffen, E., Hefner, R., Macdonald, D. W. & Ucko, M. 1992a. Diet and foraging behaviour of Blanford's foxes, *Vulpes cana*, in Israel. *Journal of Mammology*, 73:395-402.
- Geffen, E., Hefner, R., Macdonald, D. W. & Ucko, M. 1992b. Habitat selection and home range in the Blanford's fox, *Vulpes cana*: compatibility with the resource dispersion hypothesis. *Oecologia*, 91:75-81.
- Geffen, E., Hefner, R., Macdonald, D. W. & Ucko, M. 1992c. Morphological adaptations and seasonal weight changes in Blanford's fox, *Vulpes cana*. *Journal of Arid Environments*, 23:287-292.
- Gratz, N.G. 1973. Urban rodent-borne disease and rodent distribution in Israel and neighboring countries. *Israel Journal of Medical Sciences*, 9(8):969-79.
- Habibi, K. 1994. *The Desert Ibex*. NCWCD & Immel Pub. Ltd. 192 pp.
- Hahn, H. 1934. Familie der Procavidae. *Zeitschrift für Säugetierkunde*, 9:207.
- Harrison, D. L. 1959. *Footsteps in the Sand*. Ernest Benn, London. 254 pp.
- Harrison, D. L. & Bates, P. J. 1991. *The Mammals of Arabia*. Harrison Zoological Museum, Kent. xvi+ 354.
- Harrison, D. L. 1957. Some systematic notes on the trident bats (*Asellia tridens* E. Geoffroy) of Arabia. *Mammalia*, 21:1-8.
- Harrison, D. L. 1964. *The Mammals of Arabia, Vol. 1. Insectivora, Chiroptera, Primates*. Ernest Benn Ltd. 192 pp.
- Harrison, D. L. 1968. *The Mammals of Arabia, Vol. 2: Carnivora, Artiodactyla, Hyracoidea*. E. Benn, London, 193-382 pp.
- Harrison, D. L. 1972. *The Mammals of Arabia, Vol. 3: Lagomorpha and Rodentia*. E. Benn, London, 385-670 pp.
- Harrison, D. L. 1977. Mammals obtained by the expedition with a checklist of the mammals of the Sultanate of Oman. In: The Scientific Results of the Oman Flora and Fauna Survey 1975. *Journal of Oman Studies Special Report*, 13-26.
- Harrison, D. L. 1981. *Mammals of the Arabian Gulf*. George Allen & Unwin, London. 92 pp.
- Hart, H. C. 1891. Some Account of the Fauna and Flora of Sinai, Petra, and Wadi Arabah. Watt, London, X + 255 pp.
- Hasselquist, F. 1757. *Iter Palaeestinum*. Stockholm. 619 pp.
- Hatough, A. & Al-Eisawi, D. M. 1988. The Arabian Oryx in Jordan. *Journal of Arid Environments*, 14: 291-300.
- Hatough-Bouran, A. & Disi, A. M. 1991. History, distribution and conservation of large mammals and their habitats in Jordan. *Environmental Conservation*, 18:19-32.
- Hatough-Bouran, A. 1990. The burrowing habits of desert rodents *Jaculus jaculus* and *Gerbillus dasyurus* in the Shawmari Reserve in Jordan. *Mammalia*, 54:341-359.
- Hatt, R. T. 1959. *The Mammals of Iraq*. Miscellaneous Publication of the Museum of Zoology, Michigan University, No. 106:1-113.
- Hellwing, S. 1970. Reproduction of the white-toothed shrew *Crocidura russula monacha* Thomas in captivity. *Israel Journal of Zoology*, 19:177-178.
- Hemmer, H. 1978. Nachweis der sandkatze (*Felis margarita harrisoni*) Hemmer, Grubb and Groves, 1976) in Jordanien. Ergebnisse der Reisen von R. Kinzelbach in ländern des Hohen und Mittleren Ostens. Nr. 1. *Zeitschrift für Säugetierkunde*, 43:62-64.
- Hoogstraal, H. 1962. A brief review of the contemporary land mammals of Egypt (Including Sinai). 1. Insectivora and Chiroptera. *Journal of the Egyptian Public Health Association*, 37:143-162.
- Hoogstraal, H. & Kaiser, M. 1959. Ticks (Ixodidae) of Arabia, with special reference to the Yemen. *Fieldiana. Zoology*, 39(28):297-322.
- Hoogstraal, H., & Kaiser, M. 1960. *Boophilus kohlsi* n. sp. (Acarina: Ixodidae) from sheep and goats in Jordan. *Journal of Parasitology*, 46(4):441-448.
- Ilani, G. 1983. Blanford's fox, *Vulpes cana* Blanford 1877, a new species in Israel. *Israel Journal of Zoology*, 32:150.
- Ilani, G. 1987. Polecats everywhere. *Israel Land & Nature*, 12 (3):125.
- Kamhawi, S., Abdul-Hafez, S. K. & Arbagi, A. 1995. A new focus of cutaneous leishmaniasis caused by *Leishmania tropica* in northern Jordan. *Transactions of the Royal Society of Tropical Medicine & Hygiene*, 89:255-257.
- Kerbis-Peterhans, J. & Horwitz, K. 1992. A bone assemblage from a striped hyaena (*Hyaena hyaena*) den in the Negev Desert, Israel. *Israel Journal of Zoology*, 37:25-245.
- Khadim, A. H., Mustafa, A. M. & Jabir, H. A. 1979. Biological notes on jerboas *Allactaga euphratica* and *Jaculus jaculus* from Iraq. *Acta Theriol.*, 24:93-98.
- Kingdon, J. 1990. *Arabian Mammals - A Natural History*. Academic Press Harcourt Brace Jovanovich Publishers, San Diego. 279pp.
- Kingswood, S. C. & Blank, D. A. 1996. *Gazella subgutturosa*. *Mammalian Species*, 518:1-10.
- Klaus, S., Axelrod, O., Jonas, F. & Frankenburg, S. 1994. Changing patterns of cutaneous leishmaniasis in Israel and neighbouring territories. *Transactions of the Royal Society for Tropical Medicine & Hygiene*, 8(6):649-650.
- Kock, D. & Nader, I. 1983. Pygmy shrew and rodents from the Near East (Mammalia: Soricidae, Rodentia). *Senckenbergiana Biologica*, 64:13-23.
- Kock, D. 1969. Die Fledmaus -fauna des Sudan. (Mammalia, Chiroptera). *Abhandlungen senckenb. naturforsch. Ges.*, 521:1-238.
- Kock, D. 1983. Identifizierung der Palästina-

REFERENCES

- Genetten von J. Aharoni als *Vormela peregusna* (Güldenstaedt, 1770). *Zeitschrift für Säugetierkunde*, 48 (6): 381-383.
- Kock, D., Shafie, D. M. & Amr, Z. S. 1993. The jungle cat, *Felis chaus* Güldenstaedt, 1776, in Jordan. *Zeitschrift für Säugetierkunde*, 58:313-315.
- Kohler-Rollefson, I., Gellespie, W. & Metzger, M. 1988. The fauna from Neolithic Ain Gazal. *The Prehistory of Jordan*, 396.
- Kowaliski & Rzebik-Kowalska, 1991. *Mammals of Algeria*. Ossolineum. 370 pp.
- Kronfeld, N., Dayan, T., Zisapel, N. & Haim, A. 1994. Coexisting populations of *Acomys cahirinus* and *Acomys russatus*: a preliminary report. *Israel Journal of Zoology*, 40:177-183.
- Lamb, R. 1984. Oryx runs wild in Jordan after sixty years in exile. *World Wildlife News*, 1983-1984 (Winter): 18-20.
- Lewis, R. E. & Harrison, D. L. 1962. Notes on bats from the Republic of Lebanon. *Proceedings of the Zoological Society of London*, 138:473-486.
- Lewis, R. E., Lewis, J. & Harrison, D. 1965. On a collection of mammals from northern Saudi Arabia. *Proceedings of the Zoological Society of London*, 144:61-74.
- Lewis, R. E., Lewis, J. H. & Atallah, S. I. 1968. A review of Lebanese mammals. Carnivora, Pinnipedia, Hyracoidea and Artiodactyla. *Journal of Zoology* (London), 154:517-531.
- Lindsay, I. M. & Macdonald, D. W. 1986. Behaviour and ecology of the Rüppell's fox, *Vulpes rueppelli*, in Oman. *Mammalia*, 50:461-473.
- Lloyd, M. 1965. The Arabian oryx in Muscat and Oman. *Journal of East African Wildlife*, 3:14-127.
- Long, A. 1957. *The Bioclimatology and Vegetation of Eastern Jordan*. Rome (F.A.O.).
- Macdonald, D. W. 1978. Observations on the behaviour and ecology of the striped hyaena, *Hyaena hyaena*, in Israel. *Israel Journal of Zoology*, 27, 189-198.
- Macdonald, S. M., Mason, C. F. & Shalmon, B. 1986. A survey for otters in Israel. *Oryx*, 20:233-236.
- Meinertzhagen, R. 1924. An account of a journey across the southern Syrian desert from Amman in Transjordan to Ramadi on the Euphrates. *Ibis*, 6:87-100.
- Mendelssohn, H., Yom-Tov, Y., Ilany, G. & Meninger, D. 1987. On the occurrence of Blanford's fox, *Vulpes cana* Blanford, 1877, in Israel and Sinai. *Mammalia*, 51:459-462.
- Morrison-Scott, T. C. S. 1951. Exhibition of photograph of skin of Arabian Cheetah. *Proceedings of the Zoological Society of London*, 1:2.
- Mountfort, G. 1965. *Portrait of a Desert*. Collins Pub. London. 192 pp.
- Nader, I. A. & Kock, D. 1982. A new slit-faced bat from central Saudi Arabia (Mammalia: Chiroptera, Nycteridae). *Senckenbergiana Biologica*, 63:9-15.
- Nader, I. A. 1991. First record of the Marbled Polecat *Vormela peregusna* (Güldenstaedt, 1770) for Saudi Arabia (Mammalia: Carnivora: Mustelidae). *Fauna of Saudi Arabia*, 12:416-419.
- Nehring, A. 1902. Über einen neuen Sumpfluchs (*Lyncus chrysolanotis*) aus Palästina. *Sitzungsberichte Ges. naturf. Fr. Berlin*, 1-7. (127,147).
- Nelson, B. 1973. *Azraq: Desert Oasis*. Allen Lane, London, pp. 436.
- Nelson, B. 1985. Return to Azraq, *Oryx*, 19:22-26.
- Nevo, E. 1961. Observations on the Israeli populations of the Mole Rat, *Spalax ehrenbergi* Nehring 1898. *Mammalia*, 25:127.
- Nevo, E. 1969. Mole Rat, *Spalax ehrenbergi*: Mating behaviour and its evolutionary significance. *Science*, 163:484-486.
- Novikov, G. A. 1962. *Carnivorous Mammals of the Fauna of the USSR*. Israel Program for Scientific Translation. Jerusalem.
- Nowell, K. & Jackson, P. 1996. *Status, Survey and Conservation Action Plan-Wild Cats*. IUCN, Switzerland. 382pp.
- Olds, N. & Shoshani, J. 1982. *Procyon capensis*. *Mammalian Species*, 171: 1-7.
- Osborn, D. & Helmy, I. 1980. The contemporary land mammals of Egypt (including Sinai), *Fieldiana, Zoology N.S.*, 5:1-579.
- Petter, F. 1961. Répartition géographique et écologie des rongeurs désertiques (du Sahara occidental à l'Iran oriental). *Mammalia*, 25 (supl.):1-219.
- Piccirillo, M. 1982. Forty years of Archaeological Work at Mount-Siyagha in Late Roman-Byzantine Jordan In: *Studies in the History and Archaeological of Jordan*. Vol. 1.
- Pocock, R. I. 1944. The wild cat (*Felis lybica*) of Palestine. *Annals and Magazine of Natural History*, 11:125-130
- Ponticelli, S. C. 1979. Testimonianze neolitiche nel deserto della Giordania Meridionale Estratto da Sudi per lecologia del Quaternario. Stampo dalla Litografia IP-via Bocaccio. Vol. 1.
- Poore, M.E. & Robertson, V.C. 1964. *An Approach to the Rapid Description and Mapping of Biological Habitats*. London (Sub-Commission on Conservation of Terrestrial Biological Communities of the International Biological Programme).
- Qumsiyeh, M. B. 1980. New records of bats from Jordan. *Säugetierkundliche Mitteilungen*, 28:36-39.
- Qumsiyeh, M. B. 1985. The bats of Egypt. *Special Publication, Museum of Texas Tech University*, 23:1-102.
- Qumsiyeh, M. B. 1996. *Mammals of the Holy Land*. Texas Tech University Press. 389 pp.
- Qumsiyeh, M. B., Amr, Z. S. & Shafei, D. M. 1993. Status and conservation of carnivores in Jordan. *Mammalia*, 57:55-62.
- Qumsiyeh, M., Amr, Z. S. & Budairi, A. 1996. The status and conservation of Artiodactylia in Jordan. *Mammalia*, 60:417-430.

- Qumsiyeh, M., Amr, Z. S. & Al-Oran, R. 1998. Further records of bats from Jordan and a synopsis. *Turkish Journal of Zoology*, 22:277-284.
- Qumsiyeh, M., Disi, A. & Amr, Z. 1992. Systematics and distribution of the bats (Mammalia: Chiroptera) of Jordan. *Dirasat*, 19:101-118.
- Qumsiyeh, M., Schlitter, D. & Disi, A. 1986. New records and karyotypes of mammals from Jordan. *Zeitschrift für Säugetierkunde*, 51:139-146.
- Rabie, Y., Amr, Z. S. & Hyland, K. 1990. Observations on the ixodid ticks associated with domestic ungulate animals in Jordan. *Zoology in the Middle East*, 4:85-91.
- Rahamat, O. 1982. The Wild Boar. *Al Reem*, 10: 12-13.
- Raswan, C. R. 1935. *The Black Tents of Arabia*. Hutchinson Pub., London, 280 pp.
- Rifai, L. B., Al-Melhim, W. N. & Amr, Z. S. 1998. On the diet of the Barn Owl, *Tyto alba*, in northern Jordan. *Zoology in the Middle East*, 16:31-34.
- Rifai, L. B., Al-Melhim, W. N., Gharaibeh, B. M. & Amr, Z. (In press). The diet of the Desert Eagle Owl, *Bubo bubo ascalaphus*, in the Eastern Desert of Jordan. *Journal of Arid Environments*.
- Rifai, L., Al-Shafee, D., Al-Melhim, W. & Amr, Z. S. 1999. The Status of the marbled polecat, *Vormela peregusna* (Güldenstaedt, 1770), in Jordan. *Zoology in the Middle East*, 17:5-8.
- Roberts, T. J. 1977. *The Mammals of Pakistan*. London, Ernest Benn Ltd. XXVI + 361 pp.
- Saliba, E. K. & Oumeish, O.Y. 1999. Reservoir hosts of cutaneous Leishmaniasis. *Clinical Dermatology*, 17:275-7.
- Saliba, E. K., Higashi, G. I., Yates, J. A. & Oumeish, O. Y. 1988. Cutaneous leishmaniasis in Jordan: biochemical identification of human and *Psammomys obesus* isolates as *Leishmania major*. *Annals of Tropical Medicine & Parasitology*, 82:21-25.
- Saliba, E. K. & Amr, Z. S. 1985. A contribution to the fleas of Jordan and their association with mammals hosts. *Dirasat*, 12:21-24.
- Saliba, E. K., Amr, Z. S., Wassef, H. Y., Hoogstraal, H. & Main, A. J. 1990. The ticks (Ixodoidea) of East Jordan and the West Bank. *Dirasat*, 17:156-175.
- Saliba, E. K., Disi, A. M., Ayed, R. E., Saleh, N., Al-Younes, H., Oumeish, O. & Al-Ouran, R. 1994. Rodents as reservoir hosts of cutaneous leishmaniasis in Jordan. *Annals of Tropical Medicine & Parasitology*, 88:617-622.
- Schlitter, D. & Qumsiyeh, M. 1996. *Rhinopoma microphyllum*. *Mammalian Species*, No. 542:1-5.
- Schoenfeld, M & Yom-Tov, Y. 1985. The biology of two species of hedgehogs, *Erinaceus europaeus concolor* and *Hemiechinus auritus aegyptius*, in Israel. *Mammalia*, 49:339-355.
- Searight, A. 1987. Some records of mammals from North-Eastern Jordan. *Proceedings of the Symposium on the Fauna and Zoogeography of the Middle East*, 311-317.
- Shenbrot, G., Krasnov, B. & Khokhlova, I. 1994. On the biology of *Gerbillus henleyi* (Rodentia: Gerbillidae) in the Negev Highlands, Israel. *Mammalia*, 58:581-509.
- Shenbrot, G., Krasnov, B. & Khokhlova, I. 1997. Biology of Wagner's gerbil, *Gerbillus dasyurus* (Wagner, 1842) (Rodentia: Gerbillidae) in the Negev Highlands, Israel. *Mammalia*, 61:467-486.
- Shkolnik, A. & Borut, A. 1969. Temperature and water relations in two species of spiny mice (*Acomys*). *Journal of Mammalogy*, 50:245-255.
- Shkolnik, A. 1966. Studies in the comparative biology of Israel's two species of spiny mice (genus *Acomys*). Ph. D. dissertation. Hebrew University. Jerusalem.
- Stewart, D R. M. 1963. The Arabian Oryx, (*Oryx leucoryx* Pallas), 2. *East African Wildlife Journal*, 2:18.
- Stuart, B. & Clyton, D. 1983. *Kuwait Natural History: An Introduction*. Ed. Clyton, D. Kuwait Oil Co. Pub.
- Talbot, L. M. A. 1960. A look at threatened species. A report on some animals of the Middle East and southern Asia which are threatened with extermination. *Oryx*, 5:153.
- Tristram, H. B. 1866. *The Land of Israel. A journal of travels in Palestine undertaken with special reference to its character*. Soc. for promoting Christian Knowledge Pub. London. pp 649.
- Tristram, H. B. 1876. Note on discovery of the Roebuck (*Cervus capreolus*) in Palestine. *Proceedings of the Zoological Society of London*, 1876:420.
- Tristram, H. B. 1884. *The Survey of Western Palestine. The Fauna and Flora of Palestine*. Palestine Exploration Fund, London. 455 pp.
- Van Aarde, R. J., Skinner, J. D., Knight, M. H. & Skinner, D. C. 1988. Range use by a striped hyaena (*Hyaena hyaena*) in the Negev desert. *Journal of Zoology, (London)*, 216: 575-577.
- Von Lowenstern, E., Pinna, G. & Ponticelli, C. 1977. *Le Incison Rupestri di Wadi Rum (Giordania Meridionale)*. Tippografia Fusi-Pavia.
- Weisbein, Y. 1989. [The biology and ecology of the caracal (*Felis caracal*) in the Arava Valley of Israel.] M.S. thesis, Tel Aviv Univ., Tel Aviv.
- Weisbein, Y. 1988. The caracal: A first study in Israel. *Israel Land & Nature*, 14:223-228.
- Wilson, D. E. & D. M. Reeder (eds). 1993. *Mammal Species of the World*. Second Edition. Smithsonian Institution Press, Washington D. C. 1206 pp.
- Wozencraft, W.C. 1989. The phylogeny of the recent carnivora. Pp. 437-465. In: *Carnivore behavior, evolution and ecology*. Volume (J.G. Gittleman). Cornell University Press, Ithaca.
- Yerbury, J. W. & Thomas, O. 1895. On the mam-

REFERENCES

- mals of Aden. *Proceedings of the Zoological Society of London*, 1895:542-555.
- Yom-Tov, Y. 1986. Otters between extinction and survival. *Israel Land & Nature*, 11:167-169.
- Yom-Tov, Y., Makin, D. & Shalmon, B. 1992a. The insectivorous bats (Microchiroptera) of the Dead Sea area, Israel. *Israel Journal of Zoology*, 38:125-137.
- Yom-Tov, Y., Makin, D. & Shalmon, B. 1992b. The biology of *Pipistrellus bodenheimeri* (Microchiroptera) in the Dead Sea area of Israel. *Zeitschrift für Säugetierkunde*, 57:65-69.
- Zahavi, A. & Wahrman, J. 1957. The cytotaxonomy, ecology and evolution of the jerbils and jirds of Israel (Rodentia: Gerbillinae). *Mammalia*, 21:341-380.

List of localities and their coordinates

Locality	LAT.	LONG.	Locality	LAT.	LONG.
Abu Anseer	32°03'N	35°52'E	Dead Sea	31°30'N	35°30'E
Ajlun	32°20'N	35°45'E	Dibbin	32°15'N	35°50'E
Al 'Adasiyah	32°40'N	35°37'E	Disah	29° 37'N	35° 33'E
Al 'Aqabah	29° 31'N	35° 00'E	Faydat ad Dahikiyah	31°33'N	37°10'E
Al Baqurah	32°39'N	35°36'E	Gazahlah	31°49'N	36°04'E
Al Bariyah	32°34'N	35°50'E	Gharandal	30°05'N	35°12'E
Al Birkatayn	32°18'N	35°54'E	Ghawr al Mazra'	31°16'N	35°32'E
Al Hammah	32°28'N	35°36'E	Ghawr as Safi	31°02'N	35°28'E
Al Hasa	30°49'N	35°59'E	Ghawr Nimrin	31°54'N	35°34'E
Al Hasida	30°50'N	36°59'E	Ghawr Seisaban	31°51'N	35°35'E
Al Hazim	31°35'N	37°15'E	Harta	32°42'N	35°51'E
Al Hummar	32°01'N	30°49'E	Ibbin	32°22'N	35°49'E
Al Jafr	30°18'N	36°13'E	Irbid	32°33'N	35°51'E
Al Jizah	31°42'N	35°57'E	Ishtafayna	32°22'N	35°45'E
Al Jubayhah	32°01'N	35°52'E	Jarash	32°17'N	35°54'E
Al Karak	31°11'N	35°42'E	Jawa	32°20'N	37°02'E
Al Lajjun	31°14'N	35°52'E	Jordan River	31°46'N	35°33'E
Al Mafraq	32°21'N	36°12'E	Jordan Valley	32°40'N	35°30'E
Al Majdal	32°14'N	35°51'E	Juhfiyah	32°30'N	35°49'E
Al Mazar	32°28'N	35°48'E	Kharja	32°40'N	35°53'E
Al Muwaqqar	31°49'N	36°06'E	Khinzirah	32°28'N	35°42'E
Al Qatranah	31°15'N	36°03'E	King Hussein Bridge	31°52'N	35°32'E
Al Quwayrah	29°48'N	35°19'E	Kufr Kifiya	32°30'N	35°46'E
Al Raddas	31°43'N	35°57'E	Kufrinjah	32°18'N	35°42'E
Al 'Unab	29°58'N	36°54'E	Ma'an	30°12'N	35°44'E
Al Wisad	31°53'N	37°57'E	Madaba	31°43'N	35°48'E
Amman	31°57'N	35°56'E	Mahis	31°59'N	35°46'E
An Naqah	31°02'N	35°29'E	Maqarin (Dam Station)	32°43'N	35°53'E
An Naqb	31°32'N	35°37'E	Marw	32°37'N	35°53'E
Aqraba	32°44'N	35°48'E	Mu'tah	31°06'N	35°42'E
Ar Ramtha	32°34'N	36°00'E	Mu'ab	31°54'N	35°46'E
Ar Ruwayshid	32°30'N	38°12'E	Mursi'	32°05'N	35°48'E
As Salt	32°03'N	35°44'E	Mushash Hadraj	30°20'N	37°23'E
As Sarih	32°30'N	35°54'E	North Shunah	32°37'N	35°36'E
Ash Shawbak	30°32'N	35°34'E	Petra	30°20'N	35°26'E
Ash Shawmari	30°37'N	36°28'E	Qa' Duwaylah	32°02'N	37°20'E
At Tafilah	30°50'N	35°36'E	Qasr al Hallabat	32°06'N	36°20'E
At Tayyibah	32°33'N	35°43'E	Qasr 'Amrah	31°48'N	36°35'E
Ayn el Tabah	29°32'N	34°52'E	Qasr Burqu'	32°37'N	37°58'E
Ayn Ghazal	32°41'N	35°53'E	Qastal	31°44'N	35°57'E
Ayn Musa	30°20'N	35°30'E	Qatranah	31°15'N	36°03'E
Ayun Buweiridah	30°35'N	35°19'E	Qurayqira	30°40'N	35°26'E
Az Zarqa'	32°05'N	36°06'E	Quwaylibah	32°40'N	35°52'E
Azraq	31°50'N	36°49'E	Quwayrah	29°48'N	35°19'E
Azraq ad Duruz	31°53'N	36°50'E	Ra's an Naqb	30°18'N	35°23'E
Azraq ash Shishan	31°50'N	36°49'E	Rahmeh	30°01'N	35°03'E
Ba'ir	30°46'N	36°41'E	Rishah	30°15'N	35°14'E
Ba'un	32°23'N	35°44'E	Safawi	32°10'N	37°07'E
Baq'a	32°05'N	35°50'E	Samma'	32°34'N	35°42'E
Bayt Yafa	32°31'N	35°47'E	Shawmari Reserve	31°45'N	36°43'E
Bi'r Madhkur	30°24'N	35°21'E	Sil Jarash	32°14'N	35°54'E
Burqa	30°07'N	35°25'E	South Shunah	31°54'N	35°37'E
Busayra	30°44'N	35°36'E	Suf	32°19'N	35°50'E
Dab'ah	31°36'N	36°04'E	Suwaylih	32°02'N	35°50'E
Damiya	32°06'N	35°33'E	Suwaymah	31°47'N	35°36'E
Dana	30°41'N	35°37'E	Tabaqat Fahl	32°27'N	35°37'E
Dana Nature Reserve	30°41'N	35°37'E	Tel Hesbon	31°48'N	35°48'E
Dayr Abu Sai'd	32°30'N	35°41'E	Thagret Asfour	32°20'N	35°54'E

Locality	T.	LONG.	Localitv	LAT.	LONG.
Umm al Hiran	31°56'N	36°02'E	Wadi edh Dhuleil	32°09'N	36°03'E
Umm al Jimal	32°36'N	35°47'E	Wadi Faynan	30°38'N	35°26'E
Umm Rasas	31°30'N	35°55'E	Wadi Fidan	30°46'N	35°18'E
Wadi al 'Arabah	30°10'N	35°10'E	Wadi Khinzirah	32°22'N	35°54'E
Wadi al Hasah	30°56'N	37°35'E	Wadi Ramm	29°41'N	35°27'E
Wadi al Haydan	31°27'N	35°36'E	Wadi Sakib	32°17'N	35°49'E
Wadi al Jarrah	31°19'N	35°33'E	Wadi Zarqa	32°07'N	35°33'E
Wadi al Kafrayn	31°50'N	35°35'E	Wadi Zarqa' Ma'in	31°37'N	35°34'E
Wadi al Karak	31°17'N	35°31'E	Waqqas	32°33'N	35°36'E
Wadi al Mawjib	31°23'N	35°51'E	West Adh Dohaybeh	31°31'N	35°46'E
Wadi al Quilat	31°31'N	36°28'E	Yarmuk River	32°38'N	35°34'E
Wadi Aqraba	31°36'N	35°47'E	Zarqa River	32°07'N	35°33'E
Wadi as Sir	31°57'N	35°49'E	Zubiya	32°26'N	35°46'E
Wadi Ben Hammad	32°06'N	35°52'E			



Jordan Country Study on Biological Diversity
Mammals of Jordan