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Original article

## A survey of mammal diversity in the Turaif province, Kingdom of Saudi Arabia

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## ABSTRACT

One hundred and forty mammals of fifteen different species belonging to nine families, collected during one-year survey period in Turaif province of Saudi Arabia, are reported. Collections were made during studying the diversity of land vertebrate fauna of Turaif area at the northern province of Saudi Arabia. Cricetidae (n = 64) was the most common family. *Jaculus jaculus vocator* (n = 34) was recorded the highest number of events for any mammal in the surveyed area followed by *Gerbillus nanus* (n = 23). Two species of mammals namely *G. nanus* (n = 23) and *Felis margarita* (n = 3) were reported for the first time in the study area. The geographical distribution of the collected species within this province was mapped.

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## 1. Introduction

Like all desert ecosystems, the desert fauna of Saudi Arabia has received much less scientific research attention than forest systems (Durant et al., 2012). Despite the vast size and diverse topography of Saudi Arabia, studies on the ecology and distribution of its terrestrial fauna has not been explored well, especially in the northern province of the country (Al-Sadoon et al., 2016). There still remain significant gaps in our understanding of how biodiversity in these systems is changing with time due to a lack of systematic monitoring (Davies et al., 2012).

Compared to insects and reptiles, mammals are generally not well represented in desert environments – including the Saudi Arabia. Unfortunately, published literature on the terrestrial mammals of the Saudi Arabia is still scant although a few contributions by various authors have increased the information for a number of species. Harrison and Bates (1991) published an updated version of the Mammals of Arabia, which today is possibly still the most comprehensive study of mammals from the Arabian Peninsula. Other earlier books on mammals include a publication by

Gasperetti et al. (1985) on the carnivores of Arabia. Harrison (1964, 1968, 1972, 1981) described in very comprehensive scientific texts the mammals of the Arabian Peninsula and the neighboring countries. His excellent zoological work gives the most valuable information regarding the mammals of the region. Fifteen carnivore's species of Arabia are discussed in great detail by Gasperetti et al. (1987). A total of 22 species of mammals including three domestic animals were reported within the reserve's boundaries of Harrat al-Harrah (Seddon et al., 1997). Bruce et al. (2016) published a survey report on Mammal diversity in the Ibex Reserve of Saudi Arabia in which he mentioned that the deserts of Saudi Arabia contain a number of mammalian species highly adapted for the variable conditions of the desert including the Nubian ibex (*Capra nubiana*), Arabian oryx (*Oryx leucoryx*), Arabian grey wolf (*Canis mlupus arabs*) and the Blanford's fox (*Vulpes cana*).

There is a need for an updated information to estimate the species richness of mammals in Turaif as the first step to increase our knowledge of the regional mammalian fauna. The aim of this study was to fill the gap in the inventory of mammals in this important area by updating information on mammalian distribution. A survey can be an important addition to understanding the biodiversity in the region of Turaif and can provide important information on mammals of the area.

## 2. Materials and methods

Mammal survey took place in Turaif (31°40'39"N 38°39'11"E), northern west border Province, Saudi Arabia, close to the border

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with Jordan, with a total area of 20,400 km<sup>2</sup>. It is characterized by its unique topography, geomorphology, and biodiversity, possessing several landscape types, such as Sandy habitat, Highland habitat, Mountain habitat, Sabkha (Qa'a) habitat and Wetland habitat (Al-Sadoon et al., 2016). In the study area the air temperature averages 45 °C in summer to below freezing point in winter, whereas, mean annual precipitation ranges from 14.3 mm (December) to 5.4 mm (March) and to 0 mm in June–July (Al-Sadoon et al., 2017).

Mammal surveys were undertaken during different seasons of the year (2014–2015) and the report was compiled. Occasional field surveys were conducted to cover the main habitats of Turaif region. The most favorable time for collection was between March and July. All mammal sightings and signs were recorded. Active ground searches were undertaken throughout the study site. The survey was principally opportunistic and based on observations using different techniques (track surveys, live traps, Binoculars Jeory 6 × 30 and camera captures). Traps with baits for small and average size mammals like rodents, fox, wild cats, and hedgehog (8 × 9 × 23 cm) whereas for fox, wild cats and large mammal traps of dimensions (40 × 40 × 110 cm) were used.

The collected specimens were deposited at College of Science, Department of Zoology, King Saud University. Date, locality, Co-ordinates: latitude, longitude and altitude, of the collected specimens were recorded by a GPS.

### 3. Results

Table 1 shows the mammal species collected or observed in different habitats of Turaif province and their co-ordinates: latitude, longitude and altitude recorded by a GPS. A total of 140 specimens belonging to 15 mammal species were recorded from the study area during our survey. These 15 species belong to 9 families (Erinaceidae, Leporidae, Cricetidae, Dipodidae, Erethizontidae, Canidae, Mustelidae, Hyaenidae and Felidae). Among the 9 families Cricetidae was represented by 4 genera, Canidae by 3 genera, Dipodidae by 2 genera and remaining all families were represented by 1 genus each. From the standpoint of species richness within the described families of the surveyed region, family Cricetidae represented 26.67% (n = 4) followed by Canidae 20% (n = 3) of the total species (n = 15) collected from the studied area. No data concerning reproduction were collected from these specimens.

The following is a checklist of the mammals collected during this survey.

#### 3.1. Family: Erinaceidae

Members of this family can easily be distinguished by the thorns spread over a large part of the skin surface except the lower sides of the body. Their snout is free of hair and constantly moving and blowing. The tail is short. The front and rear limbs ends with five clawed fingers, and the palm of hands and soles of the feet are free of hair. One species of this family was recorded in Turaif region.

##### 3.1.1. *Paraechinus aethiopicus* Ehrenberg, 1832

This Ethiopian hedgehog is a nocturnal animal common across the Arabian Peninsula. Eight specimens of this hedgehog were collected from mountainous areas, open deserts and desert plains of the study area. Their body is covered by brown thorns with white edges giving the animal a gray color. The ventral side is covered with soft fur. It has black tapering snout and long legs. Thorns acts as a natural protection for the hedgehog against predators.

#### 3.2. Family: Leporidae

Leporids, the family of rabbits and hares are small to moderately sized mammals, adapted for rapid movement. These animals have soft fur, long ears, short tails, and powerful rear legs that they use to hop and jump. The hind legs are long, with four toes on each foot, and fore legs are shorter, with five toes each. The upper lip is bifid. Females often have three to five pairs of nipples of breast glands. Only one species was recorded in Turaif region.

##### 3.2.1. *Lepus capensis* Linnaeus, 1758

Three specimens of *L. capensis* were collected from the study area from the plateaus and mountainous habitats. These nocturnal animals prefer shrubs, rather than grasses, to shelter under in summer. Cape hare is a typical hare in appearance, with long, slender limbs, large hind feet, a short tail, large eyes and large ears. The fur is soft and straight, body color ranges from gray-brown to reddish-brown, with white ventral parts and a black and white tail. Wild rabbits live almost in all habitats and they are abundant in deserts and sandy plains.

#### 3.3. Family: Cricetidae

Cricetidae is an extremely diverse and one of the largest family of muroid rodents. They have small elongated bodies, long tails, large eyes, prominent ears and are gray or brown in color. Four species of this family were recorded in Turaif region.

##### 3.3.1. *Gerbillus nanus* Blanford, 1875

Twenty-three specimens of *G. nanus* were collected from the study area in rocky areas and gravel plains. The body of *G. nanus* is covered by colored fur suitable for the environment in which they live, and characterized by naked ankles, dark brown back hairs and the tail ends with a flock of dark hair. It is found in many parts of the Arabian Peninsula, in the northern regions, along the western coast and the northern east region. It is active at sunset and night, moving to long distances in search of food.

##### 3.3.2. *Gerbillus cheesmani* Thomas, 1919

Eight specimens of this species were recorded in the surveyed area. *G. cheesmani* is characterized by sandy-beige color, while the belly is white, long limbs, large black eyes and long tail. This nocturnal rodent is small in size and like many gerbil species, looks like a mouse to a large extent. It live in sandy environments, and were recorded mostly around *Calligonum comosum* plants which provide them shelter. Like other rodents, they are prey for many birds, mammals and reptiles.

##### 3.3.3. *Meriones libycus* Lichtenstein, 1823

Nineteen specimens of *M. libycus* were recorded in the surveyed area. This animal was characterized by the presence of long black tail that ends in a black tuft, black claws and the body is covered with sandy colored soft and fine fur. This species is found all over large areas of the Arabian Peninsula. This rodent is diurnal living, used to live in colonies and feed on desert plant.

##### 3.3.4. *Merionae crassus* Sundevall, 1842

Fourteen specimens of *M. crassus* were recorded in the surveyed area. It is the most common rodents in the central region especially in sandy areas of Saudi Arabia. The body is covered with thick sandy colored hair, with the presence of white tufts behind the ear. The abdomen is white and the tail ends with a black tuft. It is nocturnal species and used to live in colonies, inhabits burrows around the roots of trees. As the sun sets, it goes out searching for food, which is grains and grass.

**Table 1**  
Co-ordinates: Latitude, longitude and altitude, of the collected specimens by a GPS.

Scientific name	Status	Coordinates							
<i>Jaculus jaculus vocator</i>	Highly abundant	N 31 45.469	N 31 46.420	N 31 46.118	N 31 46.001	N 31 46.072	N 31 44.408		
		E 039 01.329	E 039 01.620	E 039 54.989	E 039 00.763	E 038 59.552	E 039 05.185		
		N 31 49.363	N 31 43.018	N 31 42.749	N 31 47.200	N 31 41.182	N 31 44.395		
		E 039 03.925	E 038 55.951	E 038 55.821	E 038 55.145	E 038 55.314	E 039 00.177		
		N 31 43.903	N 31 42.541	N 31 48.605	N 31 40.851	N 31 40.953	N 31 41.696		
		E 038 57.466	E 038 58.103	E 038 58.557	E 038 58.820	E 038 54.989	E 039 06.472		
		N 31 36.688	N 31 39.007	N 31 39.233	N 31 44.670	N 31 47.483	N 31 58.597		
		E 039 06.472	E 038 58.433	E 038 58.198	E 039 05.186	E 038 52.662	E 039 00.968		
		N 31 56.944	N 31 57.115	N 31 57.307	N 31 57.534	N 31 57.530	N 31 57.976		
		E 039 01.130	E 038 59.867	E 039 01.073	E 039 01.698	E 038 58.986	E 038 57.140		
		N 31 58.208	N 31 51.208	N 31 51.503	N 31 51.503				
		E 038 58.938	E 038 01.938	E 038 59.938	E 038 58.976				
		N 31 56.944	N 31 57.530	N 31 39.007	N 31 44.395				
		E 039 01.130	E 038 58.986	E 038 58.433	E 039 00.177				
		<i>Allactaga auphratica</i>	Common	N 31 46.519	N 31 46.072	N 31 46.200	N 31 44.408	N 31 47.119	N 31 46.347
E 039 02.444	E 038 59.552			E 038 00.450	E 039 05.185	E 039 02.071	E 039 56.102		
N 31 44.551	N 31 43.505								
<i>Gerbillus cheesmani</i>	Common	E 039 02.493	E 039 02.991						
		N 31 46.244	N 31 46.519	N 31 42.944	N 31 46.072	N 31 44.551	N 31 44.395		
		E 039 00.336	E 039 02.444	E 038 56.102	E 038 59.552	E 039 02.493	E 039 06.177		
<i>Gerbillus nanus</i>	Abundant	N 31 44.408	N 31 47.200	N 31 40.549	N 31 40.549	N 31 39.746	N 31 44.996		
		E 039 05.185	E 083 55.145	E 038 58.820	E 039 06.662	E 039 06.734	E 039 04.915		
		N 31 44.334	N 31 44.297	N 31 41.806	N 31 40.753	N 31 39.172	N 31 57.976		
		E 039 05.062	E 038 57.549	E 039 06.684	E 039 06.560	E 038 59.963	E 038 59.140		
		N 31 58.321	N 31 58.451	N 31 58.597	N 31 57.534	N 31 57.925			
		E 039 00.714	E 039 00.426	E 039 00.968	E 039 01.698	E 038 59.902			
		N 31 46.170	N 31 46.244	N 31 44.408	N 31 46.519	N 31 42.944	N 31 50.841		
		E 038 59.784	E 039 00.336	E 039 05.185	E 039 02.444	E 038 56.102	E 039 04.182		
		N 31 43.989	N 31 39.801	N 31 40.858	N 31 44.666	N 31 42.908	N 31 57.115		
		E 039 06.109	E 038 59.336	E 39 06.537	E 038.58.202	E 038 57.856	E 038 59.867		
		N 31 57.214	N 31 58.573						
		E 039 00.315	E 039 00.507						
		<i>Meriones crassus</i>	Common	N 31 44.408	N 31 46.519	N 31 46.104	N 31 45.849	N 31 43.204	N 31 51.438
				E 039 05.185	E 039 02.444	E 038 56.028	E 038 55.291	E 039 05.185	E 039 04.951
				N 31 44.351	N 31 39.801	N 31 40.858	N 31 44.888	N 31 47.419	N 31 58.458
E 039 06.109	E 038 59.336			E 039 06.537	E 039 05.154	E 038 55.647	E 039 01.918		
N 31 48.762	N 31 57.564			N 31 58.265	N 31 58.321	N 31 58.451	N 31 57.214		
E 039 04.048	E 039 01.808			E 039 00.393	E 039 00.714	E 039 00.426	E 039 00.315		
<i>Meriones libycus</i>	Highly abundant	N 31 58.597							
		E 039 00.968							
		N 31 45.515	N 31 46.244	N 31 45.849	N 31 46.072	N 31 44.408	N 31 47.093		
		E 039 04.931	E 039 00.336	E 038 55.291	E 038 59.552	E 039 05.185	E 038 54.648		
		N 31 45.238	N 31 45.403						
<i>Vulpes ruppelli sabaea</i>	Highly abundant	E 039 02.513	E 039 02.444						
		N 31 41.696	N 31 38.399	N 31 36.754	N 31 40.944	N 31 40.851	N 31 44.855		
		E 039 06.477	E 039 04.967	E 039 04.967	E 038 56.102	E 38 58.820	E 038 55.288		
		N 31 41.057	N 31 44.706	N 31 49.697	N 31 47.443	N 31 46.954			
		E 038 57.739	E 039 05.164	E 038 02.107	E 038 55.647	E 038 55.925			
<i>Vulpes vulpes arabica</i>	Highly abundant	N 31 46.104	N 31 46.244	N 31 44.408	N 31 47.013	N 31 46.925	N 31 58.597		
		E 039 00.400	E 039 00.336	E 039 05.185	E 038 54.648	E 038 54.393	E 039 00.968		
		N 31 58.458	N 31 58.581						
		E 039 01.918	E 039 01.088						
<i>Paraechinus aethiopicus</i>	Common	N 31 58.423	N 31 43.839	N 31 46.232					
		E 039 00.127	E 039 01.521	E 039 55.450					
<i>Lepus capensis</i>	Rare	N 31 58.663	N 31 52.553						
		E 038 59.533	E 039 01.636						
<i>Hystrix indica</i>	Rare	N 31 46.954	N 31 43.244						
		E 038 55.925	E 039 01.361						
<i>Canis lupus</i>	Rare	N 31 46.925							
		E 038 54.393							
<i>Mellivera capensis</i>	Rare	N 31 46.519	N 31 46.954						
		E 039 02.444	E 038 55.925						
<i>Hyaena hyaena</i>	Rare	N 31 46.104	N 31 47.251	N 31 43.206					
		E 039 00.400	E 038 51.925	E 039 02.490					

### 3.4. Family: Dipodidae

The members of this family are distributed throughout the Arabian Peninsula. They are small sized mammals characterized by much longer hind limbs than the forelimbs, and get around by jumping. The last third of the skull is fully occupied by hearing parts, where it is evidence that these rodents are badly in need of good hearing sense. The end of limbs often covered with a hair

tuft. These rodents have long tufted tails used as a fulcrum. Two species belonging to this family were recorded in Turaif region.

#### 3.4.1. *Jaculus jaculus vocator* Linnaeus, 1758

Thirty-four specimens, most abundant among all mammals recorded, were collected in the surveyed area. This rodent is undoubtedly one of the commonest rodents throughout the desert areas of the Arabian Peninsula. It does not appear to be restricted

to sandy areas and most of the individuals observed and collected occurred in stony desert at considerable distance from sand. It is a small rodent known by its hopping form of locomotion like the kangaroo. Due to its short front limbs and long hind ones, this rodent is able to jump high to escape from enemies. This small rodent has soft fur coats on sandy colored body with a paler underside and a very long tail, used for balance when jumping. The presence of small hairs between fingers enables the animal to walk on the sand, and the structure of the ear also enables it to hear low sounds. The species is exclusively nocturnal, spending the daylight in its burrows. These rodents are prey to many wild animals such as birds, mammals and reptiles. They are also hunted and eaten in the central region and northern areas of the Kingdom.

#### 3.4.2. *Allactaga euphratica* Thomas, 1881

Four specimens of *A. euphratica* were recorded in the surveyed area. They are characterized by the existence of five fingers on its hind long feet, but it uses only three middle fingers in motion while the other two are vestigial which are found high up on the hind foot. It has small forelimbs, tall ears and black and white tufts of fur on the ends of their tails. This species is nocturnal and lives in burrows with many entrances so as to escape from enemies.

#### 3.5. Family: *Erethizontidae*

The *Erethizontidae* is a family of rodents commonly known as the New World porcupines. These rodents are medium-sized to large nocturnal animals. All *erethizontids* share certain characteristics, such as hairs modified into spines with overlapping barbs and are mostly arboreal animals. Only one species belonging to this family was recorded in Turaif region.

##### 3.5.1. *Hystrix indica* Kerr, 1792

Two specimens of *H. indica* were recorded in the surveyed area. This Porcupine is considered as a largest rodent in the Kingdom of Saudi Arabia, and it reach up to a meter in length and weighs about 15 kg. It is the only species of family *Erethizontidae* within the Order *Rodentia*. It is an animal characterized by the presence of sharp long thorns that cover the animal's body, while the head and the front part of the body covered with short black hairs and there is a strong coarse hair on the neck.

#### 3.6. Family: *Canidae*

Members of this family are characterized by presence of relatively long limbs with five toes on the forefeet and four on the hind feet but the first finger (thumb) on the forefeet seems to be very short and can be described as vestigial. These animals have non-retractile claws. The front half of the skull seems to be relatively long with elongated facial region. The famous mammals of this family are dogs, wolves, foxes, and jackals where they are fairly similar in terms of the external features. Three species belonging to this family were recorded in Turaif region.

##### 3.6.1. *Canis lupus arabus* Linnaeus, 1758

Only two specimens of Arabian wolf were recorded in the surveyed area. The Arabian wolf has long limbs and the tail reaches the heels with misty coarse hair ending with black ones. The wolf is known from many localities of the Arabian Peninsula. It is a nocturnal living animal. Despite of their wide spread, they are continuously being killed especially in deserts, leading to poor populations in many areas.

##### 3.6.2. *Vulpus vulpus arabica* Thomas, 1902

Eleven specimens of Arabian Red fox were recorded in the surveyed area in desert areas, plains, valleys and near residential

areas. This is the largest of the four species of foxes that exist in the Kingdom of Saudi Arabia. The body is covered with soft reddish fur and has long tail ends with a white tuft of hairs. It has black hairs behind the ears and dark brown or black nose.

##### 3.6.3. *Vulpus rueppellii sabaeva* Schinz, 1825

Eight specimens of sand fox were recorded in the surveyed area. This sand fox is smaller than the red fox and is characterized by long ears and the tail ends with thick white fur. The body has sandy pale color and there is no black hair behind the ear. They were observed in sandy open areas. The Sandy fox is nocturnal. The thin legs and soft, fur-covered foot pads suggest that, unlike some other foxes, this fox does not burrow.

#### 3.7. Family: *Mustelidae*

These mammals are characterized by elongate bodies with short legs and a short rostrum. The limbs end with five fingers and the first one (Thumb) on the front end grow well and in contact with the ground. The fingers end with non-retractile claws. Only one species was recorded in Turaif region.

##### 3.7.1. *Mellivera capensis* Schreber, 1776

Only one specimens of *M. capensis* was recorded in mountainous habitat of the surveyed area. This Skunk also called the Honey Badger, is a distinctive animal with black or dark brown color with a white or yellowish bold line on the middle of the back. The forefeet are strong and wide, with large claws capable of drilling on the ground. In contrast, the hind feet are small with short claws. It has a thick skin which provides protection from enemies. It is one of the worst enemies of traditional honey breeders, where it digs and burgles the honeycombs. The thick skin provides him with a protection against bee stings when attacking beehives.

#### 3.8. Family: *Hyaenidae*

These mammals are considered as relatively big and characterized by back limbs shorter than the front ones, bushy tail and rounded ears. The limbs end with four fingers ending with non-retractile claws. only one species was recorded in Turaif region.

##### 3.8.1. *Hyaena hyaena* Linnaeus, 1758

Only two specimens of *H. hyaena* were recorded in the surveyed area. *Hyaena* is also known as Striped *Hyaena* for the existence of black lines on the sides of the animal's body that distinguish it from the dotted hyena. This nocturnal species is characterized by strong structure with long legs and large front teeth capable of smashing bones and skulls. The body is covered with gray thick hair and the animal can erect the long hair on the neck which it does when it feels threatened. The black and white tail is long and bushy and the feet bear short, blunt claws.

#### 3.9. Family: *Felidae*

All felids bear a strong resemblance to one another. The head is semi-round, making the mouth short. The front limbs end with five fingers, while the rear ones end with 4, and the fingers end with retractile claws using them for defense, predation and climbing trees. Tail is considered as relatively long. Only one species was recorded in Turaif region.

##### 3.9.1. *Felis margarita* Loche, 1858

Three specimens of *F. margarita* were recorded in the arid desert habitat of the surveyed area. The Sand Cat looks like a wild cat in the overall appearance, but is the smallest cat species in Arabia. The Sand Cat has bigger broad and sensitive ears. Its foot pads

are covered with thick hair. The body has a yellowish gray color and the front limbs with broad strikes. The tail ends with black tuft. It is nocturnal and therefore rare to be seen during the day. Sandy cat is considered as one of the most beautiful animals in sandy environments.

#### 4. Discussion

The mammalian fauna of Kingdom of Saudi Arabia is highly heterogeneous and diversified. The animals scattered in different regions of Saudi Arabia have been explored, yet not enough studies were made to provide basic information about the species richness and diversity of mammals, especially in Turaif region. Mammals occupy specific habitats within the different ecozones of Saudi Arabia, which suit their environmental requirements. For the implementation of this study, various field visits were made during the different seasons of the year to study the mammal fauna of the Turaif region of Saudi Arabia. The mammal fauna has been studied in different regions of Saudi Arabia (Lewis, 1963; Al-Nafie, 1989; Seddon et al., 1997; Boug et al., 2012; Bruce et al., 2016).

This study revealed fifteen species of mammals in the Turaif region of Saudi Arabia (Table 1). The spreading of these species is different in the different habitats, some of them are abundant such as members belonging to the family Cricetidae and dipodidae, while others were not common in the study area. The *J. jaculus vocator* was most frequently encountered species followed by *G. nannus* and *M. libycus*. This survey shed new light on the distribution and abundance of various mammal species. The two species *G. nanus* and *F. margarita* recorded first time in the study area, Turaif was the highlight of this report. The presence of *J. jaculus vocator* and *G. cheesmani* were also confirmed from west of Turaif province by Lewis (1963). No data concerning reproduction were collected from the specimens collected in the surveyed area.

The level of survey undertaken does not permit conclusions to be drawn about the total species comprising the mammal assemblages in the study area. However, information presented here is sufficient to provide a basis from which to discuss the potential significance of the study area for mammals. However, recording the different animal species by our group like Al-Sadoon et al. (2016) (lizard fauna), Al-Sadoon et al. (2017) (snake fauna) and the present study on mammal fauna inhabiting Turaif region, there is need for additional research concerning to the fauna and flora of the region, their history, adaptation, distribution, characteristics, and how they are influenced by different environmental factors. There is also a need for maps illustrating the past and present

distribution of large mammals and presenting their relationships to other environmental factors and human activities.

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