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Mammalian diversity of Shekhawati region in arid zone of Thar Desert, India

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Abstract
Shekhawati region located in north-eastern of Rajasthan and cover only 8% area of the state. Climatic condition of the area is both extreme – very hot summer and very cool winters. The region lies in semi-arid zone with low floral diversity due to scantly and irregular rainfall. Wind velocity in the region is quite high during the summer and sand storms are common feature of the area. Sand dunes are dominant in the entire region especially in north-western part. The region is part of Indian Thar Desert exhibit little mammalian diversity. During last three decades numbers of large mammals has been drastically decreased in the Shekhawati region due to inference of people in natural habitats of mammals for their beneficiary activities. The mammalian diversity of Shekhawati region is represented by 40 species of mammals belonging to 20 families and 31 genera. The region covers 9% mammalian diversity of India and 58.8.% of Thar. During survey of mammalian species both direct methods like line transect method and indirect methods by identification of sign were used. The conversion of desert land into irrigated agriculture is also affecting the biodiversity scenario in the region. Mammals that are adapted to desert environment is rapidly vanishing due to interference and destructive activities of man.

Keywords: Desert, mammal, carnivorous, transact, diversity, sand dune

1. Introduction
Thar desert in Rajasthan has only 6% area of the total area of the country. Within this little area, with hostile climatic conditions, about 15.8% (68 out of 428) mammalian species are surviving. Earlier workers (Bates *et al*. 1994a, b, c; Joshi, 1984; Prakash, 1994, 1995; Rahmani, 1991; Rana, 1980; Rice, 1991; Sankaran, 1992; Sankhala, 1979; Saxena, 1975; Singh and Sharma, 1985; Tehsin, 1980, 1987; Tripathi *et al*., 1985; Wada, 1984 and Singh, 1995) [101, 102, 103, 31, 60, 61, 75, 77, 80, 85, 86, 104, 105, 106, 98, 99, 107, 93] have done a faunistic survey and made significant contribution towards study of mammals in Rajasthan. Wilson and Reeder (1993) [100] listed the mammalian species of the world. On basis of his report Agarwal (1998) [2] reported 13 orders, 42 families, 180 Genera and 390 species of mammals in India. Of these, 8 orders, 23 families, 45 Genera and 66 species have been recordred from Thar desert of Rajasthan (Chakarborthy *et al*., 2005) [18]. Alfred and Agarwal (1995) reported 68 species belonging to 9 orders dwelling in the thar desert.

The Thar, as an ecosystem, is under the process of ecological transformation. This transformation has largely been brought about by the mighty Indira Gandhi Canal and partly through global climate changes. Indira Gandhi Canal water in the Churu and Jhunjhunu district is mainly used for drinking purpose. Because of this Canal irrigation, shadow effects on flora had been observed and 42 plant species of irrigated area have expanded their distribution to non-irrigated area. Uncontrolled mining in mountain range of Aravalli and other small hiclocks in Jhunjhunu and Sikar districts are also affecting the floral and faunal diversity. Changing floral composition will definitely affect the faunal composition of the region. Many mesic species of small mammals are expanding their distribution towards the the Thar (Parkash, 1995), many aquatic birds have recently invaded the Thar (Soni, 1994; Idris *et al*. 2009) [108, 29]. The present inventory of mammals and birds will help in monitoring the population in future.

Shekhawati region is not so rich in carnivores and large mammals' diversity as compared to other districts of the Thar desert. Major reason for the poor diversity of these animals is high human population, fast destruction of natural habitats, industrialization, illegal mining, irrigation, shrinking forest covers and poaching. Only protected area of the region, Tal Chhapar Blackbuck sanctuary, is a small fenced area of about 7.19 sq km.

It is vast grassland with sporadic trees here and there. In addition to Blackbucks, some snakes, lizards, harriers and some other predator avian species are found in the sanctuary. Important mammals found in the region are Desert fox, Blackbuck, Blue bull, Desert cat, Mongoose, Hedgehog, Musk shrew, Desert gerbil, Indian gerbil and eight chiropteran species. Cobra, Saw-scaled viper and Krait are poisonous snakes of the area. Varanus, Garden lizard, Wall lizard and many other lizards are found here, while turtles and tortoises are absent from the region. *Rana tigrina* and *Bufo melanostictus* are the common amphibians of the districts, while fish fauna is almost absent due to dearth of aquatic bodies. No significant work on vertebrate diversity of Shekhawati region has been carried out, except the systematic of small mammalian study of CAZRI team (Prakash, *et al*., 1971) [71].

2. Materials and Methods

The Shekhawati region of Indian Thar desert, located in the north-east part of Rajasthan lies in between 27°24′ to 29° 02′ N latitude and 73°4′ to 76° 5′ E longitude at a height of about 320 meters from sea level. The region covers an area of 27,529.44 sq km and connects with the boundaries of Hanumangarh district in north, Hissar in north-east, Bhiwani, Rohtak and Mahendragarh districts of Haryana in south-east, Jaipur and Nagaur in south and with Bikaner district in west. Not much work has been carried out on survey of existing mammalian species in Shekhawati region of Thar desert. Though, Chakraborthy *et al.* (2005) [18] made a district-wise survey on mammalian diversity of Thar desert.

Present study is largely based on our observations in the field during last six years from May 2008 to March 2014. For this, the area was divided into three parts based on its eco-physiological characters *viz* 1. Middle-eastern part of the Shekhawati region - Plain agricultural area 2. Southern-eastern part of the Shekhawati region - Arawali mountainary range, its foothill site and small hillocky areas. 3. North-western part of the Shekhawati region – Thar desertic area. The Mammals of the region were monitored all the year round, during all the seasons. During study period minimum one site was visited per month to record the mammals and their related parameters. Total 84 sites were visited in the study area. During field survey of mammalian species both direct and indirect methods were used. Following methods were applied:

Line transects method (Rodger, 1988, 1991) [82-84]: In this method, line transact of 1 square km. were used in different locations of study area and observation were made by walking along the road side both on foot and by vehicle. The observations were taken in early morning and late evening hours. The presences of different mammalian species in the particular habitats were noted. Large mammals like *Semnopithecus entellus, Macaca mulata*, *Boselaphus tragocamelus, Antelope cervicapra, Gazella gazelle etc.* that can tolerate the humans presence and allow the observations to be made from close quarters by necked eyes in open field, dense forest or in hilly part of the region. 8x40 Olympus binoculars were also used for observing mammals. Photographs were taken by using Cannon Supershot and hp 945 digital Camera.

Water source method was also applied for observation of mammals during the noon and sometime at night in the summer because this time temperature reached on peak and water crisis begins and mammals comes near water body in search of water.

During field visit in the area for identifications of mammalian species some indirect methods were also used. Animal signs such as pellets, scats, quills, kill and burrows which are indicate the presence of an animal in the area, were carefully observed and photographs were taken.

Rural people also helped us in identification by presence or absence of mammals by providing them photographs and pictorial guides for identification that are likely to be found in the area. Confusing and difficult group of mammals were confirmed by sending the photographs to wildlife experts.

3. Results

A total of 40 species of mammals are found in the study area. They belong to 8 orders, 20 families, and 31 genera. Out of 110 species of order Chiroptera present in India, 18 have been reported in Thar desert of Rajasthan and only eight are present in Shekhawati region. Pholidota and Lagomorpha are smallest orders in the region with only one species each. In the study area order Chiroptera has maximum number of six families; while order rodentia, with 14 species is largest one constituting 35% of the total mammals (Table 2 and figure 1).

Some species of small and large mammals like chinkara, mongoose and hares were predominantly found in the desertic crop area of north-west part of study region, where as jackal, fox, jungle cats, etc. were predominantly observed in the community lands, hilly areas and near water bodies. Blue bull, desert cat and many small rodents were well distributed in all kinds of ecological settings. Interestingly two primate species were also seen in the area of Shakambari and Loharlgarl, Kirdoli and some other parts of southeast of Shekhawati region (Table 1). Out of 40 mammalian species found in this study area, six species are in Schedule I and one species is in schedule III, of five species listed in Schedule II and six species in schedule IV and thirteen species are in Schedule V of Wildlife (protection) act, 1972 and the status of remaining species is not mentioned.

Three species *Gazella bennetti*, *Antelope cervicapra* and *Boselaphus tragocamelus* belong to the large mammal category and rest to small mammals. Blackbuck and Chinkara are common in Thar ecosystem and are more or less restricted in protected areas or in and around Bisnoi-inhabited villages, owing mostly to water scarcity and poaching pressure. *Boselaphus tragocamelus* has been observed in all three districts of study region, where as *Gazella bennetti* and *Antelope cervicapra* have been seen in all tehsils Churu district and also in northern-western part of Sikar and Jhunjhunu districts. At Tal Chhapar wildlife Sanctuary (Churu) and around it, both the species are quite abundant. *Macaca mulata* occurs in eastern and southeastern Rajasthan (Wada, 1984; Tehsin, 1980; Sankaran, 1992) [107, 106, 85]. In study area two species of primates, *Macaca mulata* and *Semnopithecus entellus* have been observed in south part of Jhunjhunu and north-east part of Sikar district. Most of the observed species of Rodents are found in all districts of Shekhawati region except *Hystrix indica* which is being reported from Jhunjhunu district only. Three species of Mongoose are found in the field and also near houses where dirt of Ziziphus and thorny plants are collected as fire wood.

Table 1: Checklist of Mammals of the Shekhawati region

A	B	C	D	E	F
Order – Insectivora					
Family – Erinaceidae					
1.	Indian Hedgehog	*Paraechinus micropus*	–	C	O
Family – Soricidae					
2.	Grey Musk Shrew	*Suncus murinus*	–	VC	O
Order – Chiroptera					
Family - Pteropodidae					
3.	Flying Fox	*Pteropus giganteus*	V	C	F
Family – Megadermatidae					
4.	Greater False Vambire Bat	*Megaderma lyra*	–	VR	C
Family – Rhinolophidae					
5.	Blyth's Horse shoe Bat	*Rhinolophus lepidus*	–	R	I
Family – Rhinopomatidae					
6.	Greater mouse-tailed Bat	*Rhinopoma microphyllum*	–	C	I
7.	Lesser mouse-tailed Bat	*Rhinopoma hardwickei*	–	C	I
Family – Emballonuridae					
8.	Egyptian tomb bat	*Taphozous perforatus*	–	R	I
Family – Vespertilionidae					
9.	Common Pipistrellus	*Pipistrellus pipistrellus*	–	C	I
10.	Asiatic Yellow House Bat	*Scotophilus heathi*	–	C	I
Order – Primates					
Family - Cercopithecidae					
11.	Hanuman Langur	*Semnopithecus entellus*	II	R	H
12.	Rhesus Macaque	*Macaca mulata*	II	R	H
Order – Carnivora					
Family – Canidae					
13.	Jackal	*Canis aureus*	II	R	C
14.	Desert Fox	*Vulpes vulpes*	I	C	C
Family – Viverridae					
15.	Small Indian Civet	*Viverricula indica*	II	VR	O
Family – Herpestidae					
16.	Small Indian Mongoose	*Herpestes javanicus*	IV	R	C
17.	Grey Indian Mongoose	*H. edwardsi*	IV	C	C
18.	Ruddy Mangoose	*H. smithi*	IV	R	C
Family – Felidae					
19.	Desert Cat	*Felis silvestris*	I	R	C
20.	Jungle Cat	*F. chaus*	II	VR	C
Family – Ursidae					
21.	Sloth Bear	*Melursus ursinus*	I	–	O
Order – Artiodactyla					
Family – Bovidae					
22.	Nilgai	*Boselaphus tragocamelus*	III	VC	H
23.	Black buck	*Antelope cervicapra*	I	C	H
24.	Indian Gazelle	*Gazella gazella*	I	C	H
Order – Pholidota					
Family – Manidae					
25.	Indian Pangolin	*Manis crassicaudata*	I	VR	I
Order – Logomorpha					
Family – Leporidae					
26.	Desert Hare	*Lepus nigricollis*	IV	R	H
Order – Rodentia					
Family – Sciuridae					
27.	Five Striped Palm Squirel	*Funambulus pennanti*	IV	VC	H,G
Family – Muridae					
38.	House Rat	*Rattus rattus*	V	VC	O
29.	Kutchch Rat	*Cremnomys cutchicus*	V	C	O
30.	House Mouse	*Mus musculus*	V	VC	O
31.	Phillips' mouse	*Mus phillipsi*	V	R	O
32.	Flat-haired Mouse	*Mus platythrix*	V	R	O
33.	Sadhu Mouse	*Mus saxicola*	V	R	O
34.	Bush Rat	*Golunda ellioti*	V	C	O
35.	Metad	*Millardia meltada*	V	R	O
36.	Indian desert Gerbil	*Meriones hurrianae*	V	VC	O
37.	Indian Gerbil	*Tatera indica*	V	VC	O
38.	Hairy-footed Gerbil	*Gerbillus gleadowi*	V	R	O
39.	Baluchistan Gerbil	*Gerbillus nanus*	V	R	O
Family – Hystricidae					
40.	Indian Porcupine	*Hystrix indica*	IV	R	O

Abbreviations used in Table 10.4
A = S. No., B = Common name, C = Scientific name, D = Wildlife status, E = Abundance status or conservation status, F = Foraging status
Wildlife status: I = Schedule I; IV = Schedule IV; V = Schedule V; NLA = Not listed in act; 0 = Information not available
Abundance status or conservation status: R = Rare, VC = Very common, C = Common, VR = Very Rare,
Foraging status: O = Omnivores, H = Herbivores, C =Carnivores, I = Insectivores, G = Grainivores, S = Scavenger, N = Nectrivore, F = Frugivores

Table 2: Order and Family–wise distribution of genera and species of mammals in the Shekhawati region.

S.No.	Orders	Family	Genera	No. of species	% of the Species
1.	Insectivora	2	2	2	5
2.	Chiroptera	6	6	8	20
3.	Primates	1	2	2	5
4.	Pholidota	1	1	1	2.5
5.	Carnivora	5	6	9	22.5
6.	Artiodactyla	1	3	3	7.5
7.	Lagomorpha	1	1	1	2.5
8.	Rodentia	3	10	14	35
Total	8	20	31	40	100

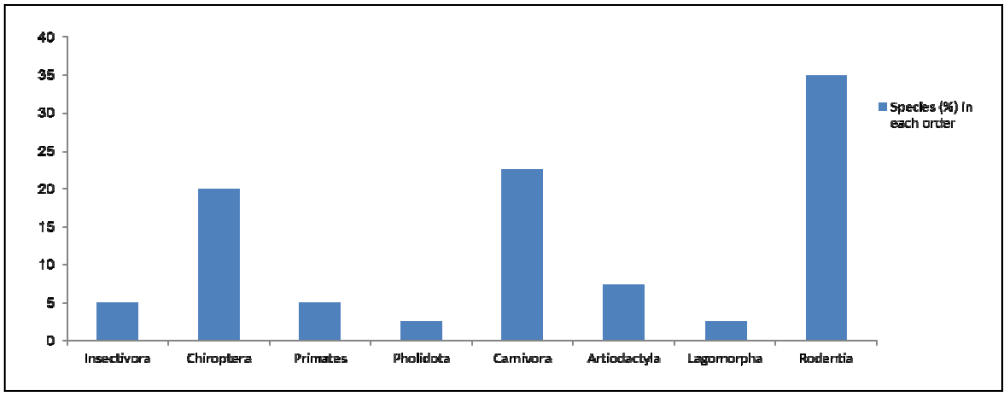
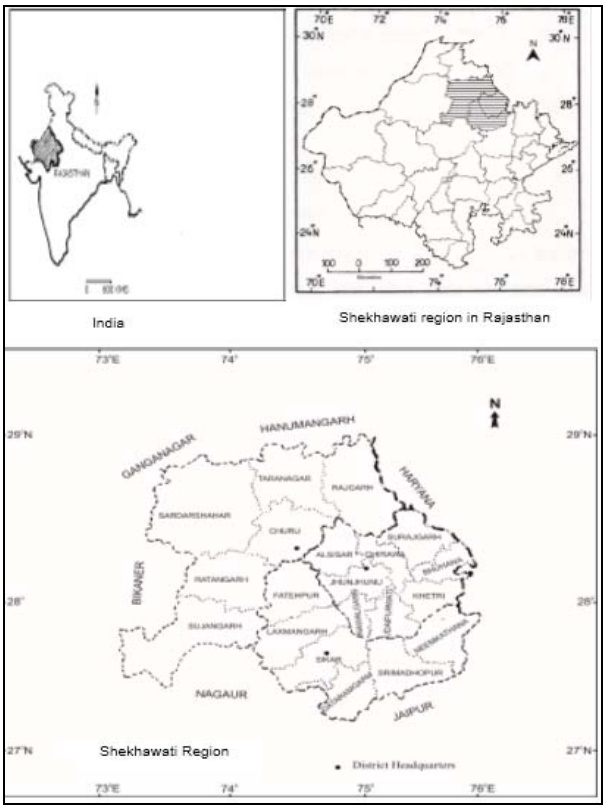


Fig 1: Species number (in percentage) in each mammalian order



Map 1: Shekhawati region

4. Discussion & Conclusions

As per IUCN Red list (2012) [109], out of the 428 mammal species, 44 species are endemic and 4 species are extinct from India. The current conservation status of the Indian mammals of Threatened Species is enhancing day by day. There is no doubt that biodiversity of the Thar is changing with adding few new species in or around the canal or irrigated areas but this increase is at the cost of desert-dwelling species. Uncontrolled use of pesticides in agricultural fields, transportation, and deforestation were found causing highest impact to the forest ecosystem and mammalian fauna as well.
The crux of problem is – should we welcome this increase in mammalian diversity which is at the cost of desert adapted species? The reality is that the desert–adapted species like desert fox, jackal, desert cat, etc. will become extinct from this fragile but unique ecosystem. Use of pesticides in agricultural practices by the farmers of the region may have direct impact on herbivores and finally on carnivores. The rapidly increasing pattern of urbanization and colonization may also be responsible for loss mammalian habitat. Southern-eastern part of the region, where Arawali mountain range is found is facing illegal mining problem that is one of the most dangerous threats to mammals in the area.
Road accident cases is also major threats to wild mammals, during the present study we recorded accidents of palm striped Squirrel, small Indian Mongoose, Jungle cat, Indian Fox, Pale Hedgehog, and Black buck. The study indicates that natural habitats of the study area should be protected for conservation of mammalian fauna.

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