

# Ecology of desert mammals

Ishwar Prakash

Desert Regional Station, Zoological Survey of India, 107 Kamla Nehru Nagar, Jodhpur 342 009, India

The Thar desert of western Rajasthan exhibits a rich mammalian diversity. In recent years, however, the number of large mammals, artiodactyles and carnivores, has drastically dwindled due to expansion of human population. They are being replaced by small mammals, shrews and rodents. The highly adapted *Gerbillus gleadowi* is a predominant species in the extreme desert largely dominated by sand dunes. The sandy plain in the central desert is the most species-rich habitat and is inhabited by 68 mammal species. Certain rodents like *Cremnomys cutchicus* and *Mus phillipsi* are found in the rocky habitats. The transformation of desert grasslands to irrigated agricultural fields is changing the biodiversity scenario in the desert. Consequently, typical desert-adapted, endemic mammals are vanishing and they are being replaced by mesic elements. Behavioural adaptation of mammals for survival in the inhospitable desert environment is discussed in this paper.

THE Indian Thar desert is located on the south-eastern fringes of the Great Palaearctic Desert, extending over two continents, from Sahara to Gobi desert. Sixty per cent of the Indian Thar is situated in western Rajasthan. The Archaean Aravalli range borders it in the east. The time and origin of the Thar desert still remains a disputed subject. On the basis of archaeological and historical evidences it was regarded to be of recent origin, xeric conditions having been established due to unlimited exploitation and destruction of vegetation<sup>1,2</sup>. However, recent geological<sup>3</sup>, geomorphological<sup>4</sup> and palynological<sup>5,6</sup> studies point out that Thar is a very old desert and its aridity has been established over a long and continued period. The floristic and faunal evaluation of the desert biota confirms the latter view<sup>7,8</sup>. The arid region of western Rajasthan is not a vast stretch of sand dunes, but is interspersed with low hills and gravel plains. Human habitations are scattered all over since it is the most populated desert of the world, 78 humans per km<sup>2</sup>. Consequently, the desert presents an interesting intermingling of habitats occupied by a species-rich mammalian fauna.

## Mammalian abundance

During the beginning of the present century, when human numbers were low, the desert region sustained a great preponderance of larger mammals. The now-extinct cheetah, *Acinonyx jubatus* was distributed throughout the

desert and was commonly found around Jaipur<sup>9</sup>. Black buck, gazelle and wild boar have also been widely reported<sup>10</sup>. Herds of two hundred wild ass, *Equus hemionus khur* were reported from Bikaner and Jaisalmer<sup>11</sup>. The medium-sized mammals, the caracal, wolf, jackal, desert fox, desert cat, plentiful up to 1950, have almost vanished. This is mainly due to shrinkage of their native habitat, which is now being taken over by man for agriculture. The larger mammals are also being replaced by smaller mammals like insectivores and rodents. However, the blue bull, *Boselaphus tragocamelus* has benefited by the expansion of agriculture. This is because they are not killed on sentimental grounds. During the 1950s and the 1960s, the house shrew, *Suncus murinus* was collected only from residential premises and their vicinity. Later, during 1970–1971 trapping of small mammals was taken up throughout the desert of Rajasthan. It yielded a few shrews from crop fields, but our recent studies (1993–1994) revealed a high preponderance of this insectivore, especially in the crop fields<sup>12</sup>. The house shrew has apparently altered its ecological niche from houses to crop fields. Likewise, with the fast-changing landuse pattern, the density of several small mammals has enhanced like that of the bush rat, *Golunda ellioti* and the metad, *Millardia mel-tada*, which were seldom collected earlier. Moreover, a few species which did not occur in the desert have invaded it from Peninsular region, like the bandicoot, *Bandicota bengalensis* and the little mouse, *Mus terricolor*<sup>13</sup> which inhabit the irrigated crop fields. The mammalian scenario in the xeric environment is fast changing with man's intervention.

## Habitat preference

The sand dune-dominated, tree-less, 100 mm rainfall region in the extreme western zone of Jaisalmer and Barmer districts is largely inhabited by the hairy-footed gerbil, *Gerbillus gleadowi*, which is endemic to the Thar desert. Its preponderance in the region is astonishing, about 40 gerbils/100 snap traps/24 h compared to 1–8 rodents per 100 traps per 24 h in other parts of the desert. The nocturnal species has been found to be one of the most adapted rodents as it is highly salt-tolerant and is more renal efficient than any other desert mammal<sup>14</sup>.

Another finding we have made is that the porcupine occurs among tall sand dune systems of the extreme



desert<sup>15</sup>. Elsewhere, *Hystrix indica* inhabits rocky habitat. Is this isolated population thriving in the deep desert, probably since times prior to deposition of sand and when it was a continuous stretch of hills? Similarly the relict Deccanean rock rat, *Cremnomys cutchicus*, occurring on every hill scattered throughout the Thar desert of Rajasthan, is at present the most abundant small mammal over the Aravalli range<sup>12</sup>. The central desert receiving average annual precipitation up to 400 mm is relatively a species-rich region because of diversity of habitats, the rocky outcrops, gravel plains, lakes, beds of ephemeral rivers and village complexes. In the rocky habitat, thickets of *Euphorbia caducifolia* provide shelter to the desert hare *Lepus nigricollis* and several species of mice. Crevices in the rocks are the special niche of the most abundant *Cremnomys cutchicus*. The larger caverns and caves are occupied by about 16 species of microchiropteran bats, only sometimes by rare species like wolf, jackal, hyaena and panther. Over the hillocks, which are protected from grazing livestock, porcupine is also found.

Village settlements occur in every habitat in western Rajasthan and they provide an important habitat for mammals. Whereas the magnificent black buck has almost vanished from the desert region, its free-living populations are still found around villages of Bishnoi people, who regard it sacred and protect it. Along with black bucks, the Indian gazelle, *Gazella bennetti* also congregates around Bishnoi habitations. The desert cat, *Felis silvestris* has so much intermingled with the domestic cats that it is difficult to find a pure-bred wild form. Old buildings, forts and deep wells are inhabited

by microchiropteran bats. The two megachiroptera, the flying fox, *Pteropus giganteus* and the smaller frugivore *Cynopterus sphinx* are found over large trees in gardens. The striped squirrel, *Funambulus pennanti* is the most common mammal in the vicinity of human dwellings.

The northern desert, Sri Ganganagar and Hanumangarh districts have been transformed from open desert grasslands to irrigated cropping with the advent of Gang Canal during the 1930s. At present the Himalayan water is flowing into the desert up to Jaisalmer through the Indira Gandhi Canal. Extensive agriculture has already come up very close to Bikaner. In this irrigated region the moisture regime pattern in the sand has been totally altered, it is moist all the year round. Consequently, the vegetation type has changed and typical deserticolous animals are being replaced by mesic forms. The gazelles have migrated to dry zone and they are being replaced by the blue bull. The highly-adapted desert rodents (*Gerbillus*, *Meriones*) have been replaced by mesic *Bandicota*, *Mus* and *Millardia* (Table 1). The latter species are serious pest of standing crops and very dangerous from the epidemiological point of view as they are very susceptible to the plague bacillus. Moreover, the desert is losing its endemic xeric fauna, which is not found anywhere else in India, due to altering landuse pattern.

### Desert adaptations

The desert animals and plants are confronted with thermal extremes, paucity of drinking water and food, and scanty shelter. The desert mammals have evolved a series of adaptive strategies for their survival in the inhospitable desert environment. About 80% mammals inhabiting the arid zone are nocturnal, and by restricting their activities to cooler nights, they avoid the heat of the day. Moreover, when the air temperature falls below  $-5^{\circ}\text{C}$ , most of



Early during the century the black bucks (*Antelope cervicapra*) were found in the desert region in groups of 5000 to 8000. At present, however, free-roaming antelopes are found only in the vicinity of Bishnoi village complex. This community of desert dwellers protects wildlife and trees on religious grounds. It is an unique example of human-animal relationship. (Photo: B. S. Lamba).



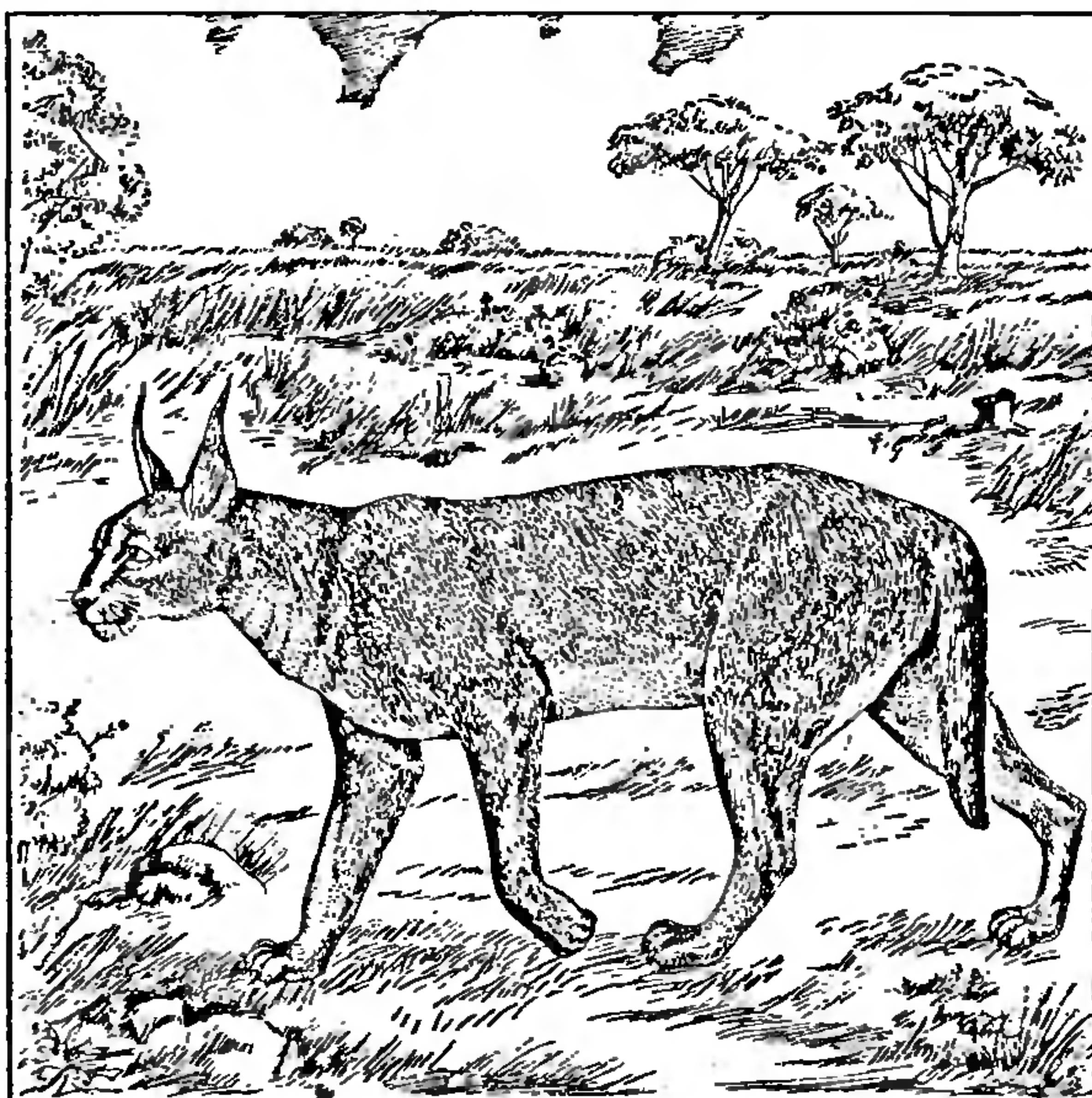
Herds of wild ass occurred in Bikaner and Jaisalmer before the turn of the last century. At present, *Equus hemionus* is restricted in the Little Rann of Cutch. (Photo: S. P. Sanyal).



them cease their activities and enter their hideouts. It has been observed that during summer, the Indian gerbil, *Tatera indica* ventures out of its burrow at about 17.30 h and the peak in its activity is reached at 23.00–24.00 h and terminates early in the morning. However, during the winter season when the nights are very cool, the peak activity is advanced, soon after dusk, at about

**Table 1.** Succession of species replacement in the desert region under Indira Gandhi Canal Command

Period	Mammals (arranged in the order of abundance)
Prior to incoming or irrigation	<i>Gazella</i> , <i>Gerbillus</i> , <i>Meriones</i> , <i>Tatera</i>
25 years after incoming of irrigation	<i>Gazella</i> , <i>Tatera</i> , <i>Millardia</i> , <i>Meriones</i>
65 years after	<i>Boselaphus</i> , <i>Millardia</i> , <i>Tatera</i> , <i>Mus</i> , <i>Bandicota</i>

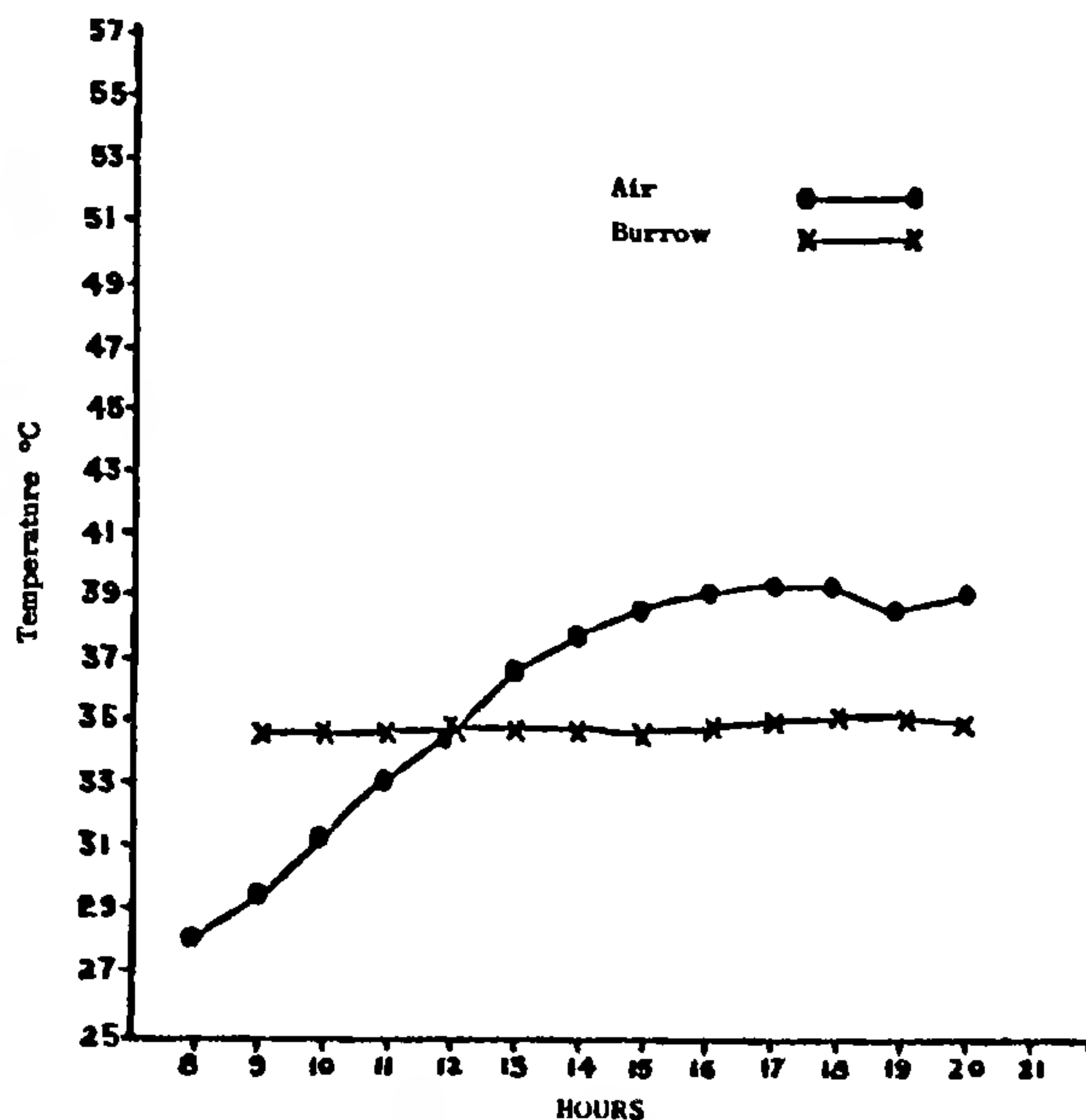


The caracal (*Felis caracal*). Locally known as *Siyagosh*, the caracal was a rare animal even at the turn of the last century. Distributed in deserts of Iran, Arabia, Pakistan and the Thar desert, at present, it is considered as a threatened species. Caracal is stout mammal with long limbs, larger than a cat, long ears with a tuft of black hair on the tip. Inhabits open grasslands and feeds on birds and small mammals. It has been reported to spring upon low flying birds up to about two metres. It is so powerful that it can chase and kill a gazelle. People used to tame and train it to catch peafowls, cranes, hares and other medium-sized mammals. The caracal is extremely agile and swift. When let loose amongst pigeons feeding on the ground, the caracal strikes down 10–12 birds before they can escape by flight. Alas! this magnificent animal is on the verge of extinction in the Indian Thar desert [Diagram: Arun Ghosh].

19.00 h and ceases by 24.00 h. By restricting its outside-burrow activity, it avoids exposure to the mid-night extreme cold. Likewise, the diurnal desert gerbil, *Meriones hurrianae* also shifts its diel activity into Bimodal pattern during summer months: during mornings and evenings. However, in winter it forages all through the day. Desert mammals shift their diel activity to comfortable periods to avoid the extremes of temperature.

The smaller mammals (56%) have adapted to live a fossorial life; insectivores (4 species), medium-sized carnivores (13), pholidote (1) and rodents (17). The temperature inside the burrows does not fluctuate as much as the air temperature does during the day (Figure 1). When the desert gerbil, *Meriones hurrianae* develops hyperthermia due to continuous exposure to sun, it intermittently visits the cooler environments of the burrow and unloads the excessive heat. This may be the reason that diurnal rodents excavate extensive, multi-tier burrows as compared to the nocturnal ones. All the microchiropteran bats (25% of mammal species) inhabit cooler environments of caves, tunnels, and ruins of buildings.

Almost all the mammals are very versatile as far as their food habits are concerned. It is not surprising to find that 90% of the stomach contents of the insectivorous *Suncus murinus*, examined all through the year, constituted leaves of an inedible shrub, *Mimosa hamata*. Likewise, stomach contents of carnivorous desert fox, desert cat and jackal were found full of fruits of cucurbits



**Figure 1.** Diurnal variations in air temperature and inside burrow of desert gerbil.



**Table 2.** Distribution of litter size of the desert hare during a year. The litters of 3 and 4 young occurred only during monsoon months

Month	No. of litters of different sizes			
	1	2	3	4
January	5	—	—	—
February	1	—	—	—
March	3	—	—	—
April	3	—	—	—
May	4	5	—	—
June	0	0	0	0
July	—	5	2	1
August	—	1	3	2
September	2	1	3	1
October	—	5	2	1
November	9	1	—	—
December	1	—	—	—

**Table 3.** Zoogeographical affinities of mammal in the Thar desert

Order	Number of species and their affinities		
	Saharan	Tharian	Oriental
Insectivora	2	—	2
Chiroptera	8	1	9
Primates	—	—	2
Pholidota	—	—	1
Carnivora	11	—	5
Perissodactyla	—	1	—
Artiodactyla	2	—	3
Lagomorpha	1	—	—
Rodentia	8	1	11
Total	32	3	33

Macroendemism: 4.4%

Microendemism: 20 subspecies, Tharian.

and berries of *Ziziphus nummularia*. The seedivorous-desert rodents switch over to insects during the summer months when vegetation is without any water content. Insect bodies contain about 80% water. The shift to insect food during summer also helps them in osmoregulation. The gerbils show spectacular fluctuations in feeding on various plant parts over the year depending on their availability in the desert ecosystem. Our study<sup>16</sup> revealed that during winter, when the seeds are available after flowering season, the gerbils feed on maximum quantity of seeds, 60% of the total. During monsoon, when green food is available, blades of grasses and leaves of herbs are consumed (30–40%). But during summer, they totally depend on stem, rhizomes of sedges and grasses; and insects. Moreover, during summer when

food is scarce, the merion gerbils have been observed to scent-mark dry clumps of grasses, probably to indicate their territoriality over it to other conspecifics. Omnivory is one of the major strategies for survival in the desert.

Most mammal species coincide their maximum breeding time to monsoon months because of the prevalence of conducive environmental condition and availability of green food. Our field data has clearly shown that the survival rate of the young born during the latter half of the year is significantly ( $P < 0.01$ ) superior to those born during the first six months of the year. Moreover, among the mammals which litter all the year like the desert hare, *Lepus nigricollis dayanus* (Table 2), the largest litters are born during July to October, the rainy months.

### Zoogeography

A detailed analysis of mammalian distribution in African and Asian deserts has revealed that some genera like *Meriones* and *Gazella* are spread from Sahara to Gobi desert and find their south-eastern limit in the Thar desert. A few species are Turano-Tharian and about 50% species exhibit oriental affinities (Table 3). Three mammalian species and 20 subspecies are Tharian in origin.

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