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Micro chiropteran Bats: Diversity and roosting sites in Girwa Tehsil of Udaipur District of Rajasthan (India)

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Abstract
Bats are the second most species of mammals after rodents. In this paper we reported diversity and roosting site of bats in the Girwa tehsil of Udaipur district, Rajasthan recorded from November 2007 to February 2009. Various surveys were performed in the tehsil to identify roosting sites of bats. After identification of the site, bat species were identified and numbers were counted each month. A total of six Micro chiropteran bat species belonging to five families were recorded in Girwa tehsil during the study period. The highest number of individuals of *Rhinopoma microphyllum* was recorded in Girwa tehsil. Variety of habitats and availability of surface water in good quantity throughout year may be a key factor for such good number of bat species in this tehsil.

Keywords: micro chiropteran, bats, Udaipur, Rajasthan, diversity, habitat

Introduction
After rodents, Chiroptera is the largest order, making up about 20% of mammal species [12]. Bats are now classified on the basis of molecular evidence into the suborders Yinpterochiroptera (containing the families Craseonycteridae, Hipposideridae, Megadermatidae, Pteropodidae, Rhinolophidae, Rhinonycteridae, and Rhinopomatidae) and Yangochiroptera (containing Cistugidae, Emballonuridae, Furipteridae, Miniopteridae, Molossidae, Mormoopidae, Mystacinidae, Myzopodidae, Natalidae, Noctilionidae, Nycteridae, Phyllostomidae, Thyropterydae, and Vespertilionidae) [21, 22, 5]. Bats are found throughout the world in tropical and temperate habitats. They are missing only from Polar Regions and from some isolated islands. Although bats are relatively common in temperate regions, they reach their greatest diversity in tropical forests. (The tropics include the Equator and parts of North America, South America, Africa, Asia, and Australia) [7, 15, 23]. Many Micro chiropterans have labile body temperatures and some do hibernate [7, 17, 23]. They generally drop their body temperature in this state to 6–30 °C (43–86 °F) and may reduce their energy expenditure by 50 to 99%. Around 97% of all microbats use torpor[6]. They may roost in caves, crevices, trees, under logs and even in human dwellings. Bats may also use different types of roosts at different times. Some species that hibernates in a cave during the winter may use crevices in tree holes as roosts during warmer months. A wide variety of sites are used by Micro chiropteran bats for roosting. A comprehensive review of the roosting ecology of bats is given by Kunz (1982c) [11]. In the present paper we reported diversity and roost site of Micro chiropteran bats in the Girwa tehsil of Udaipur district of Rajasthan.

Materials and methods
Udaipur district is one of the 33 districts of Rajasthan state in western India. This district comprises 15 tehsils (administrative division of a district) namely Badgaon, Bhindar, Girwa, Gogunda, Jhadol, Kanor, Kherwara, Kotra, Lasadiya, Mavali, Rishabhdeo, Salumbar, Semari, Sarada, Vallabhnagar. Girwa is a tehsil of Udaipur District. The annual average rainfall in Girwa tehsil is 608 mm with an average of 32 rainy days per year. The district as well as Girwa tehsil harbors a significant amount of the state's biodiversity [9, 10, 4].
The study was carried out for a period of fifteen months, i.e., from November 2007 to February 2009. We conducted various surveys in the entire Girwa tehsil to locate the roost sites and diversity of the bats. All possible sites were scanned during the survey. Locals were interviewed to identify bat roosts and the sites where bats could not be observed directly, their presence was noted through their droppings.

After identification, the sites were visited twice a week every month for counting the number of bats. After locating the sites, bats were observed, identified and counted by direct sighting with the help of binoculars and on the basis of their time of emergence from roost. Observations were made between 17.30 h to 20.00 h on every visit.

Result

A total of six bat species belonging to five families were observed in Girwa tehsil during the study period. The details of roosting sites and approximate number of bats in all season are presented in Table 1. Highest number of recorded individuals were of *Rhinopoma microphyllum* (Greater Mouse-tailed Bat), recorded at two sites (i.e, Gupteshwar Mahadev Temple and Sajjangarh or Monsoon Palace) while the number of other bat species ranged from 0 to 30. Number of Micro chiropteran bats (*Taphozous nudiventris, Taphozous melanopogon, Tadarida aegyptica, Megaderma lyra*) decreased during winter (Table 1).

Rhinopoma microphyllum were found to occupy two roost sites and the number of individuals increased in caves (Gupteshwer Mahadev) when temperature was low (in winters) and decreased during the hot season (Table 2). Further, it was observed that their numbers increased enormously at Monsoon Palace, Sajjangarh Wildlife Sanctuary (WLS) during summers. This palace is located on top of a hill and so is a comparatively cooler place in the hotter season. In the month of July, 2008 approximately 50-60 bats were found clustered close together. Probably, this was the time when their congregation included pups and lactating mothers. Three such clusters were seen in the basement of Monsoon palace Sajjangarh WLS. R. m*icrophyllum* share their roosts with Naked-rumped tomb bat (*Taphozous nudiventris*).

Naked-rumped tomb bat (*Taphozous nudiventris*) was observed in the Monsoon Palace, Sajjangarh Wildlife Sanctuary WLS. They were observed to roost behind windows and left the site on our approach (Figure 5). However, the bats would return to the roost after we would leave. Only one individual was present in the monsoon season during the study period in the palace.

The Black-bearded Tomb Bats *Taphozous melanopogon* were observed in Monsoon Palace, Sajjangarh WLS. They were found to roost on ceiling in deserted rooms. Maximum number (0 to 30) was seen during summer season while minimum (0 to 3) was recorded during monsoon session. No individual was seen winter session (Table 1) September and March, and it is likely that they migrated elsewhere.

The Egyptian Free-tailed bat (*Tadarida aegyptiaca*) was recorded in the basement of the Monsoon Palace in Sajjangarh WLS. Only two individuals were recorded in monsoon during the study period.

The Indian Pygmy Pipistrelle (*Pipistrellus tenuis*) was also observed to roost behind the broken plaster on the wall in the Monsoon Palace, Sajjangarh WLS. Their presence was noted by their dropping on the ground and by their habit of early rising. They are the first of all bats to leave their roosts in the evening. Exact number of individuals of this bat in a roost could not be counted when they were present inside because their roost confided to a very narrow crevice. The numbers provided are on the basis of their observation on the time of emergence from roost.

Indian False Vampire Bat (*Megaderma lyra*) is a relatively large carnivorous social bat. This bat was observed to visit the lake Bari for drinking water at sunset. Also, this bat was observed in old buildings near Bari lake. During summer season, 4 to 15 bats were observed, 4 to 20 individuals are recorded in monsoon season and in winter season no individual was seen during the study period.

Discussion

Bats are found roosting in tall tree and in the vicinity of the water body. The association of insectivorous bats with forest edges has been broadly documented for other regions [8, 13,16] and this is also true for aquatic habitats [3, 14, 24]. The water channel may represent an important source, since frequent water ingestion is a critical factor for the water balance of insectivorous bats [18].

A good number of bats are found in Udaipur district due to the presence of many old buildings, palaces, forts, crevices, caves and surface water, which form favorable sites for bat roosting. It was observed that bats use caves, dark rooms, crevices, temples, behind banners, and in tree hollow. Bat preferences for roosting site depend on various physical parameters like favourable temperature, light intensity and humidity. A favorite roosting place for Micro chiropteran bats is on the ceiling (Figure1 and 2). A line of droppings beneath roosting site is often a good indication of their presence. From table 2 it was observed that number of *Rhinopoma microphylllum* in Monsoon Palace Sajjangarh WLS were decreased during winter season that may be due to they migrated elsewhere to escape from low temperature. While in summer season their number increases where they found roosting in high ceilings of mansoon palace of Sajjangarh WLF (Figure 2). Individuals of *Rhinopoma microphylllum* in Gupteshwar Mahadev Temple are found to be higher in winter season and lesser in summer season. *Rhinopoma microphylllum* choose dark and warm places for roosting (Figure 1). In winter season the rituals of offering lamps daily in temples keep the walls warm providing suitable site for roosting. In summer seasons they migrated elsewhere due to increase in temperature. The association of bats with forest has been documented in various regions [8, 16].

Other Micro chiropteran bats, *Taphozous nudiventris, Taphozous melanopogon, Tadarida aegyptica, Megaderma lyra* decreased during winter it may be due to the bats went into hibernation and gradually numbers of bats increased during summer seasons. These results interpret that there is tendency for high bat activity in the summer and monsoon season and lower activity in winter season. Since insectivorous bats use watercourses for spatial orientation [19, 20], the channel can also be used as a flying route. The activity patterns of bats found to markedly reduced in the winter and are influenced by fluctuations in temperature.

During the study period it was observed that bats face many threats to their roosting sites, such as habitat destruction, use of pesticides by farmers, roost-site loss or disturbance and even the noise pollution.

Table 1: List of Micro chiropteran bat species in Girwa Tehsil of Udaipur district, Rajasthan recorded from November 2007 to February 2009.

S. No.	Latin Name	English Name	Family	Roosting site	Approximate number of Bats in Summer season (March-June)	Approximate number of Bats in monsoon season (July -September)	Approximate number of Bats in Winter season (October - February)
1.	*Rhinopoma microphylllum*	Greater Mouse-tailed Bat	Rhinopomatidae	In caves of Gupteshwer Mahadev temple	40-60	60-75	80-500
				Basement of Monsoon Palace, behind banner	400-563	400-600	3-170
2.	*Pipistrellus tenuis*	Pygmy Pipistrelle	Vespertilionidae	Behind plaster in wall of Monsoon Palace	2-4	2-4	2-5
3.	*Taphozous nudiventris*	Naked-rumped Tomb Bat	Emballonuridae	Behind window in basement room of Monsoon Palace	0-1	0-1	0-0
4.	*Taphozous melanopogon*	Black beard Tomb Bat	Emballonuridae	Outer room of Monsoon Palace	0-30	0-3	0-0
5.	*Tadarida aegyptica*	Free- tailed Bat	Mollossidae	Basement of monsoon palace in SWLS	0-0	0-2	0-0
6.	*Megaderma lyra*	Indian False Vampire Bat	Megadermatidae	Found flying at sunset near Bari Lake	4-15	4-20	0-0

Table 2: Approximate number of *Rhinopoma microphylllum* bat in Gupteshwar Mahadev Temple and Monsoon Palace Sajjangarh WLS

S.No.	Month (08-09)	Approx. Number of individuals In Gupteshwar Mahadev Temple	Approx. Number of individuals in Monsoon Palace Sajjangarh WLS
1.	March 08	40	400
2.	April	50	450
3.	May	55	563
4.	June	60	563
5.	July	70	600
6.	August	75	540
7.	September	60	400
8.	October	80	170
9.	November	300	30
10.	December	390	25
11.	January 09	400	3
12.	February	500	10

Fig 1: *Rhinopoma microphyllum* (Gupteshwer Mahadev temple)

Fig 2: *Rhinopoma microphyllum* (Monsoon Palace Sajjangarh WLS)

Fig 3: *Rhinopoma microphyllum* (In old building)

Fig 4: *Megaderma lyra* (abandoned House)

Fig 5: *Taphozous nudiventris* (Behind Window)

Conclusion

Girwa tehsil of Udaipur district supports a good number of Micro chiropteran bats species. Human interference and lose of disturbance in natural resources affect the biodiversity and roosting site of bats. In future, with the improvement of the habitats and more field work and scientific study could help to increase the number of these species.

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