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**Studies on diversity,  
distribution and habitat  
preference of Bat species in  
Pune district, Maharashtra**

**V.S. Korad  
M.C. Gaikwad  
A.L. Koratkar**



**ZOOLOGICAL SURVEY OF INDIA**

**RECORDS OF THE  
ZOOLOGICAL SURVEY OF INDIA**

**Studies on diversity, distribution and habitat  
preference of Bat species in Pune district, Maharashtra**

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## INTRODUCTION

Chiroptera is the second largest order of class Mammalia and it includes about 123 species at the subcontinental level. The Western Ghats is considered as one of the 50 hot spots for richness of biodiversity at global level (Myers, 1990; Myers *et al.*, 2000). The Western Ghats region of India is reported to harbor about 50 bat species (Korad *et al.*, 2007). The literature available is mostly in form of the results of Mammalian Survey performed in the first quarter of the last century (Wroughton, 1916;1921, Wroughton & Davidson, 1920) and a study performed exclusively for bat fauna in central western India in early sixties of last century (Brosset, 1962a, 1962b, 1962c, 1963). Bates *et al.* (1994a, 1994b & 1994c) resurveyed this region in the last decade of the previous century.

Remarkable contributions published in past are available on morphology, taxonomy, distribution and ecology of bats from Western Ghats of India. Jerdon, (1874); Dobson, (1877); Blanford, (1888-91); Andersen, (1912); Wroughton, (1899, 1912a,1912bi,1912c,1913i,1916ai,1916aii,1916aiii,1919,1921i,1921ii); Ryley, (1913a, 1913bii); Wroughton & Davidson, (1920i, 1920ii); Lindsay, (1927i); McCann, 1934a, 1934b & 1940); Hutton, (1949a, 1949b); Khajuria, (1953, 1967); Brosset, (1962a,1962b, 1962c); Tiwari *et al.*, (1971); Bhat & Sreenivasan, (1972 & 1990); Agrawal, (1973); Sinha, (1970, 1973, 1976, 1980, 1981a, 1981b & 1986); Topal, (1974, 1975); Hill, (1976); Bastawde & Mahabal, (1976); Ramakrishna & Madhavan, (1977); Bhat *et al.* (1980); Naidu & Gururaj, (1984, 1985, 1986); Das, (1986 & 2003); Chandrashekar & Marimuthu, (1987); Marimuthu, (1988); Usman, (1988); Bhat & Jacob, (1990); Kock & Bhat, (1994); Jones *et al.*, (1994); Bates *et al.*, (1994c,1994d); Muni *et al.*, (1994a, 1994b, 1994c); Ramachandran & Jayson, (1994), Das *et al.*, (1995), Pradhan & Kulkarni (1997), Korad & Yardi, (2004a & 2004b), Wilson & Reeder, (2005), Talmale, (2007, unpublished Ph. D. Thesis by personal communication) are some of the noteworthy publications available in this regard.

Ecological conditions are changing drastically since last decade of 20<sup>th</sup> century. It is therefore essential to perform a study of fauna in such regions, which are constantly under the threat of ecological stress. Recently Korad and Yardi (2004a and 2004b) reported 15 species of bats in the urban area of Pune city (Maharashtra state, India), of these 3 species were new records in the central western India. These results encouraged authors to undertake the similar studies at district level.

## METHODOLOGY

### Scanning of the area and sampling :

Pune district was scanned taluka wise for understanding its topography, vegetation, rate of urbanization and likely sites for bat roosting. The primary survey regarding

bat fauna was performed by filling up of the simple questioner forms printed in English as well as in regional language. The opinions of the farmers, tribal people, school children, forest guards and forest officers were noted.

The likely sites were visited for survey of bat colonies for three years (2002-2005). Each visit in the region was accompanied by local field guides. Approximate bat population was recorded using sample area multiplication method, as described by Kunz (1988) and Kunz et al., (1996). Whenever possible, the bat colonies were visited in the evening to note down the emerging time and for estimation of number of individuals per colony by method of actual counting. The roosting site was photographed by using handycam (Sony-).

### **Identification of species**

A few bat specimens were also trapped with the help of butterfly net, Japanese mist net or simple forceps. The parameters pertaining to external morphology, cranium and dental features of these bats were considered for measurements. The publications of Corbet and Hill, (1992) and Bates and Harrison, (1997) were referred for identification of species. The reports were maintained in tabular form mentioning all the necessary details regarding ecological studies.

Final report was prepared with the help of suitable photographs, tables and graphs. Each bat species is mentioned referring its common name, scientific name and conservation status in South Asia (IUCN, 2001 and CAMP Report, 2002). The fruit bats are also referred for the Schedule to which they belong as referred by Wild Life (Protection) Act, 1972 (Act No 53 Of 1972)-Amendment Act, 2006 (39 of 2006).

The identified bat specimens were deposited for the collection at Museum, Zoological Survey of India (WRS), Akurdi, Pune.

## **OBSERVATIONS**

### **About the study area**

**Geography :** Pune district (Fig. 1 & 2) is located 17°.54' to 19°.24' North and 73°.19' to 75°.10' east, covering the area of about 15, 642 square km. It forms a part of the Deccan trap region, which is primarily a plateau. It is surrounded by Thane and Ahmadnagar districts in North and Solapur and Satara districts in South. Sahyadri or Western Ghats forms the western side of the district. Pune district is about 450 to 600 m above sea level, but in the Ghats region the altitude reaches up to 1,000 m to 1,200 m (Harishchandragad in north is 1424 m above sea level). The low altitude spurs are in the range of 600 m - 900 m and named separately as Harishchandra hill range, Shingi hill range, Tasubhai and Mandavi hill ranges. These hill ranges extend from high altitude in west to low altitude in east. Tamhini and Ambala hill ranges and hills of Purandar are some of the additional noteworthy geographical landmarks of the district.

Pune district is traversed by tributaries of river Bhima, which emerges from Bhimashankar situated in Western Ghats (Fig. 1). Kukadi River is one of the prominent

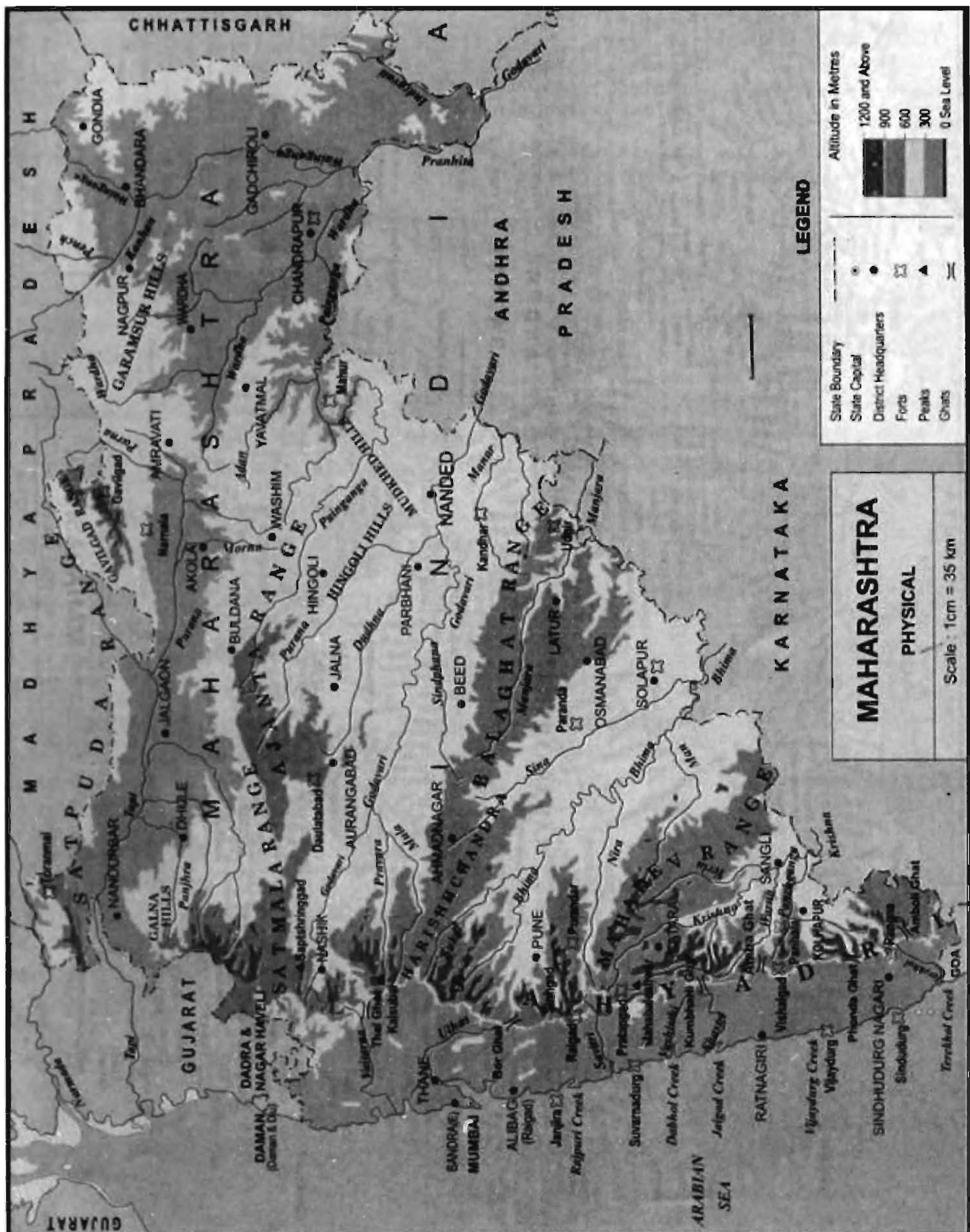


Fig. 1 : Physical map of Maharashtra

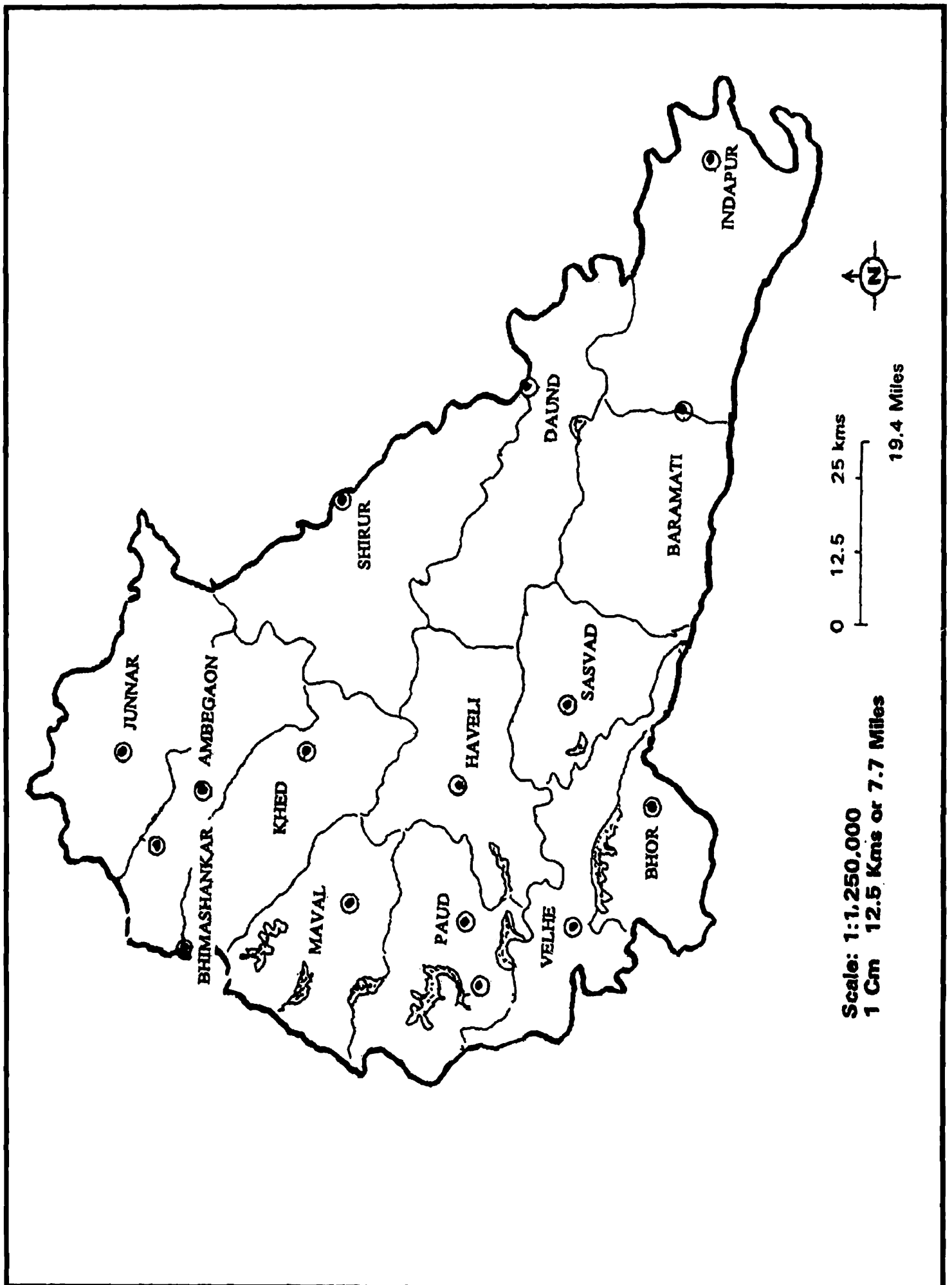


Fig. 2 : Map of Pune district

tributaries of Bhima in the northern part of the district and also borders (partly) its eastern boundary. Other important tributaries of Bhima River are Ghod, Mula, Mutha, Pavana, Bhama and Indrayani rivers. Many multipurpose dams have been constructed in this region, such as Manik Doh, Pavana, Temghar, Mulshi, Panshet, Khadakvasla, Bhatghar and Ujani, etc. They are important sources for water and electricity supply as well as for irrigation. Neera River that borders the southern boundary of Pune district, extends up to Neera-Narsingpur, where it meets Bhima River.

Besides the dams, some natural lakes and ponds are noteworthy as a source of water at the district level. Andhra, Kasurdi, Motoba, Shirsufal, Bhadalwad and Varvand are noteworthy lakes of the district.

**Climate :** The climate of Pune district is moderate. The average temperature on the western side is 22° Celsius and a little more on the eastern side i.e. about 30° Celsius. In winter the temperature goes down up to 8° Celsius, but even lower on the western side, due to high altitude. Annual rainfall varies remarkably in Pune district. In the western zone it receives rains up to 3200 mm, however in the eastern zone it may go only up to 500 mm. The relative humidity of the atmosphere is low throughout the district.

**Geology and Soil :** Almost the whole rock of Pune district is stratified trap. Parallel and alternate beds of Basalt and Amygdaloid rock are the peculiarities of the district. There are three varieties of soil: Black, Red and Brown. Brown soil is the peculiarity of the medium and low rain regions, like Khed, Haveli, Shirur, Daund and Purandar. Red soil is the characteristic of the western region. Alluvial soil is rich and appears in sheds of fresh yellow to dark brown on the banks of the main rivers.

**Forests :** The forests types of the district are mainly tropical evergreen, semi evergreen, deciduous and mixed type in the western zone, while tropical thorn forest is found in the dry eastern zone. Teak, Bamboo, Hirda, Ficus and Palm species are common to the western zone, while acacian species are common to dry thorn forests of the eastern zone.

**Agriculture :** The rural population depends mainly on agriculture. About 1674000.43 ha area represents the total irrigated land, which is only about 13.3% of available land. Millet and fodder are main crops of dry eastern zone. Rice is the main crop of the hilly and heavy rain region of western side. Besides wheat, pulses, groundnut and cotton are crops of dry but medium rainfall region of the middle part of the plateau. Sugarcane is the cash crop and is grown in well irrigated parts of Baramati, Junnar, Ghodegaon, Khed and Haveli regions of the district.

## **ABOUT THE STUDY ON DIVERSITY, DISTRIBUTION AND HABITAT PREFERENCE OF BAT SPECIES IN THE STUDY AREA**

The survey performed (2002-2005) for bat diversity from Pune district reports 25 species. The frugivorous bats found in the study area belonged to the sub order Megachiroptera. The insectivorous bats (one species is also reported consuming small vertebrates) belonged to the sub order Microchiroptera. The bat species reported from

the study area are enlisted in Table-1. The details of feeding habit, habitat preference and IUCN status of each bat species is mentioned in Table-2.

**Table-1 :** Systematic position of the Bat (Chiroptera: Mammalia) species from Pune district, Maharashtra (2002-2005).

		<b>Genus</b>	<b>species</b>
Suborder 1	Megachiroptera		
Family 1	Pteropodidae	1. <i>Rousettus</i> 2. <i>Pteropus</i> 3. <i>Cynopterus</i>	1) <i>Rousettus leschenaulti</i> 2) <i>Pteropus giganteus</i> 3) <i>Cynopterus sphinx</i>
Suborder 2	Microchiroptera		
Family 2	Megadermatidae	4. <i>Megaderma</i>	4) <i>Megaderma lyra</i>
Family 3	Rhinolophidae	5. <i>Rhinolophus</i>	5) <i>Rhinolophus rouxii</i> 6) <i>Rhinolophus lepidus</i> 7) <i>Rhinolophus beddomei</i>
Family 4	Hipposideridae	6. <i>Hipposideros</i>	8) <i>Hipposideros ater</i> 9) <i>Hipposideros fulvus</i> 10) <i>Hipposideros pomona</i> 11) <i>Hipposideros speoris</i>
Family 5	Molossidae	7. <i>Tadarida</i>	12) <i>Tadarida aegyptiaca</i> 13) <i>Tadarida plicata</i>
Family 6	Vespertilionidae	8. <i>Scotophilus</i> 9. <i>Myotis</i> 10. <i>Pipistrellus</i>	14) <i>Scotophilus heathii</i> 15) <i>Scotophilus kuhlii</i> 16) <i>Myotis horsfieldii</i> 17) <i>Pipistrellus pipistrellus</i> 18) <i>Pipistrellus javanicus</i> 19) <i>Pipistrellus coromandra</i> 20) <i>Pipistrellus tenuis</i> 21) <i>Pipistrellus ceylonicus</i> 22) <i>Pipistrellus savii</i> 23) <i>Pipistrellus kuhlii</i> 24) <i>Pipistrellus affinis</i> 25) <i>Pipistrellus (Scotozous) dormeri</i>

The western region of the district harbored forest species of bats, roosting in caves, crevices, dry log wood and broad foliage. The density of bat population was found highest in the Western Ghats (Table 3). Some bat species were found well adapted to the ecological conditions of the rural as well as urban area of spurs. While the species diversity and bat population found sparse in the dry eastern region.

### SPECIES-WISE SYSTEMATIC ACCOUNT

[Corbet & Hill, 1992 and Bates & Harrison, 1997 were referred for identification. The bat species were confirmed by Dr. M. S. Pradhan, Incharge, Mammal section, ZSI (WRS), Pune].

#### Class MAMMALIA

#### Order CHIROPTERA

#### Suborder MEGACHIROPTERA

#### Family PTEROPODIDAE

#### Genus *Rousettus* Gray, 1821

#### 1. *Rousettus leschenaulti* (Desmarest, 1820)

**Common name :** Fulvous Fruit bat

**Diagnosis :** The medium sized fruit bat, heavier than *Cynopterus*. There is a large claw on the first digit and a smaller one on the second. A short tail is present. The rostrum of the skull is moderately elongated. The fore-arm length ranges between 75 mm - 86 mm (average 80.6 mm). Second phalanx of third digit is less than 47 mm, the thumb including claw is less than 31 mm, the condylo-basal length ranges between 33.5 and 37.7 mm (average 35.8 mm) and upper tooth row averages 14.2 mm (13.5 mm - 15.2 mm). Dentition is smaller and delicate.

**Dental formula :** 
$$\begin{array}{ccccccc} -2 & 3 & 1 & & - & 2 & 3 & 4 & & 1 & 2 & - \\ i\text{-----}, & c\text{---}, & pm & \text{-----}, & m\text{-----} & = & 34 \\ & 1 & 2 & - & 1 & & - & 2 & 3 & 4 & & 1 & 2 & 3 \end{array}$$

**Ecological notes:** During the survey of bats in Pune district, *Rousettus leschenaulti* was found to be confined to the hilly region, where stagnant water was available in the vicinity. The permanent roosting sites of this bat were located in the evergreen, semi evergreen, mixed and dry deciduous forests. The preferred roosting sites were tunnels, arches of the bridges, caves or old ruined buildings. The interior of the roosting site had a peculiar odor of excreta on the floor and of the skin glands of the bat. The interior of the roosting place was always cool and humid (21° Celsius and relative humidity 66% even in the hot days of summer in April).

The size of the colony reported in the study area ranged from 50 + bats to about 10,000 and more bats. The colony members appeared restless during day time, and emerged late just on the onset of darkness in the sky. Emergence usually continued

for 15 to 45 minutes, depending on the size of the colony. It was also observed that the bats leaved the day roost in groups; they rested on the nearby rock before they fly in the sky. The dispersal of the bat was random and in all directions. The fluttering of wings sounded peculiar.

This bat species seemed to consume wild variety of plants available in the forests. The color of droppings reflected the food consumed. In summer the dry drops of purple colored droppings in the vicinity of the roosting site was a common phenomenon, as they consumed mostly the fruits of black plum during these days. The heaps of seeds of wild fruits were also found near the roosting sites. The colonies in the human vicinity were found to be migratory and seasonal (often with mothers with their young ones), and were of smaller size.

The permanent colonies were of mixed type i.e., both adults and their young ones lived under the same shelter. The bat seemed to be dioestrous, the mother with single pup clung to her breast was reported in April as well as in September of the same year. The sub adults some times were found roosting separately in the nearby suitable place.

**Conservation Status** : Worldwide in distribution. A wide spread species in Asia. It is categorized as LC (Least Concern), in South Asia [CAMP Report, 2002]. In the present survey, only 4 roosting sites were sighted, of which 2 were small colonies of 50+ bats and remaining 2 were of some thousand bats. The specificity of day roosting site suggests that, the species can be vulnerable to habitat destruction, as well as destruction of the feeding ground. The fruit bats (Except *Latidens salimalii*) of India are referred under Schedule V (Indian Wild Life (protection) Act, 1972-Amendment Act, 2006).

## Order CHIROPTERA

### Suborder MEGACHIROPTERA

#### Family PTEROPODIDAE

#### 2. *Pteropus giganteus* Brunnich, 1782

**Common name** : Indian Flying Fox

**Diagnosis** : The tail and nose-leaf are absent. Inter femoral membrane is little developed. The wing membranes arise from the sides of dorsum and from the back of the second toe. There is a small claw on the second digit of each wing. The calcars are well developed. The first upper premolar is absent. The forearm length averages 168.4 mm (152 mm - 183 mm), the condylo-basal length averages 69.9 mm (65.9 mm - 74.9 mm), the upper half tooth row averages 27mm (24.5mm-29mm), the wing span is large (850 mm - 1100 mm). The ears are long, pointed and the base of the ear is completely ringed. The tragus and antitragus absent. The thumb is with a powerful claw and the index finger with a small claw. The feet are large and have inwardly curved strong claws. The nape and mantle, shoulder and underside of body generally paler than back. The head is dark brown to blackish brown in color, neck and nape uniformly buffy brown to brown; lower shoulder and back blackish brown with some gray hair

scattered uniformly. Belly varies in color from brown to russet brown. The length of rostrum greatly exceeds the lachrymal breadth. The baculum though is horseshoe shaped, vary in appearance and dimensions.

Dental formula :  $\begin{array}{cccc} - & 2 & 3 & 1 \\ i & \text{---} & \text{---} & \text{---} \\ 1 & 2 & 1 & \end{array}, \begin{array}{cccc} - & 2 & 3 & 4 \\ c & \text{---} & \text{---} & \text{---} \\ 1 & - & 2 & 3 & 4 \\ 1 & - & 2 & 3 & 4 \end{array}, \begin{array}{ccc} 1 & 2 & - \\ m & \text{---} & \text{---} \\ 1 & 2 & 3 \end{array} = 34$

**Ecological notes :** The Indian flying fox was the most abundantly found bat species in the study area. About 63 colonies were reported during survey of three years. Most of the colonies were reported in the low altitude spurs of Western Ghats region. The bat colonies were also located in the dry area of eastern side of the district, but the size of the colony was remarkably small. The highest number of flying fox colonies (8 colonies) was reported in the Pune city area and the number of flying fox in single colony was also reported highest (8,000+) in the same area. The colony reported in the Bhor city was another remarkably huge colony of almost 5000 and more bats.

The flourishing state of flying fox colonies also indicated abundance of food in the foraging ground. These bats preferred tall trees near river or canal. Trees like mango (*Mangifera indica*), Pipal (*Ficus religiosa*), black plum (*Syzygium cumini*), rain tree (*Albizia labbak*), tamarind (*Tamarindus indica*), cassurina (*Cassurina equisetifolia*), *Accacia* and *Eucalyptus* etc. were preferred for day roosting. It was also noticed that they fed on moderately tender leaves, flowers and ripen fruits of above mentioned plants and many more of wild types from nearby forest.

Mothers with single young one were reported in February-March. The sub adults remained in the same colony.

Ticks and mites were the common parasites found in abundance on the body of the flying foxes.

**Conservation Status :** It is worldwide and wide spread species found in abundance. It has been ranked as LC (Least Concern) following CAMP Report, 2002. The fruit bats (Except *Latidens salimalii*) of India are referred under Schedule V (Indian Wild Life (protection) Act, 1972-Amendment Act, 2006).

## Order CHIROPTERA

### Suborder MEGACHIROPTERA

#### Family PTEROPODIDAE

Genus *Cynopterus* Cuvier, F., 1824

3. *Cynopterus sphinx* Vahl, 1797

**Common name :** Short-nosed Fruit bat

**Diagnosis :** The muzzle is shorter and relatively broader with a deep emargination between the projecting nostrils. It is a medium sized fruit bat. The ears are simple

and naked and have a well defined pale anterior and posterior border. Tragus and antitragus are absent. The tail is short, half projecting and free from the inter femoral membrane, which is not very extensive. The index finger has a distinct claw. The forearm length averages 70.2 mm (64 mm - 79 mm). The metacarpals and digits supporting the wing membrane appear paler and distinct. Skull is smaller than that of *Rousettus leschenaulti*. The condylo-basal length averages 30.9 mm (28.4 mm - 33.3 mm). The half upper tooth row averages 20.6mm (17.5 mm - 24 mm). The upper canine is bicuspid and crown of molar is marked with longitudinal furrow.  $M^2$  and  $M_3$  are absent. The appearance of this species is more robust as compared to *C. brachyotis* and remarkably larger in size. The pelage is soft and pale brown with black hair tips on the dorsal side. The males are rich russet brown on neck and fore head, while females are paler, tawny brown in color.

**Dental formula :**  $\begin{array}{ccccccc} - & 2 & 3 & & 1 & - & 2 & 3 & 4 & & 1 & 2 & - \\ i & \text{---} & \text{---} & , & c & \text{---} & , & pm & \text{---} & \text{---} & , & m & \text{---} & \text{---} = 30 \\ & 1 & 2 & - & & 1 & & - & 2 & 3 & 4 & & 1 & 2 & - \end{array}$

**Ecological notes :** The short-nosed fruit bat *Cynopterus shinx* is another fruit bat species, which appeared in abundance in small but a number of colonies in the study area. As compared to the forests, this species appeared in abundance in the rural and urban areas. It preferred to roost in the dark corners of the old buildings; roofed in wood and clay tiles, under the dense foliage of drooping ashok (*Polialthia longifolia*) and rain tree (*Albizia labbak*). It was also found in the hollow inflorescence of the fishtail palm (*Caryton urens*) and in the tree holes. The feeding habit of this bat was almost similar to that of flying fox but its range of foraging was naturally confined to the vicinity of the roosting site. It preferred trees of medium height. The day roosts of this bat differed from the night roosts; these bats were often observed carrying their food items to the night roosts and ate leisurely. The heap of half eaten fruits, droppings, seeds and chewed leaves with only veins left behind was the common sight of the floor of their night roosts.

The isolated young bats of *C. sphinx* were observed in the months of December and January as well as in May and June. The single colony comprised 4-5 to 15-20 bats including adults and sub adults. The bats were also noticed to shift their roosting sites in the same vicinity as per season. The lactating mothers were observed in November and April.

**Conservation Status :** Worldwide, a wide spread species ranked as LC (Least concern) in South Asia (CAMP Report, 2002). In the present study, this bat species though is distributed throughout the study area; it is abundant in the spurs of Western Ghats. The fruit bats (Except *Latidens salimalii*) of India are referred under Schedule V (Indian Wild Life (protection) Act, 1972 - Amendment Act, 2006).

## Order CHIROPTERA

## Sub Order MICROCHIROPTERA

## Family MEGADERMATIDAE

Genus *Megaderma* E. Geoffroy, 1810.4. *Megaderma lyra* E. Geoffroy, 1810**Common name** : Greater False Vampire bat

**Diagnosis:** The false vampire bat is a robust species with an average forearm length 66.4 mm (56 mm-71.5 mm). It is distinguished externally by the presence of large oval ears, which are joined above the fore head. The tragus is bifid, its anterior part is low and the posterior part is tall and pointed. The nose leaf is simple, straight and erect, about 10mm in height and with a longitudinal median ridge. The base is simple and horizontal. In the lesser false vampire bat *M. spasma* it is smaller, with convex side and distinctly heart shaped base. The tail is absent. The second finger of wing has only one phalanx and the third one with 2 phalanges. The condylo-canine length averages 25.4 mm (24.5 mm-27.8 mm). The upper tooth row averages 11.2 mm (10.6 mm-12.1 mm), thus exceeds considerably in size as compared to *M. spasma*. The upper incisors are lacking. The premaxillae are tiny and thread-like. The canine projects noticeably and is bicuspidate. The lower jaw extends beyond the upper one. The snout is naked and flesh colored. The pelage is soft and moderately long, the dorsal pelage is mouse colored and ventral one is almost white.

**Dental formula :**

$$\begin{array}{ccccccc} \text{---} & 1 & - 2 - 4 & 1 2 3 & & & \\ \text{i---}, \text{c---}, & \text{pm---}, & \text{m---} & =28. & & & \\ 1 2 - & 1 & - 2 - 4 & 1 2 3 & & & \end{array}$$

**Ecological notes** : During the present survey, this species was reported to be the widely distributed microchiropteran species, found from northern to southern part of the Pune district. It was found in group of 5-7 bats to some hundred bats under the same shelter. They were found in caves, subterranean constructions in the old ruined buildings and in the dome of the temples. They preferred the dark corners and aggregated in a compact cluster; while some bats of the same colony clung to the roof and walls.

This bat species fed on hard shelled insects as well as on fishes, small birds and small bats. When trapped and kept in the cotton bag along with a small pipistrelle, it was eaten up next morning leaving a single long bone behind, proving its carnivorous habit of feeding.

The bat species was more common in the rural area than the urban area. The river, stream, small pond, lake and open agricultural field served as feeding ground for this bat. If not disturbed, the colonies of this species preferred same roosting place for years together. The heap of guano on the floor formed considerably thick layer. In dry area the guano was observed converted into humus very fast. Some farmers used

the dry guano as fertilizer, mixing it in the soil. The guano was said to be good for floriculture.

Both sexes were found in the same colony. The lactating mothers were reported in June. A single young one was observed clung to the belly of the mother.

**Conservation Status** : It is a worldwide species, commonly occurring and geographically wide spread species. It is ranked as LC (Least Concern) in South Asia (CAMP Report, 2002).

### Order CHIROPTERA

#### Suborder MICROCHIROPTERA

#### Family RHINOLOPHIDAE

#### Genus *Rhinolophus* Lacepede, 1799

#### 5. *Rhinolophus rouxii* Temminck, 1835

**Common name** : Rufous Horseshoe bat

**Diagnosis** : The family is characterized by nose-leaf on the muzzle. It consists of lancet, which remains erect, a lower horizontal horseshoe surrounding the external nostrils and a perpendicular median sella. The nose-leaf varies in complexity and diagnostic at species level. The tail is well developed and enclosed fully in inter-femoral membrane. The ears are pointed. The tragus is absent, but the antitragal lobe is well developed.

The species is variable in size and color. The average fore-arm length is 49.3 mm (44.4 mm - 52.3 mm). The nose-leaf is broad, but does not cover the muzzle, the lancet is variable in height and the sides may be straight and appears triangular or the tip may be well developed and spatula like. The sella is narrow above with a broadly curved tip and fleshy broad base. The metacarpal of the wing is slightly shortened, the first phalanx is less than half the length of the metacarpal, but the second phalanx is usually less than 66% of the length of the metacarpal. The average condylo-canine length is 19.3 mm (17.5 mm-21 mm) and the upper tooth row averages 8.6 mm (8.1 mm-9.2 mm). The pelage is soft and silky and its color varies orange, russet brown, buffy brown with some grey tinge. The variation is said to be season dependent. In hot season, the color is dull.

**Dental formula** : 
$$\begin{array}{ccccccc} - & 2 & - & 1 & & - & 2 & - & 4 & & 1 & 2 & 3 \\ i & \text{---} & , & c & \text{---} & , & pm & \text{---} & \text{---} & , & m & \text{---} & \text{---} & = 32 \\ 1 & 2 & - & 1 & & - & 2 & 3 & 4 & & 1 & 2 & 3 \end{array}$$

**Ecological notes**: This was the forest species of Western Ghats part of the study area. It was found in ever green or semi evergreen forest at high altitude. The bats were found in small groups of 3-4 to a big colony of 100 bats. The young bats were reported in isolation, while big colonies often included adults and sub adults. When released in the forest, the bats often flew below the forest canopy and hid themselves under the canopy or preferred a nearby suitable shelter.

The pregnant mothers were reported in February.

**Conservation status** : This bat species is geographically wide spread cosmopolitan species. As per CAMP Report (2002), this species is ranked as NT (Near Threatened) in South Asia. The species is confined to the Western Ghats region of the district.

Ordr CHIROPTERA

Suborder MICROCHIROPTERA

Family RHINOLOPHIDAE

Genus *Rhinolophus* Lacepede, 1799

6. *Rhinolophus lepidus* Blyth, 1844

**Common name** : Blyth's Horseshoe Bat

**Diagnosis** : This is a small sized rhinolophid bat. The average fore-arm length is 39.8 mm (37 mm - 41.8 mm). The overall built of the body is slender. The nose-leaf complex differs from that of *R. rouxii*, the lancet is triangular in outline; either with the straight sides or sides concave. The sella has broadly rounded off tip and significantly projected. The 3<sup>rd</sup> metacarpal is equal to or exceeds combined length of its phalanges. The 2<sup>nd</sup> phalanx of 4<sup>th</sup> metacarpal is short, slightly longer than the 1<sup>st</sup> phalanx. The average condylo-canine length is 14.6 mm (13.8 mm - 15.5 mm). The palatal width ranges 5.8 mm - 6.3 mm. The pelage color is typically grey brown dorsally and slightly paler ventrally. Some specimens appear remarkably darker.

**Dental formula** : 
$$\begin{array}{ccccccc} - & 2 & - & & 1 & & - & 2 & - & 4 & & 1 & 2 & 3 \\ i & \text{-----} & , & c & \text{---} & , & pm & \text{-----} & , & m & \text{-----} & = & 32. \\ & 1 & 2 & - & & 1 & & - & 2 & 3 & 4 & & 1 & 2 & 3 \end{array}$$

**Ecological notes**: This species was restricted to the western part of the district, particularly in the Western Ghats region, where the rainfall is heavy and the forest is intact. The bats were located in the narrow caves, which in most of the cases were occupied by the porcupine. Such caves were also abundant in the Velhe and Bhor taluka of the district. But the porcupines were regularly hunted in this region. The hunting techniques had disturbed the bat fauna in almost all caves visited in this region in such a way that there was no sign of occurrence of either the porcupine or *R. lepidus*. The forest in this region was also badly destroyed; the slopes of the Ghats are almost barren, without crust of the soil.

Bhimashankar, Lonavla, Malshej Ghat, Lohgad and Visapur were some of the places, where this species sighted in groups of 2 to 15. Pregnant females were observed in late May.

**Conservation status**: This is the wide spread worldwide distributed species. The species is considered LC (Least concern) in South Asia (CAMP Report, 2002). Present survey indicates alarming condition for this species in the Western Ghats region of the study area.

## Suborder MICROCHIROPTERA

## Family RHINOLOPHIDAE

Genus *Rhinolophus* Lacepede, 17997. *Rhinolophus beddomei* Andersen, 1905

**Common name** : Lesser woolly Horseshoe Bat

**Diagnosis** : This is the large species of the genus *Rhinolophus*, with the average forearm length 62.7 mm (61.3 mm - 64.3 mm). The nose-leaf is peculiar, large and covers almost the entire muzzle. The cup of the anterior lip is broad, with a distinct middle notch, the edges of the cup turn upward. The sella is prominent and provided with the prominent, circular basal lappets, one on either side. The sella is deflected downwards and forwards. The lancet is well developed with a slightly rounded tip. The 3<sup>rd</sup> metacarpal of the wing is typically shorter than the 4<sup>th</sup>one. The phalanges of the 3<sup>rd</sup> metacarpal also exceed the metacarpal in length. The average condylo-cranial length is 23.9 mm (23.4 mm-24.4 mm). The pelage is darker, long and woolly in the texture and appearance. The pelage is darker, long and woolly in the texture and appearance.

**Dental formula** : 
$$\begin{array}{cccc} - 2 - & 1 & - 2 - 4 & 1 2 3 \\ i\text{-----}, c\text{---}, pm\text{-----}, m\text{-----}=32. \\ 1 2 - & 1 & - 2 3 4 & 1 2 3 \end{array}$$

**Ecological notes** : This *Rhinolophus* species was reported from the north-western part of the district, where relative humidity of the surrounding was high and the forest was intact. The bats of this species were found in small colonies of 1-3 bats, which included one adult male or the pair of adult male and female with their pup. A single sub adult was reported in the month of October. The bats were observed to use forest corridor for foraging and seemed to consume hard shelled big sized forest insect including orthopteran and coleopteran species.

**Conservation status** : This is an endemic species to Indian subcontinent. This species is ranked NT (Near Threatened) as per CAMP report (2002) for South Asia. The present survey agrees with the current status.

## Order CHIROPTERA

## Suborder MICROCHIROPTERA

## Family HIPPOSIDERIDAE

Genus *Hipposideros* Gray, 1831.8. *Hipposideros ater* Templeton, 1848

**Common name** : Dusky Leaf-nosed bat

**Diagnosis** : The leaf-nosed bat with ears broad at the base and pointed at the tip. The ears are large, with broad rounded tips. They are separate and without tragus, the antitragus is well defined. The long tail is included in the inter-femoral membrane.

The nose-leaf comprises an anterior leaf, central or intermediate leaf and the posterior leaf, all held horizontally and not vertically and often with accessory foliates. The anterior leaf is without supplementary leaflets or a median emargination. The intermediate lobe is triangular in shape with rounded tips and little fleshy. The nostrils are separated by a septum, and each has a small narial lappet on its outer margin. The posterior leaf slightly exceeds the width of the anterior and intermediate leaves. It is subdivided by ill-defined septa into 4 cells. In the male, there is frontal sac behind the posterior lip and on the lower fore head. This is a small species, superficially similar to *H. fulvus*, the forearm averages 41.48 mm (40.4 mm - 42.5 mm) in length. The feet are small. In the wing, the 4<sup>th</sup> metacarpal exceeds the fifth in length. The 3<sup>rd</sup> metacarpal is the shortest one. The combined length of the phalanges of the 3<sup>rd</sup> metacarpal greatly exceeds the length of the metacarpal. The first phalanx of the 4<sup>th</sup> metacarpal exceeds the second in length. The skull is small and has distinct but low sagittal crest. The average condylo-canine length is 15.48mm (14.4-16 mm). The cranium is bulbous, and its width [average 8.42 mm (7.3 mm - 9.1 mm)] is slightly sub-equal to that of the zygomata [9.15 mm (9 mm - 9.5 mm)]. The zygoma lacks the dorsal process. The tympanic bullae are small but the cochleae are moderately developed. The first upper premolar is small, functionless, compressed in the tooth row or displaced outwards. The canine is tall and slender. The first lower premolar (pm<sub>2</sub>) is about half to two thirds the crown area of the second (pm<sub>4</sub>). The dorsal pelage is soft dark brown with pale grey tips on the back.

**Dental formula :** 
$$\begin{array}{ccccccc} - 2 - & 1 & - 2 - 4 & 1 2 3 \\ i \text{-----}, c\text{---}, pm\text{-----}, m\text{-----}=30. \\ 1 2 - & 1 & - 2 3 4 & 1 2 3 \end{array}$$

**Taxonomic remarks :** Specimens from peninsular India and Sri Lanka are referred to *H. a. ater*. Specimens from Nicobar Islands are provisionally referred to *H. a. nicobarulae*. They are similar in appearance, but little larger in size. And in contrast to *H. a. ater*, the jugal bone of each zygoma is without a dorsal projection. Surprisingly enough, the present specimen of *Hipposideros ater* reported from the central Western Ghats of Maharashtra state, resembles *H. a. nicobarulae* rather than *H. a. ater* in measurements. All the measurements exceed greatly from that of *H. ater* and vary slightly from those mentioned for *H. a. nicobarulae* (Bates & Harrison, 1997). Further studies in details are recommended to ascertain the taxonomic status of *H. ater* from Central Western Ghats.

**Ecological notes :** This species was restricted to the northern part of the district. It was reported from three places in the district near Bhimashankar, Lonavla and Khopoli. The colonies of 10 to 25 adult bats were found in the caves surrounded by evergreen to semi evergreen forest. One colony was located in the subterranean cave.

The bats of this species roosted singly; clung to the rough surface of the roof with their inwardly curved claws. The bats emerged about 35 to 45 minutes after sunset, just before dark and continued to emerge even after dark. They left the diurnal roost one after the other, but intermittently. Lactating mothers with their young ones were reported in mid May.



The bats of this species used to visit the foraging ground several times during night time. This species was reported to prefer the nearby forest area as foraging ground. Lactating mothers were seen in late May.

**Conservation status:** *Hipposideros fulvus* is ranked as LC (Least Concern) for South Asia (CAMP Report, 2002). In the present study this species is found abundant throughout the study area. The abundance of this species was highest in the Western Ghats region.

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family HIPPOSIDERIDAE

Genus *Hipposideros* Gray, 1831.

10. *Hipposideros pomona* Andersen, 1918

**Common name :** Andersen's Leaf-nosed bat

**Diagnosis :** This is a small to medium sized bat. The length of the forearm averages 41.62 mm (40 mm – 42 mm), which is almost similar to *H. ater* and *H. fulvus*. It is greater than that of *H. pomona pomona* reported from southern India, however resembles to that of *H. pomona gentilis* from North-East India (Bates & Harrison, 1997).

General appearance of the body is delicate as compared to that of *H. fulvus*. The snout is elongated and narrow as compared to that of *H. ater*. The nose-leaf and wing structure are similar to those of *H. ater*, but the width of the posterior leaf hardly exceeds that of the anterior leaf. The condylo-canine length averages 15.78 mm (15.1 mm - 16.2 mm), which is greater than that of *H. pomona pomona* [14.4 mm (14.2 mm - 14.6 mm)] reported from southern India. The palate is also narrow, which is reflected in measurements of M<sup>3</sup>-M<sup>3</sup> [6.23 mm (6 mm – 6.5 mm)] and C<sup>1</sup>-C<sup>1</sup> [3.86 mm (3.7 mm – 4 mm)]. The peculiarity of the first lower premolar (pm<sub>2</sub>) in relation to the second lower premolar (pm<sub>4</sub>) is similar to that of *H. ater*, but the canines are delicate and sharp. The dorsal pelage is pale brown to pale gray, with hair bases paler than tips. The ventral pelage is almost whitish throughout.

Dental formula :    - 2 -    1            - 2 - 4    1 2 3  
                           i -----, c—, pm-----, m-----=30.  
                           1 2 -    1            - 2 3 4    1 2 3

**Taxonomical remarks :** All specimens from Southern India are referable to *H. p. pomona* (Bates & Harrison, 1997). The specimens from northern Myanmar and Northern India are referred to *H. p. gentilis* with larger condylo-canine length. However the species reported from the study area shows resemblance with *H. p. gentilis*. A detailed taxonomic study of the population from this region is strongly recommended to ascertain its specific status.

**Ecological notes :** This species was restricted to the north-western part of the district, which was the heavy rainfall region of the district and part of the Western Ghats. It was reported from 6 localities in the Ambegaon, Maval and Mulshi talukas. The bats were found in the narrow and slanting caves. In most of the cases, the cave was partially divided into many chambers. When disturbed, the bats managed to escape from one chamber to the other. The permanent colonies of this bat species were undisturbed and flourishing.

Emerging and biological cycle were reported to be similar to those of *H. fulvus*.

**Conservation Status :** This is geographically wide spread but little studied species. It is ranked as LC (Least concern) in South Asia, (CAMP Report, 2002). As per the present survey report, this species appears to be vulnerable in this region, since no single colony was reported from the Southern part of the district, which is similar to the Northern part in topography and climatic conditions.

### Order CHIROPTERA

#### Suborder MICROCHIROPTERA

#### Family HIPPOSIDERIDAE

#### Genus *Hipposideros* Gray, 1831.

#### 11. *Hipposideros speoris* (Schneider, 1800)

**Common name :** Schneider's Leaf-nosed bat

**Diagnosis :** The medium sized leaf-nosed bat with moderately smaller ears. The forearm length is 51.73 mm (49.5 mm - 53.3 mm) and ear length averages 15.23 mm (13.3 mm - 18 mm). The nose-leaf has three supplementary leaflets; the outer one is inconspicuous. The supplementary leaflets are characteristic at species level. The median emargination of the anterior leaf-nose is not prominent. The upper edge of the intermediate leaf is concave. The well emarginated and fleshy posterior leaf is divided into four cells by vertical three septa. The fifth metacarpal is significantly shorter than fourth and third. The skull is elongated with a median sagittal crest. The average condylo-canine length is 16.8 mm (16 mm - 17.5 mm), the breadth of the zygomata averages 10.7 mm (10 mm - 11.3 mm) and exceeds that of the cranium [average 9.56 mm (9 mm-10 mm)]. The palate is broad and elongated. The first upper premolar (pm<sup>2</sup>) is compressed and slightly extruded from tooth row. The body color is variable from dull brown to bright golden brown. The hairs on the shoulder are long and with black tips. The ventral pelage is slightly paler in color. The baculum is simple rod like and minute with blunt tip and slightly broad base.

**Dental formula :**

$$\begin{array}{ccccccc} - 2 - & 1 & - 2 - 4 & 1 2 3 \\ i \text{-----}, c\text{---}, pm\text{-----}, m\text{-----}=30. \\ 1 2 - & 1 & - 2 3 4 & 1 2 3 \end{array}$$

**Ecological notes :** It was a wide spread species found in study area and also located from low spurs of Western Ghats region as well as from dry areas of the eastern part of the district. It was found in caves in the dry deciduous forest, ruined

constructions and subterranean tunnels. The colonies size ranged from 15+ to some hundred bats. Both adults and sub adults were noticed sheltering in the same day roost. The number of colonies and abundance of this species was reported to be highest in the Western Ghats region, but the eastern dry and plain part of the district was also rich in this respect.

The emerging, foraging and biological cycles did not differ from rest of the bat species of the same genus.

The roosting of this species could be easily located due to the typical unpleasant smell of the urine, excreta and secretion of the frontal sac of males.

**Conservation Status :** This is the endemic species to the Indian subcontinent. It is ranked as LC (Least concerned) as per CAMP Report, (2002).

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family MOLOSSIDAE

Genus *Tadarida* Rafinesque

12. *Tadarida aegyptiaca* (E. Geoffroy, 1818)

**Common name:** Egyptian Free-tailed bat

**Diagnosis :** The medium sized molossid bat with fleshy, downwardly facing ears separated on the forehead. The tragus is short, squarish and remains overlapped by the large and rectangular anti-tragus. The fleshy ear is almost round but extends in an angular tip. The earlobes are erect and held vertically on the forehead, but do not meet in the center, like those of *T. plicata*. The small eyes are just in front of the ears. The nostrils open on the pad, the upper lip is often wrinkled. The wings are long but narrow. The stout tail projects beyond the inter-femoral membrane. Foot is large with sharply curved powerful claws fringed with white, long and inwardly directed hair. There is a prominent circular pad with middle depression on the sole as well as on the base of the thumb. The skull is moderately long and the braincase is flattened. The median axis running from nasals to lambda is straight. The pre-maxillae are not co-ossified with palate.

The pelage color is clove brown on the dorsal side and distinctly pale; almost whitish brown on the ventral side. The fur in general is short and soft and extends on the flanks. The membranes, ears and snout are brownish black in color.

**Dental formula :** 
$$\begin{array}{ccccccc} - & 2 & - & & 1 & & - & 2 & - & 4 & & 1 & 2 & 3 \\ i-----, & c-, & pm-----, & m-----= & 30/32 \\ 1 & 2 & (3) & 1 & & - & 2 & - & 4 & & 1 & 2 & 3 \end{array}$$

**Ecological notes :** This bat species was found in the Western Ghats and its spurs in the study area. It was also found hiding under the metallic signboards, and in the crevices under the roof and walls of old buildings in the rural and urban areas. The

day roosting places could easily be marked by the characteristic odor of excreta and urine. The urine marks on the wall, heavily shitted floor and shrilling voice (even in day time) helped to locate them. In nature they were observed roosting in the deep and narrow crevices of the caves, and the broad crevices between the basalt rocks in the Western Ghats. Unlike other bat species, these bats were observed to tolerate day light and high temperature. The colony size ranged from about 7 to 15 bats including both sexes.

The bats of this species used to emerge after onset of dark, about 45 minutes or even late after sunset. They left the day roost one by one and intermittently. They were observed in groups on the foraging ground. The color of the excreta reflected the food item consumed.

Immature males were observed in early July. The females in the same months were found in early pregnancy with two embryos- one in each cornu of the uterus. There was no sex-wise segregation during the time of pregnancy.

**Conservation Status :** It has been ranked LC (Least Concerned) as per CAMP Rport, (2002). In the study area, human interference is found as the most likely threat for its survival.

#### Order CHIROPTERA

#### Suborder MICROCHIROPTERA

#### Family MOLOSSIDAE

#### Genus *Tadarida* Rafinesque

#### 13. *Tadarida (Chaerephon) plicata* (Buchannan, 1800)

**Common name :** Wrinkle-lipped Free-tailed bat

**Diagnosis :** It is a small species of *Tadarida*. Forearm length averages 46.7 mm (43.5 mm - 48.6 mm) and the ears are connected by a membrane across the forehead, but apparently similar to *T aegyptiaca*. The dorsal pelage is soft, dense and very short, usually dark clove brown in color and paler on the ventral side. The snout, ears and wings are blackish brown. Ears are round and differ slightly in appearance than those of *T aegyptiaca*. Premaxillary bones are complete on the palatal side and fused with surrounding bones, leaving two small foramina. The rostrum is narrow and more rounded. Distinct supra orbital processes are present. The brain case is more rounded and not flattened above. The coronoid process of mandible is weak, but the angular process is robust. The pelage color is darker than that of *T aegyptiaca*.

**Dental formula :**  $\begin{array}{ccccccc} - & 2 & - & & 1 & & - & 2 & - & 4 & & 1 & 2 & 3 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----} & = & 30/32. \\ & 1 & 2 & (3) & 1 & & - & 2 & - & 4 & & 1 & 2 & 3 \end{array}$

**Ecological notes :** This species was found throughout the district, but the sites were more abundant in the spurs and the dry eastern part of the district. The frequency of occurrence of this species was greater than that of *T aegyptiaca*. The

bats preferred to roost in small groups of 6-7, but a colony of 200 bats was reported in the urban area. The large colony was divided into small clusters of 7-10 bats.

The bats of this species used to emerge late in the evening, just before dark. The flight was steady and fast. The conceived females were observed in July–August.

**Conservation Status :** It has been ranked LC (Least Concerned) as per CAMP Rport, (2002). In the study area, human interference is found as the most likely threat for its survival.

### Order CHIROPTERA

#### Suborder MICROCHIROPTERA

#### Family VESPERTILIONIDAE

#### Genus *Myotis* Kaup, 1829.

#### 14. *Myotis horsfieldii* (Temminck, 1840)

**Common name :** Horsfield bat

**Diagnosis :** The bats under this family include small or medium sized insectivorous bats. They are characterized by simple muzzle and without any nose-leaf. The eyes are small; tail is well developed but included in the inter-femoral membrane; except the free terminal tip. Average forearm length is 37.9 mm (36.5 mm – 39.5 mm). The ears are tall, dark, and naked with rounded tips. The average length of the ear lobe is 13.18 mm (11.8 mm – 14.6 mm). The tragus is less than half the height of the ear lobe. The feet are long, exceed half the length of the tibiae. The wings are attached to the outer metatarsal region of the foot. The skull is small and lightly built. The rostrum is about equal in length to the braincase. The tympanic bullae are well developed. There are three premolars in each half of the upper and lower jaws. The average condylo-canine length is 14.02 mm (13.7 mm – 14.6 mm). The rostrum is robust with a shallow depression in its midline. The braincase is rounded posteriorly. The zygomatic arches are much flared laterally. The upper tooth row (CM<sup>3</sup>) averages 5.9 mm (5.7 mm – 6 mm). The upper canine is remarkably taller than the last upper premolar (pm<sup>4</sup>). Pm<sup>3</sup> is about half or more the crown area of Pm<sup>2</sup>. It is placed in the tooth row or displaced slightly inwardly. Pm<sub>3</sub> is two thirds the crown area of the Pm<sub>2</sub> and Pm<sub>4</sub>. The pelage color is dark brown to black on the dorsal side and slightly paler and of the same color throughout.

**Dental formula :** 
$$\begin{array}{ccccccc} - & 2 & 3 & & 1 & & -2 & 3 & 4 & & 1 & 2 & 3 \\ i & \text{-----} & , & c & \text{---} & , & pm & \text{-----} & , & m & \text{-----} & = & 38. \\ & 1 & 2 & 3 & & 1 & & - & 2 & 3 & 4 & & 1 & 2 & 3 \end{array}$$

**Ecological notes :** In the present survey this species was reported to be confined to a restricted area, particularly in the vicinity of the dams and irrigation canals, where water was available through out the year. The bats were found in small group of 6-7 individuals, but a colony as large as of 50 and more bats were also located near Lonavla. They preferred the roosting site, where the temperature was 18° – 20° Celsius

and the relative humidity of the interior was 90% to 98%. The bats usually selected the dark corners on the roof. Adults and sub adults sheltered under the same roof.

The bats emerged early in the evening, about 20 minutes after sunset. Their flight was little jerky, but straight and fast. They were observed to feed on aquatic insect.

This species was not found in abundance in the study area. The specificity in selection of the day roosting site had perhaps made them restricted to the dams and irrigation canals.

**Conservation Status :** This bat species has been ranked LC (Least Concern) as per CAMP Report, (2002). However, it appeared to be rare in the study area. The suitable habitats are restricted in the study area, which is very dry in the post monsoon season.

## Order CHIROPTERA

### Suborder MICROCHIROPTERA

#### Family VESPERTILIONIDAE

#### Genus *Scotophilus* Leach, 1821.

#### 15. *Scotophilus heathii* Horsfield, 1831

**Common name :** Asiatic Greater Yellow House bat

**Diagnosis :** It is a robust bat with an average forearm length of 60.7 mm (55.4 mm – 65.8 mm). The muzzle is blunt and broad; it is reflected in the rostral width, which ranges between 8.4 mm and 9 mm. The muzzle is swollen on the sides, almost black in color and naked. The simple nostrils are oval in outline and deflected outwards. The eyes and ears are small in relation to the head size. The tragus is half the height of the pinna and crescent shaped. The antitragus is well developed. The feet are large, 10 mm – 13 mm in length. The braincase is narrow and deep. The second upper incisor (I<sup>3</sup>) is absent and the first two upper molars have their main cusps displaced outwards, thus the usual “W” pattern is distorted. The pelage is fine, soft and silky. The dorsal pelage is dark olive-gray-brown, but ventrally it is typical satin yellow in color.

**Dental formula :**  $\begin{array}{ccccccc} - & 2 & - & & 1 & & - & - & - & 4 & & 1 & 2 & 3 \\ i & \text{-----} & , & c & \text{---} & , & pm & \text{-----} & , & m & \text{-----} & = & 30. \\ & 1 & 2 & 3 & & 1 & & - & 2 & - & 4 & & 1 & 2 & 3 \end{array}$

**Ecological notes :** In the present survey, the species was confined to the Western Ghats, but also reported from the dry region; the localities like Baramati, Daund, Indapur and Shirur of the eastern part. It was usually located near human population, under the old styled clay tiled roof, crevices of old buildings etc. The bats were found in small groups of 7-10 individuals. They emerged early, after about 20 minutes of sunset.

The pregnant females were observed in early July and lactating female in late September.

**Conservation Status :** It is a wide spread species, ranked as LC (Least concern) as per CAMP Report, (2002). However, anthropogenic disturbance has been felt as the likely threat for the species.

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family VESPERTILIONIDAE

Genus *Scotophilus* Leach, 1821.

16. *Scotophilus kuhlii* Leach 1821

**Common name :** Asiatic Lesser Yellow House bat

**Diagnosis :** This bat species is smaller than *S. heathii*. The pelage is chestnut brown above, yellowish brown below, but not characteristically satin yellow as found in *S. heathii*.

**Ecological notes :** This species was reported from Western Ghats region of the district. As compared to the frequency of occurrence of *S. heathii*, this species was not very common in the study area. This bat species was reported from the northern part of Pune district, locations like Palasdari, Khed, Ambegaon/Junnar and exceptionally from Haveli; located in south of district..

This species was quite aggressive in attitude. The crevice in which this species of bats roosted during day time appeared oily or greasy due to secretion of the oil glands of the skin. The body of the bat had a peculiar odor.

**Conservation status :** It is reported as LC (Least concern), in the South Asia, (CAMP Report, 2002). However its occurrence was very rare in the study area.

Order CHIROPTERA

Suborder MICROCHIROPTERA

Family Vespertilionidae

Genus *Pipistrellus*, Kaup, 1829.

17. *Pipistrellus pipistrellus* (Schreber, 1774)

**Common name :** Common pipistrelle

**Diagnosis:** A small pipistrelle with an average forearm length of 31.0mm. The wings are narrow. The tibiae and feet are small. The pararhinal glandular swellings are well developed. The nostrils are directed antero-laterally and there is a distinct

inter narial groove. The pararrhinal glandular swellings on the muzzle are almost naked. The ears are short and broad. The tragus is usually half the height of the pinna and its anterior border is slightly concave. The antitragus is obsolete and represented by a projection on the exterior border of the pinna. Only the extreme tip of the tail projects from the inter-femoral membrane. The rostrum is long and narrow.  $I^3$  is almost half or slightly more in height of  $I^2$ .  $Pm^2$  is equal to  $I^2$  in crown area and lies in the toothrow. The upper canine is bicuspid. The pelage is chestnut brown, soft and silky.

**Dental formula :** 
$$\begin{array}{cccc} - 2 & 3 & 1 & - 2 - 4 & 1 & 2 & 3 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----} & = & 34. \\ 1 & 2 & 3 & 1 & - & 2 & - & 4 & 1 & 2 & 3 \end{array}$$

**Ecological notes :** This bat species is not very common in the study area. It was observed in group of about 20-25 individuals of male and female sheltering under common roof. It emerged early in the evening like other species of the genus.

**Conservation status :** It is reported as LC (Least concern), in the South Asia, (CAMP Report, 2002).

## Order CHIROPTERA

### Suborder MICROCHIROPTERA

#### Family VESPERTILIONIDAE

#### Genus *Pipistrellus*, Kaup, 1829

#### 18. *Pipistrellus javanicus* (Gray, 1838)

**Common name:** Javan pipistrelle.

**Diagnosis:** The medium sized bat with snout broad and flattened. The dorsal gland at the root of the tail is absent. The ears are erect, broad at the base; blunt and little thick at the tip. There is no white border on the wing membrane running between the foot and the fifth digit. The supra-orbital region is broad and palate is strongly domed.  $FA < 35$  mm,  $CBL < 13$  mm,  $CM^3 < 5.2$  mm and the cranial profile is almost straight. Pelage color is clove brown to blackish brown dorsally and ventrally the fur is slightly paler. Fur in general is soft, long and dense.

**Dental formula :** 
$$\begin{array}{cccc} - 2 & 3 & 1 & - 2 - 4 & 1 & 2 & 3 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----} & = & 34. \\ 1 & 2 & 3 & 1 & - & 2 & - & 4 & 1 & 2 & 3 \end{array}$$

**Ecological notes :** This species was found sheltering under suitable roosting sites like under tree bark, or behind the wooden boxes mounted on the wall or metallic name plates. It was widely distributed species.

**Conservation status :** It is reported as LC (Least concern), in the South Asia, (CAMP Report, 2002).

## Order CHIROPTERA

## Suborder MICROCHIROPTERA

## Family VESPERTILIONIDAE

Genus *Pipistrellus*, Kaup, 182919. *Pipistrellus coromandra* (Gray, 1838)

**Common name** : Coromandel Pipistrelle; Indian Pipistrelle; Little Indian bat.

**Diagnosis** : This is a small pipistrelle with FA < 35 mm, the braincase is high and rounded. CM<sup>3</sup> < 5.2 mm. The cranial profile is almost straight, the narrow rostrum is not flat, supra orbital region is narrow, the hard palate is longer than wide. I<sup>2</sup> is bicuspid, its crown area is equal to that of I<sup>3</sup> & pm<sup>2</sup>. I<sup>3</sup> is little more than half the height of I<sup>2</sup>. The upper canine is bicuspid.

This small pipistrelle species has soft fur, which is clove brown through out. Ventrally the hair roots are dark and tips are pale buffy brown or whitish; giving grizzled appearance. The snout, ears and membranes dark brown. Little fur extends over the flanks and inter- femoral membrane on either side of the tail.

**Dental formula** : 
$$\begin{array}{cccc} - & 2 & 3 & 1 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----}=34. \\ 1 & 2 & - & 1 \end{array} \quad \begin{array}{cccc} - & 2 & - & 4 \\ - & 2 & - & 4 \\ 1 & 2 & 3 & \end{array}$$

**Ecological notes** : This species was found more frequently in urban and rural area. The small colonies of 5 to 25 bats were reported sheltering under clay tiles on the roof of old buildings and hollow tree logs.

**Conservation status** : It is reported as LC (Least concern), in the South Asia, (CAMP Report, 2002).

## Order CHIROPTERA

## Suborder MICROCHIROPTERA

## Family VESPERTILIONIDAE

Genus *Pipistrellus*, Kaup, 1829.20. *Pipistrellus tenuis* (Temminck, 1840)

**Common name** : Least pipistrelle or Indian Pygmy bat

**Diagnosis** : This bat shares most of the characteristics with *P. coromandra*, such as FA < 35mm, supra orbital region not broad, rostrum narrow but not flat dorsally and palate weakly domed. I<sup>2</sup> is equal to I<sup>3</sup> and pm<sup>2</sup> in crown area and the upper canine is bicuspid. It differs from *P. coromandra* as the body is tenderly built; CBL and M<sup>3</sup>-M<sup>3</sup> are of lower range.

The pelage color differs in different groups, and ranges from clove brown to blackish brown. Ventral fur is paler and gives grizzled appearance. Ears, snout and

membranes are dark brown throughout. Its head is furry and bulbous, and snout and nostrils turn upwards, thus differs from *P. coromandra* in appearance.

**Dental formula :** 
$$\begin{array}{cccc} - & 2 & 3 & 1 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----}=34. \\ 1 & 2 & 3 & 1 \end{array} \quad \begin{array}{cccc} - & 2 & - & 4 \\ - & 2 & - & 4 \\ 1 & 2 & 3 & 1 & 2 & 3 \end{array}$$

**Ecological notes :** This species was found more frequently in urban and rural area. The small colonies of 5 to 25 bats were reported sheltering under clay tiles on the roof of old buildings, hollow tree logs and behind the wooden frames on walls. This species segregated sex-wise in breeding season. A colony of pregnant mothers; more than 10 in number were reported in late April.

**Conservation status :** It is reported as LC (Least concern), in the South Asia, (CAMP Report, 2002).

### Order CHIROPTERA

#### Suborder MICROCHIROPTERA

#### Family VESPERTILIONIDAE

#### Genus *Pipistrellus*, Kaup, 1829.

#### 21. *Pipistrellus ceylonicus* (Kelaart, 1852)

**Common name :** Kelaart's Pipistrelle

**Diagnosis :** The triangular ears are broad at the base but narrowed at the apex and ends into a blunt tip. Tragus is inwardly curved and has a shallow depression along the length. FA > 35mm, CM<sup>3</sup> > 5.4mm, cranial profile is raised over frontal region. I<sup>2</sup> bicuspid and its crown area is equal to that of I<sup>3</sup> and pm<sup>2</sup>, but I<sup>3</sup> is nearly half the height of I<sup>2</sup>. Pm<sup>2</sup> is intruded and lies in the recess of upper pm<sup>4</sup> and canine.

The dorsal fur is soft, long and silky. It appears dark brown to deep brown dorsally, but paler on the ventral side with dark hair roots and pale almost gray hair tips. The snout, ears and membranes are uniformly dark brown.

**Dental formula :** 
$$\begin{array}{cccc} - & 2 & 3 & 1 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----}=34. \\ 1 & 2 & - & 1 \end{array} \quad \begin{array}{cccc} - & 2 & - & 4 \\ - & 2 & - & 4 \\ 1 & 2 & 3 & 1 & 2 & 3 \end{array}$$

**Ecological notes:** The Kelaart's pipistrelle bats were the most common evening bats found in the study area. Their abundance was found highest in the Western Ghats region, indicating the forest region as the natural abode of this species. But they were found to be perfectly adapted to rural and urban area as well as the dry region of the Eastern part of the district. In nature though they were difficult to locate, their presence was detected easily in the rural and urban areas. The bats were used to roost in the crevices, with their belly on the surface of the rock or wall and the head part downward and elbow part projecting forward- sometimes out of the crevice. When

disturbed, they moved backward deep in the crevices, and avoided coming out of the crevice; even after regular emerging time.

These bats emerged early, just 10 -15 minutes after the sun set. They were observed in group of 3-4 in a single colony, but large colonies of about 20- 30 bats were also reported in the study area. At the time of emergence, however they avoided mass movement. They preferred to leave the roost one after the other at the interval of few seconds to 5 minutes. This probably was a protective behavior for avoiding and diverting the attention of the predators. The frequent shifting of the roosting sites, a peculiarity of these bats may be correlated with the same intention. The Kalaart's pipistrelle bats used to return to their roost, just 10 -15 minutes after sunrise.

The Kalaart's bats were located in the crevices of the rocks, but more often in the tree holes, holes in the dry logwood, or in the hollow stems, especially of dry bamboo in the forests or those stacked in the timber market. They were also observed at the base of the large leaves of the trees of palm variety, particularly of coconut tree. These bats were reported from rural as well as urban area. The crevices in the wall, between the roof and the wall, the wooden beams supporting the roof, wooden hollow pillars, crevices between the wooden furniture and the wall, crevices in the arches of the bridges, temples and stony buildings were the favorite roosting sites of these bats.

These bats were observed feeding on small soft bodied insects and their developing stages. They used to catch the insects in air as well as from the surface. Insect swarms like swarms of termites attracted these small bats on the onset of monsoon. They were also found most active near the garbage, where the insect larvae were found. Their activities were also marked around the street lights.

These pipistrelle bats were found dioecious, the female bats were observed pregnant with two embryos in their womb during February to April, and again in July to October. A group of about 4- 5 bats, 1 male and remaining females were reported to be isolated from the mother colony and sheltered in the vicinity or any other suitable place during period of mating. Lactation period extended for 2 months after parturition.

**Conservation status** : It is reported as LC (Least concern), in the South Asia, (CAMP Report, 2002).

#### Order CHIROPTERA

#### Suborder MICROCHIROPTERA

#### Family VESPERTILIONIDAE

#### Genus *Pipistrellus*, Kaup, 1829.

#### 22. *Pipistrellus affinis* (Dobson, 1871)

**Common name** : Chocolate Pipistrelle.

**Diagnosis** : The bats of this species are apparently similar to those of *P. ceylonicus*, but with larger FA. The braincase is comparatively short, but the rostrum

is elongated. The Zygomata are strongly built and with prominent jugal eminence. The dorsal profile of the skull is straight. The palate is longer than its width.  $I^2$  is bicuspid and  $I^3$  is well developed.  $pm^2$  is equal to  $I^3$  in crown area. The upper canine is unicuspid and not in contact with  $Pm^4$ .  $Pm_2$  is situated in tooth row and little smaller than  $Pm_4$  in height and crown area.

Pelage color varies from light brown to dark brown on dorsal side. Ventrally the fur is paler. The tips are light buffy brown to whitish and the hair roots are dark; this gives grizzled appearance. Ears, snout and membranes are uniformly dark brown.

**Dental formula :** 
$$\begin{array}{cccc} - & 2 & 3 & 1 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----}=34. \\ 1 & 2 & 3 & 1 \end{array} \quad \begin{array}{cccc} - & 2 & - & 4 \\ - & 2 & - & 4 \\ 1 & 2 & 3 & 1 \end{array}$$

**Ecological notes :** This species was found more frequently in urban and rural area. The small colonies of 5 bats were reported sheltering under clay tiles on the roof of old buildings, hollow tree logs and in cavities on rocks.

**Conservation status :** It is reported as NT (Near Threatened) in the South Asia, (CAMP Report, 2002).

## Order CHIROPTERA

### Suborder MICROCHIROPTERA

#### Family VESPERTILIONIDAE

#### Genus *Pipistrellus* Kaup, 1829

#### 23. *Pipistrellus kuhlii* (Kuhl, 1819)

**Common name :** Kuhl's pipistrelle

**Diagnosis:** The medium sized pipistrelle with forearm length ranging between 34.8 mm – 36 mm. The tail length (33 mm – 35 mm) is sub equal to the head and body length (46.8 mm – 49.4 mm). The wing membranes are translucent and the most characteristic feature is the presence of distinct white border on the patagium running between the foot and the fifth digit. The tragus is inwardly curved, but the tip is narrow and the outer border lacks triangular projection, the presence of which is the peculiarity of *P. savii*.

The skull is long, its dorsal profile is almost straight. The lambdoid crest lies in front of the small triangular area and is well developed.  $Pm^2$  is displaced inwardly as a result the upper canine and  $pm^4$  seem to be in contact.  $Pm_2$  is smaller, about half of  $Pm_4$  in height and crown area. It differs from other closely related species in dental peculiarities.  $I^2$  is unicuspid,  $I^3$  and  $pm^2$  are small, about one half or less in the crown area of  $I^2$ . The tip of  $I^3$  extends slightly beyond the cingulum of  $I^2$ .

The dorsal pelage is dark brown and slightly paler ventrally. The hair roots on the ventral body surface have darker base. The snout, ears and wing membranes are uniformly brown.

**Dental formula :**  $\begin{array}{cccc} -2 & 3 & 1 & -2-4 & 1 & 2 & 3 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----} & =34. \\ 1 & 2 & 3 & 1 & -2 & -4 & 1 & 2 & 3 \end{array}$

**Ecological notes :** This species was not very common in the study area and reported from the dry eastern part of Pune district. Like other species of the genus, the bats of this species are found in crevices in small groups.

**Conservation status :** It is reported as LC (Least concern), in the South Asia, (CAMP Report, 2002).

#### Order CHIROPTERA

#### Suborder MICROCHIROPTERA

#### Family VESPERTILIONIDAE

#### Genus *Pipistrellus* Kaup, 1829

#### 24. *Pipistrellus savii* (Bonaparte, 1837)

**Common name :** Savi's pipistrelle

**Diagnosis:** This is the medium sized bat with uniformly dark brown long, silky, soft and dense pelage. Ventrally the hair bases are darker, while the tips are pale in color. The snout, ears and wing membranes are uniformly dark brown. The muzzle is naked and flat. The membranes are translucent. The ear lobes are long and broad at the base. The tip of the ear lobe is rounded. The tragus is long, inwardly curved and with blunt tip. On its outer margin on the lower half, there is a triangular projection. The tail is significantly shorter than the head and body length.

Inner upper incisor I<sup>2</sup> is bicuspid. I<sup>3</sup> is half or more in height to I<sup>2</sup>, but similar in crown area. Pm<sup>2</sup> is little reduced in crown area, about two thirds of that of I<sup>2</sup>. Postorbital region, supra orbital region and rostrum are moderately widened. Supra-orbital tubercles are small. Braincase is low, flat and elongate. Basial pits are lacking.

**Dental formula :**  $\begin{array}{cccc} -2 & 3 & 1 & -2-4 & 1 & 2 & 3 \\ i\text{-----}, & c\text{---}, & pm\text{-----}, & m\text{-----} & =34. \\ 1 & 2 & 3 & 1 & -2 & 3 & 4 & 1 & 2 & 3 \end{array}$

**Ecological notes :** This species was not very common in the study area. Like other species of the genus, the bats of this species are found in crevices in small groups in the semi evergreen forest as well as in the urban area.

**Conservation status :** It is reported as VU (Vulnerable) in the South Asia, (CAMP Report, 2002).

## Order CHIROPTERA

## Suborder MICROCHIROPTERA

## Family VESPERTILIONIDAE

Genus *Pipistrellus* Kaup, 182925. *Pipistrellus/Scotozous dormeri* Dobson, 1875

**Common name :** Dormer's bat

**Diagnosis:** I<sup>3</sup> is minute like a spicule reaching hardly to the cingulum of I<sup>2</sup> and lying nearly laterally to this tooth almost outward to the tooth-row. Pm<sup>2</sup> is intruded and its crown area is greater than half than that of I<sup>2</sup>. Dorsal profile of the skull is almost straight with lambda as the highest part. The palate is concave and zygomata are broad.

According to Corbet & Hill, (1992) the Dormer's bat belongs to the Genus *Scotozous*. It is a monospecific genus; limited chiefly to India. On occasion it is referred to *Pipistrellus* as a subgenus on account of an apparent or supposed resemblance to the African species *Pipistrellus rueppellii*. *Scotozous* differs from *Pipistrellus* as its first upper incisor I<sup>2</sup> is large, massive, unicuspid and is in contact with canine, or nearly so.

Dorsal pelage of these bats is uniformly dark brown with some pale tips, ventral fur is even paler. Ears, snout and wings are blackish brown. Snout is short, broad and thick. Ears are short, broad and with rounded tip. Tragus is short with slightly curved pointed tip and a projection on sub terminal posterior border. Fleshy pads are present at the base of the first finger and on the sole.

Dental formula :  $\begin{array}{cccc} - & 2 & 3 & 1 \\ i & \text{-----} & , & c \text{---} \\ 1 & 2 & 3 & 1 \end{array}$ ,  $\begin{array}{cccc} - & 2 & - & 4 \\ pm & \text{-----} & , & m \text{-----} \\ - & 2 & - & 4 \end{array}$ ,  $\begin{array}{ccc} 1 & 2 & 3 \\ m & \text{-----} & \\ 1 & 2 & 3 \end{array} = 34$ .

**Ecological notes :** This species was not very common in the study area. Like other species of the genus, the bats of this species were found in crevices in small groups in the semi evergreen forest as well as in the urban area.

**Conservation status :** It is reported as widely distributed abundantly found species, which is ranked as LC (Least Concern) in the South Asia, (CAMP Report, 2002). It is an Endemic species restricted to the Indian sub-continent.

**RESULT**

The result of the field data is summarized in form of Tables and Graphs for further analysis. Table-2 refers to i) habits and ii) habitats preferred by each bat species from the study area, iii) colony habit of each bat species and iv) their IUCN status.

Fig. 3 explains the composition of the feeding guilds of bat species from the study area. The insectivorous bat species dominates the area. The frugivorous bat species sighted from the study area comprise only 12% of total dietary habits, but their abundance in this area is remarkable.

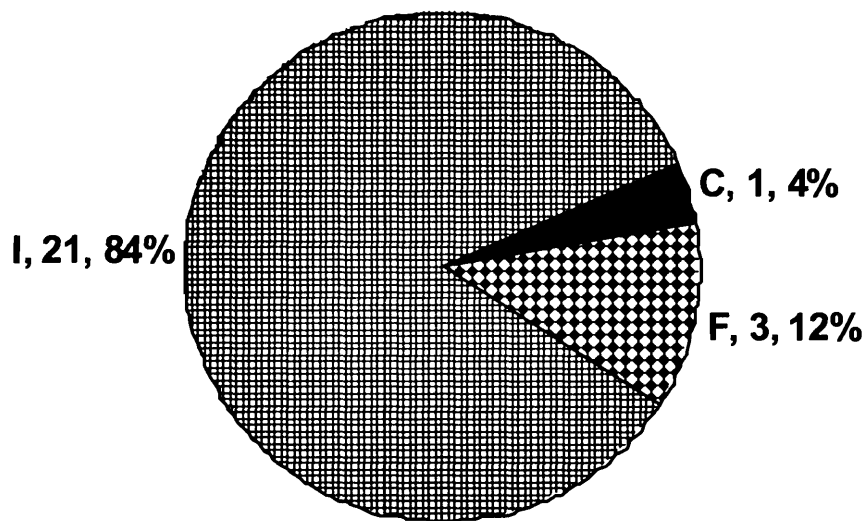


Fig. 3 : Composition of feeding guilds of bats in Pune district region. (C : Carnivorous; F : Frugivorous; I : Insectivorous).

Fig. 4 depicts various types of habitats and their usage (in %). In this regard natural caves are highly preferred as habitat by the bat species reported from the study area; and hence should be focused from the conservation point of view. The old buildings in the urban and rural area are equally important as habitat of many bat species. The result also indicates that only 3% of bat species prefer to roost in foliage, or it may be otherwise; the condition of foliage in forests or other locations may not be suitable to be preferred as habitat.

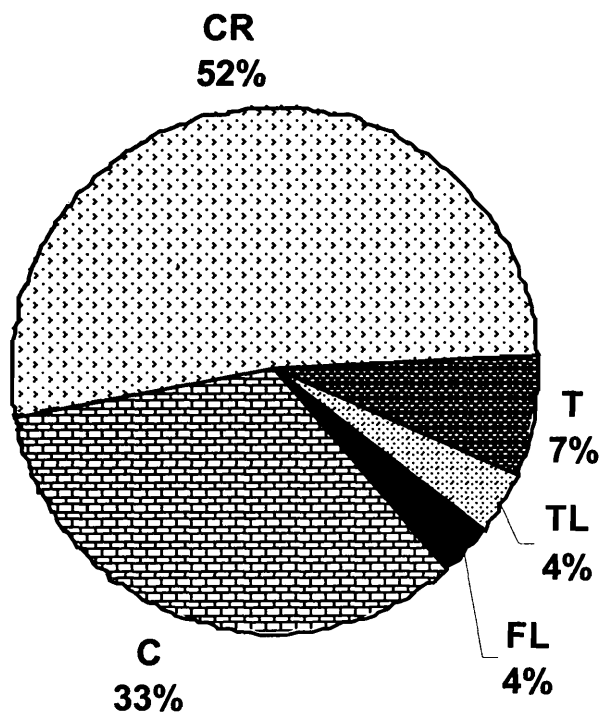
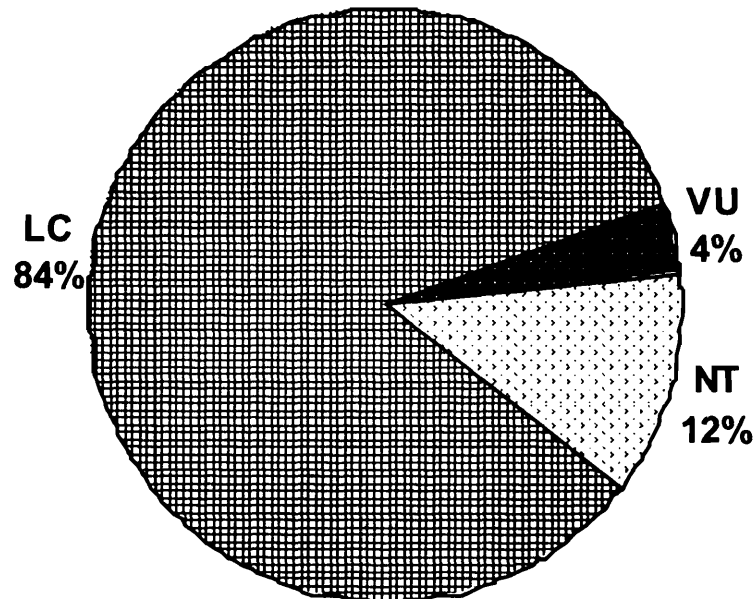


Fig. 4 : Composition of colony habitats of bats in Pune district region. (C: Cave; CR : Crevice (in rocks or man made constructions); FL : Foliage; T : Tree; TL : Log wood of trees)

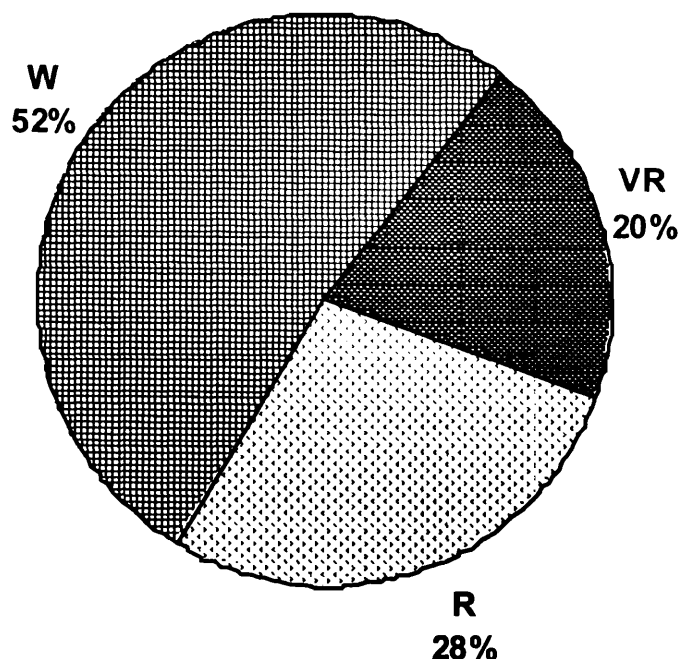
Fig. 5 indicates comparison of the bat species from various categories mentioning IUCN conservation status. In the study area 84% bat species belong to Least Concern (LC) category, 12% bat species are of Near Threatened (NT) category and 4% bat species are Vulnerable (VU).



**Fig. 5 :** Conservation status\* of bats in Pune district region. (NT- Near Threatened, VU- Vulnerable, LC- Least Concerned)

\*IUCN conservation status based on CAMP Report, 2002.

The present survey reveals that 52% of bat species sighted are distributed widely in the study area (Fig. 6). While 20% bat species have restricted and 28% bat species have very restricted distribution in the study area. The variation in distribution of bat species is noteworthy from ecological point of view.



**Fig. 6 :** Distribution range of bats in Pune district region. (W : Widely distributed; R : Restricted distribution; VR : Very restricted distribution.).

**Table-2** : Habits, habitats, distribution and conservation status of bat species from Pune district (2002- 2005).

S. No.	Species	Feeding Habit	Habitat	Colony Habit	IUCN Status*
1.	<i>Rousettus leschenaulti</i>	F	C	G	LC
2.	<i>Pteropus giganteus</i>	F	T	G	LC
3.	<i>Cynopterus sphinx</i>	F	T, FL	U	LC
4.	<i>Megaderma Lyra</i>	IC	C	U,G	LC
5.	<i>Rhinolophus rouxii</i>	I	C,TL	H	NT
6.	<i>Rhinolophus lepidus</i>	I	C	U,H	LC
7.	<i>Rhinolophus beddomei*</i>	I	C	H	NT
8.	<i>Hipposideros ater</i>	I	C	U,H	LC
9.	<i>Hipposideros fulvus</i>	I	C	U,G	LC
10.	<i>Hipposideros pomona</i>	I	C	H	LC
11.	<i>Hipposideros speoris*</i>	I	C	U,G	LC
12.	<i>Tadarida aegyptiaca</i>	I	CR	U	LC
13.	<i>Tadarida/ Chaerephon plicata</i>	I	CR	U,G	LC
14.	<i>Myotis horsefieldii</i>	I	CR	G	LC
15.	<i>Scotophilus heathii</i>	I	CR	U	LC
16.	<i>Scotophilus kuhlii</i>	I	CR	U,G	LC
17.	<i>Pipistrellus pipistrellus</i>	I	CR	U	LC
18.	<i>Pipistrellus javanicus</i>	I	CR	U	LC
19.	<i>Pipistrellus coromandra</i>	I	CR	U	LC
20.	<i>Pipistrellus tenuis</i>	I	CR, TL	U	LC
21.	<i>Pipistrellus ceylonicus</i>	I	CR, TL	U	LC
22.	<i>Pipistrellus kuhlii</i>	I	CR	U	LC
23.	<i>Pipistrellus savii</i>	I	CR	U	VU
24.	<i>Pipistrellus affinis</i>	I	CR	U	NT
25.	<i>Pipistrellus dormeri*</i>	I	CR	U	LC

F- Frugivorous; C- Caves; G- Gregarious; LC- Least Concern; I-Insectivorous  
T-Trees; U-Roosting close to human habitation; NT- Near Threatened; IC- Insectivorous +  
Carnivorous; FL-Foliage; H-Roosting at High altitude; VU- Vulnerable; TL-Dry tree logs; \*-  
Endemic to South Asia; CR- Crevices

\* IUCN Status based on CAMP Report, 2002.

The study area is divisible into three distinct regions on the basis of topography, climatic conditions and average rainfall. Table-2 indicates the number of colonies and their abundance (in bracket) per species of bats per region of the study area. The result indicates that the hills of Western Ghats and its spurs extending eastward in Pune district have equal potential to sustain the bat species. The number of colonies and abundance of bats in general is comparatively poor in the dry and plain region of the eastern part of the district; reflecting poor sustainability of this part. It is further clear that of the 25 bat species reported from the study area, 4 bat species have no specific preference, as they are sighted from all the three regions of the study area. As far as frugivorous bat species are concerned, Fulvous fruit bats (*Rousettus leschenaulti*) seem to prefer the forest area of the Western Ghats, while flying fox (*Pteropus giganteus*) prefers spurs to inhabit. Short nosed fruit bat (*Cynopterus sphinx*), however prefers spurs and plains. It is further noteworthy that 9 bat species have adapted themselves to the hot and dry climatic conditions, as they are reported substantially abundant in the plains of the eastern part of the district. Moreover, 3 bat species (*Megaderma lyra*, *Hipposideros speoris* and *Scotophilus heathii*) are more comfortable in the dry and hot plains, the abundance of food items is assumed to be the key factor for their remarkable abundance in this part of the district.

## DISCUSSION

The ecological and faunastic surveys of bats (2002-2005), have revealed that Pune district is rich in bat species diversity. The climatic conditions, geographical location and sustainability of the area perhaps are the prime factors for the richness of the bat species and their abundance. Present study reports 25 species of bats in the area of about 15, 642 sq km.

Topographically Pune district is divisible into three regions- the high altitude forest area of Western Ghats (1000-500m), the low altitude middle region and the eastern dry plains. The climatic condition therefore also varies due mainly to the difference in the rainfall. The heavy rainfall region of the Ghats is followed by the moderate rainfall region of spurs. The plains have poor rainfall and mostly dry. The number of bat colonies reported in these three regions reflects the correlation of the bat fauna and the atmospheric humidity. The Ghats region has the highest number of colonies (117 colonies), as compared to the reduced number of bat colonies (only 73 colonies) of the plains. The number of bat colonies is though moderate (109) in the spurs region, the abundance of bat fauna is highest in this region. The colonies of the plains not only are less in number, but also thin with a few exceptions.

The Western Ghats region and its spurs in the district are rich not only in diversity (reporting 21 bat species each), but also in the population size. But the richness of each of these regions varies a little. The cave species of high altitude are restricted to the forest of the Ghats, while evening bats living in crevices (natural/ artificial) dominate the spurs qualitatively as well as quantitatively.

Among the three species of Megachiropteran bats reported from Pune district, two species *Pteropus giganteus* and *Cynopterus sphinx* are found more abundantly in spurs

region. Few colonies of Fulvous fruit bat *Rousettus leschenaulti* though appeared in this region, their population size is limited to only a few hundreds in the spurs; while in the Western Ghats region they are found in many thousand in a single colony.

The evening bats are difficult to locate in the wild, because they live in small groups and use to roost in the narrow crevices. They are also reported to shift their roosting sites very often. The site location of these species in the Western Ghats therefore, is a challenge and requires skills. They are comparatively easy to trace in the rural and urban area of the spurs and hence reported as abundant. However, for these species of bats the Ghats region is plausibly richer than the spurs region with reference to species diversity and abundance.

Among 25 species of bats, 13 species of bats found abundantly in the entire district region and again out of these thirteen bat species only 7 species are found in abundance in this region. In Western Ghats and its spurs, 11 species are found abundant in each of these regions of the district. This observation indicates the fact that the nature of the habitat, temperature and relative humidity of the atmosphere ought to be the limiting factors for distribution of bat species in the study area.

The bat species of genera *Rousettus*, *Rhinolophus* and *Hipposideros* sighted from the study area are abundant in the Western Ghats region and are located mostly in the natural caves. The spurs of the Ghats are encroached by the rural and urban area. This region of Pune district shows abundance of frugivorous bats like Flying fox (*Pteropus giganteus*), Short-nosed bat (*Cynopterus sphinx*) and insectivorous bat species of genus *Pipistrellus*. The eastern dry region of the district, which includes plains, has only 7 bat species found in abundance. However, 3 species (*Megaderma lyra*, *Tadarida plicata* and *Scotophilus heathii*) are most abundantly found in this region of the district.

Most of the roosting sites of bats reported in the dry region of the eastern side of the district are located in the vicinity of seasonal ponds, lakes or rivers. Wild variety of plants and particularly the *Ficus* species are abundant on their banks, which have potential to sustain a considerable population of the frugivorous megachiropteran bats like *Pteropus giganteus* and *Cynopterus sphinx*. The microchiropteran bat species are limited to the old ruined buildings, ruined constructions and dome of the temples, which are abundant in this region.

The canal system traverses the dry area of plains of Pune district and is the major water supply of this region. This system has very positive impact on the distribution of bat species. The occurrence of Horsfield bat (*Myotis horsfieldii*) in the dry region of the study area is quite astonishing. This bat species requires very high relative humidity in their habitat and ample supply of freshwater (Das, 1986), and hence occurrence of this particular species is associated with the canal system. Though the Ghats region of the district comes under heavy rainfall region, the hills and streams are devoid of freshwater in post monsoon and summer seasons. The canal system of the eastern part of the district thus provides them suitable habitats.

Many of the species, which withstand the dryness of atmosphere (particularly of the summer season) of eastern part of the study area remained restricted to the water

bodies and prefer to avoid the competition for food felt in the moderate spurs region. In this context the cave species of high altitude like *Rhinolophus rouxii*, *Rhinolophus lepidus*, *Rhinolophus beddomei*, *Hipposideros ater* and *Hipposideros pomona* found exclusively in the region of Western Ghats appear to be less adaptable to the dry conditions. The colonies of these bat species therefore should be protected as their population seems to be very fragile.

The bat species reported in the study area are mostly (84%) insectivorous, 12% of bat species are frugivorous, but their abundance in the study area reaches to many thousand. Only one species (*Megaderma lyra*), which is truly carnivore (comprising only 4% of the total feeding guild of bats of Pune district); is common in occurrence throughout the study area.

The bats of the study area prefer to roost mostly (52%) in crevices (natural/artificial), 33% bat species prefer caves and a few bat species prefer to roost on trees, foliage or dry tree logs. The bats roosting in crevices are mainly from urban or rural area. Gregarious species (25%) are confined to the Western Ghats region and its spurs, while species roosting at high altitude (16%) are restricted to the Western Ghats region only and include cave species. The bat species prefer a variety of roosting sites of natural and man made constructions. The percentage of usage of the latter is almost equal to that of the former one, indicating close association of bat fauna with the human habitat.

Following C.A.M.P. Workshop Report, 2002, for conservation status of bat species; 21 species out of total 25 species (84%) reported from the Pune district are categorized as LC (Least Concern). 3 species (12%) e. g. *Rhinolophus rouxii*, *Rhinolophus beddomei* and *Pipistrellus affinis* are categorized as NT (Near Threatened) and 1 species (4%) (*Pipistrellus savii*) is considered as VU (Vulnerable). The present survey indicates that out of 25 species reported from the Pune district, 12 bat species (52%) are widely distributed throughout the study area, but 7 species (28%) are distributed in restricted area, while 6 species (20%) have very restricted distribution. This regional assessment for occurrence of bat species in the study area is more alarming from their conservation point of view.

The encroachment of the agricultural land on the forest region, destruction of forest area for dam construction and development of National high ways, increased activities in forest area under tourism, and increased rate of dryness in the atmosphere are some of the causes for decline in the abundance of bat fauna. The previous records of bat fauna in the study area have high lighted the Buddhist caves of Karle, Bhaje and Bedsar of Maval taluka as the most preferred habitats of Pune district. The species such as *Rhinolophus rouxii*, *Rhinolophus beddomei*, *Hipposideros galeritus*, (Brosset, 1962b), *Hipposideros fulvus*, *Pipistrellus ceylonicus* (Topal, 1975) and *Tadarida (Chaerephon) plicata* were recorded from these caves. Except *Pipistrellus ceylonicus* all these species are typical forest species, indicating well being of the forest concerned. But during present survey, only two species *Pipistrellus ceylonicus* and *Hipposideros fulvus* were reported from these caves. Remaining bat species were not found even in the nearby area. The painted bat *Kerivoula picta* (Blanford, 1888-91,

**Table-3** : Species diversity and distribution of Bat fauna in Pune District (2002-2005).

S. No.	Name of species	Western Ghats No. of colonies (abundance)	Spurs No. of colonies (abundance)	Plains No. of colonies (abundance)
1.	<i>Rousettus leschenaulti</i>	4 (30,000)**	2 (200)**	0
2.	<i>Pteropus giganteus</i>	15 (16,500)**	25 (25,830)**	23 (7,740)**
3.	<i>Cynopterus sphinx</i>	2 (12)*	25 (300)*	5 (240)**
4.	<i>Megaderma lyra</i>	7 (635)**	4 (230)**	6 (815)**
5.	<i>Rhinolophus rouxi</i>	7 (261)*	1 (1)*	0
6.	<i>Rhinolophus lepidus</i>	10 (103)*	0	0
7.	<i>Rhinolophus beddomei</i>	12 (23)*	0	0
8.	<i>Hipposideros ater</i>	5 (70)*	0	0
9.	<i>Hipposideros fulvus</i>	17 (488)**	2 (250)**	2 (115)**
10.	<i>Hipposideros pomona</i>	6 (195)*	0	0
11.	<i>Hipposideros speoris</i>	10 (1325)**	3 (237)**	7 (512)**
12.	<i>Tadarida aegyptiaca</i>	1 (10)*	4 (31)**	0
13.	<i>Tadarida/ Chaerephon plicata</i>	1 (50)**	4 (119)**	2 (207)**
14.	<i>Myotis horsfieldi</i>	3 (82)*	1 (5)*	2 (13)*
15.	<i>Scotophilus heathi</i>	3 (232)**	3 (23)*	15 (330)**
16.	<i>Scotophilus kuhlii</i>	2 (9)*	1 (1)*	0
17.	<i>Pipistrellus pipistrellus</i>	0	1 (18)*	0
18.	<i>Pipistrellus javanicus</i>	0	1 (25)*	0
19.	<i>Pipistrellus coromandra</i>	1 (10)*	5 (38)*	1 (6)*
20.	<i>Pipistrellus tenuis</i>	0	5 (32)*	1 (5)*
21.	<i>Pipistrellus ceylonicus</i>	9 (211)**	9 (97)**	6 (95)**
22.	<i>Pipistrellus kuhlii</i>	0	2 (12)*	1 (7)*
23.	<i>Pipistrellus savii</i>	1 (15)*	2 (12)*	0
24.	<i>Pipistrellus affinis</i>	3 (23)*	5 (40)*	0
25.	<i>Pipistrellus dormeri</i>	1 (7)*	4 (32)*	2 (30)*
<b>Total</b>		<b>117 colonies (21 species)</b>	<b>109 colonies (21 species)</b>	<b>73 colonies (13 species)</b>

\*Abundance is estimated by direct count, wherever the colony size is small.

\*\*For gregarious colonies or colonies roosting in dark place or deep in crevice, direct count in unit area is multiplied by total area for estimation of abundance.

Wroughton, 1916a) and the Tickell's bat *Hesperoptenus tickelli* (Brosset, 1962c), Lesser Short-nosed bat *Cynopterus brachyotis* (Pradhan & Kulkarni, 1997) inhabiting the broad foliage of forest were not reported in the present survey.

*Rhinolophus beddomei* is the endemic species to South Asia and categorized as NT (Near Threaten) [C.A.M.P. Workshop Report, 2002]. This species is also considered as the bioindicator to judge the ecological status of the forest ecosystem. Its poor abundance in the forest of Western Ghats bordering the Pune district suggests alarming condition of the forest and keen need is felt for immediate implementation of conservation measures for the well being of the forest and dependent fauna.

### SUMMARY

The ecological study and faunastic survey of bat species in Pune District reveals that the climatic conditions and sustainability of the study area is favorable for this unique fauna of small mammals. Presence of 25 bat species in the small part in the vicinity of Northern Western Ghats indicates richness of the species diversity and abundance of the fauna. The analytical study based on the distribution and abundance of bat species helps to understand the trend of adaptation in this group of mammals. Nature of habitat, relative humidity of atmosphere and availability of food items seem to be the limiting factors for the distribution of the bats in the study area.

Deforestation, tree cutting in the urban and rural area, increased use of insecticides etc. are responsible factors for decline in the population size of bat fauna.

### RECOMMENDATIONS

On the basis of the observations and discussions based on the ecological study and faunastic survey of bats from Pune District (2002-2005), following recommendations are put forward:

1. Human activities should be properly regulated in the Western Ghats of Maharashtra. The area and number of Reserved Forests should be increased.
2. The traditional farming methods, which include cutting of forests on plateau and burning of dry grassland; should be regulated properly.
3. Community education and education through schools will help in implementation of conservation measurements.
4. Attempts to be made to protect Natural caves and the fauna living in them.
5. Tree cutting under the developmental programs is unavoidable. But such trees should be transplanted safely to other suitable habitats for maintenance of low ambient temperature and high humidity of the surroundings.

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**Evergreen forest of Western Ghats in Pune district**



**Deciduous forest of Northern part of Pune district**



**Canal system in the Eastern part of Pune district has changed the natural ecological conditions of this region.**



**Flying fox roosting on tree, snapped in summer.**



**Tree holes, a favorite roosting site for evening bats.**



**Ruined dark places are favorable night/day roosts are bats.**



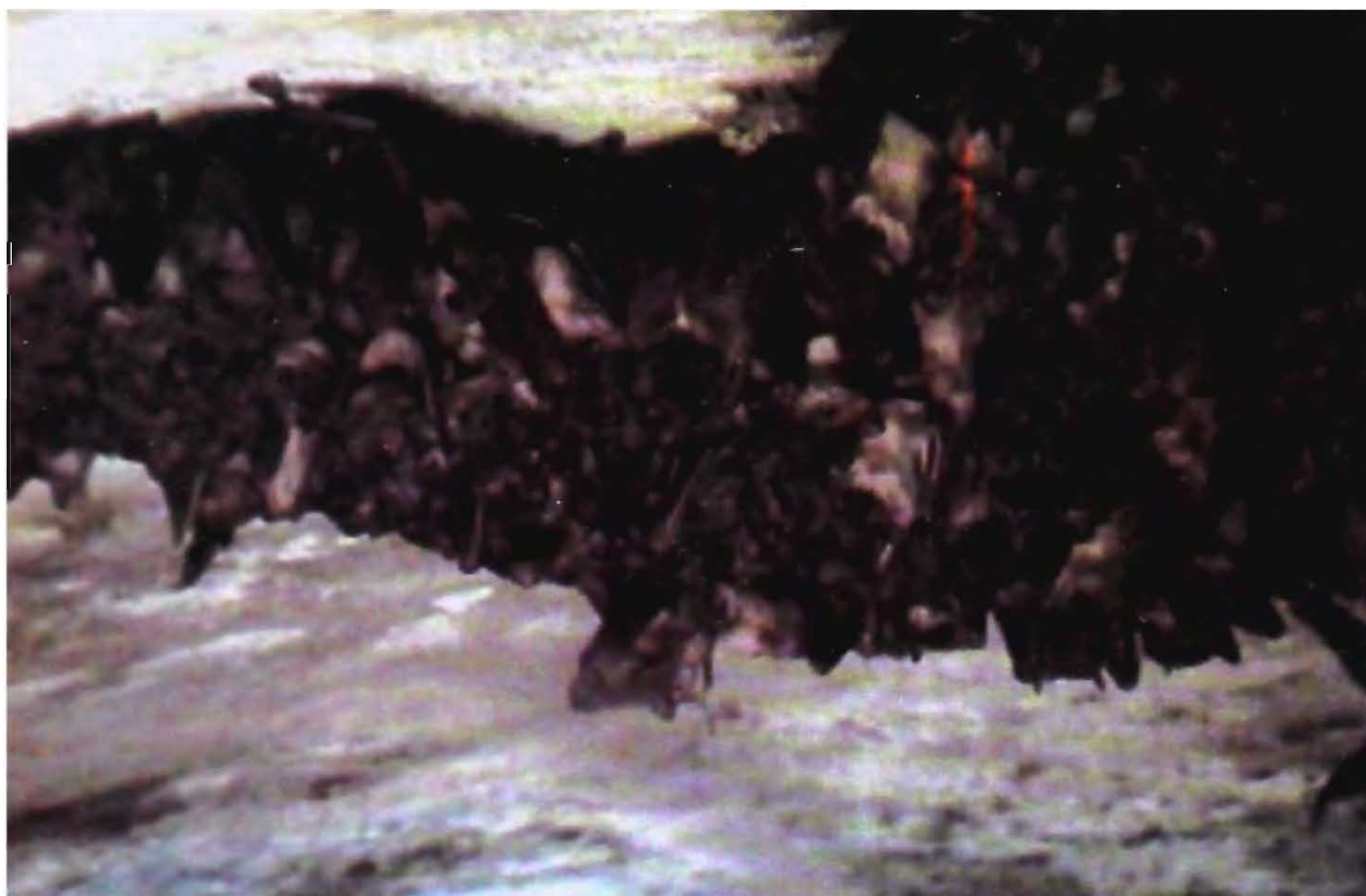
**Horizontal crevices on hills is the probable site for bats in dry region.**



**Teak bark of dry log wood – the most favorite roosting place for pipistrelles.**



**Buddhist caves in study area were the most preferred sites for forest bat species.**



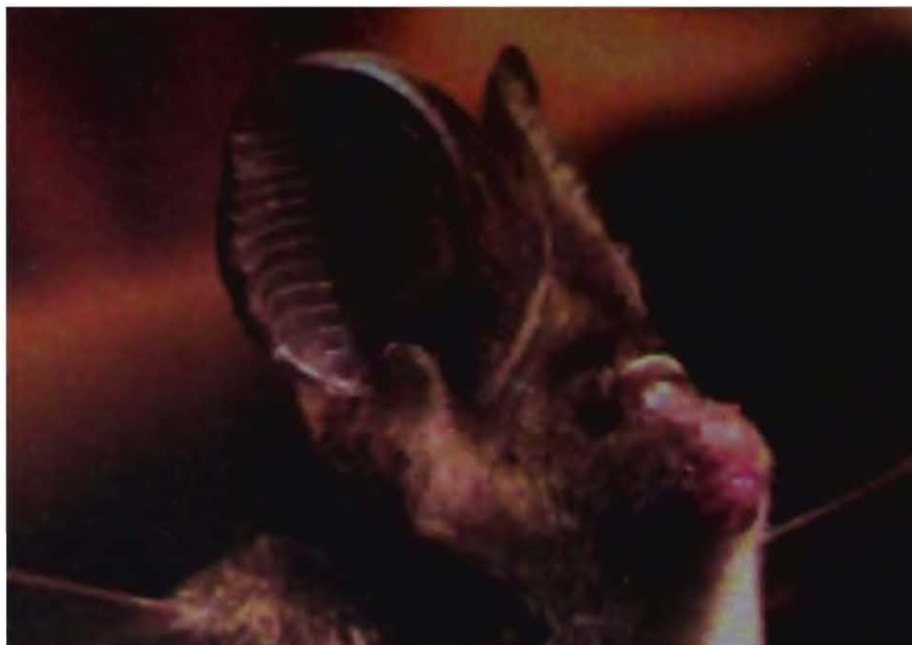
**Cluster of fulvus fruit bat *Rousettus leschenaulti***



Short-nosed fruit bat *Cynopterus sphinx* is common in rural as well as urban area.

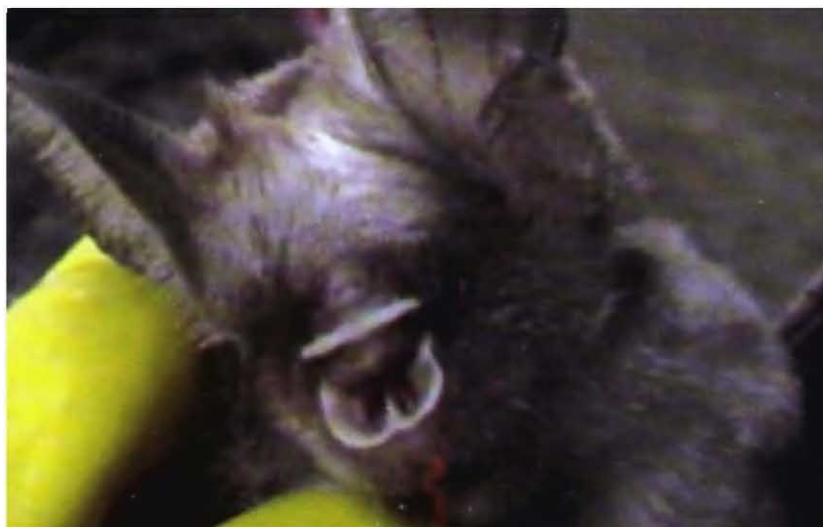


The Lesser woolly Horseshoe bat *Rhinolophus beddomei* is endemic to South Asia and a near threatened species



**The Fulvous Leaf-nosed bat *Hipposideros fulvus* is a cave bat, but also found in spurs and plains of Pune district.**

***Hipposideros pomona* is very rarely occurring bat in the study area.**



***Megaderma lyra*, the only insectivorous and carnivore species and the most abundantly occurring bat of dry region of Pune district.**



***Tadarida (Chaerephon) plicata*, the Wrinkle-lipped Free-tailed bat was widely distributed in the study area.**

**Horsefield bat *Myotis horsefieldii* is restricted in river bridges and canals in the study area.**



***Pipistrellus* is the most common evening bat of rural and urban area of Pune district**