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ECOLOGICAL STUDY AND FAUNASTIC SURVEY OF BATS FROM PUNE CORPORATION LIMITS, MAHARASHTRA STATE, INDIA

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INTRODUCTION

Bats are grouped under Chiroptera, the second largest order of class Mammalia. It includes two suborders-Megachiroptera and Microchiroptera. The former comprises big bats that are frugivorous and orient by vision and olfaction, the latter are small mostly insectivorous bats that orient by echolocation. Though both these groups are important links of the food web of the terrestrial ecosystem, are not taken seriously by ecologists. Actually these nocturnal and aerial mammals have potential to serve as bioindicators to judge the ecological status of a particular area.

The bats reported from Pune region are few, contribution of Wroughton and Davidson (1920), McCann (1934), Brosset (1962a, 1962b, 1962c, 1963), Bastawde & Mahabal, (1976), Rookmaaker and Bergmans (1981), Shivkumar Swamy *et al.* (1984), Bhat (1994), Bates *et al.* (1994a, 1994b & 1994c) is noteworthy in this regard.

Since the Pune region lies on the fringes of the Western Ghats– one of the biodiversity hotspots of the world, the study of bat fauna in the urban area of Pune city is selected as the first step to know about ecology of this small mammal fauna, which is neglected since many years and not studied for its diversity in a particular area. In the present study two genera from order Megachiroptera and five from Microchiroptera are reported. *Rousettus leschenaulti* the medium sized fulvous fruit bat, *Hesperptenus tickelli,* the Tickell's bat and *Myotis horsfieldii peshwa* the Horsfield's bat previously reported in this region are not found during the recent survey. On the contrary genus *Pipistrellus* the evening bat appeared in a wide range of species diversity.

OBSERVATIONS

In spite of destruction of old buildings and big trees throughout Pune city, the bat fauna is found to be safe to certain extent, but the cave bats in particular are found to be seriously disturbed due to human interference. The green pockets of indigenous plants throughout the city area found to be very important for sustenance of both big as well as small bats.

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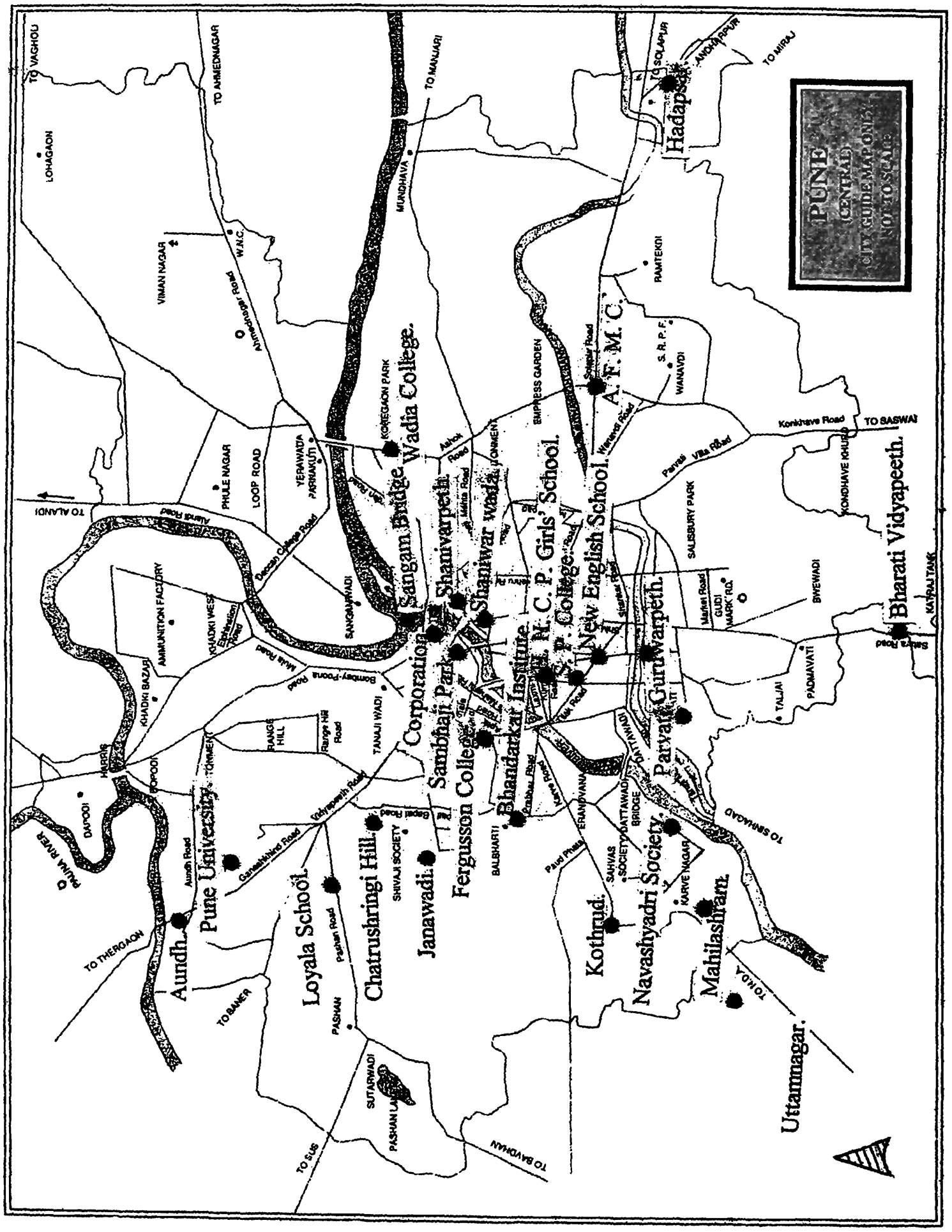

Map 1 : Map of Pune city (not up to scale) showing trapping sites of bats.

TAXONOMY AND ECOLOGICAL DETAILS OF BATS FROM PUNE

Suborder I MEGACHIROPTERA

Family I PTEROPODIDAE

Genus (1) ***Pteropus*** Brisson

1. *Pteropus giganteus* Brunnich, 1782

Indian Flying Fox

Vespertilio gigantean Brunnich, 1782 : Type-loc. : Bengal, India

Diagnosis of species : The tail and nose-leaf are absent. The interfemoral membrane little developed. The wing membranes arise from the sides of dorsum and from the back of the second toe. The wingspan is large (850–1100 mm). The base of the ear completely ringed, tragus and antitragus absent. Inner margin of nostril projecting. Index finger with a powerful claw. Hind neck, shoulder and underside of body generally paler than back. The length of rostrum greatly exceeds the lachrymal breadth. The first upper premolar absent. The crown of molars with longitudinal furrow.

Dental formula : $i\frac{-2\ 3}{1\ 2}$, $c\frac{1}{1}$, $pm\frac{-2\ 3\ 4}{-2\ 3\ 4}$, $m\frac{1\ 2}{1\ 2\ 3}$ = 34

Distribution of species : All over India, Sri-Lanka and Burma.

Systematic note : Two subspecies are recognized : *P. g. giganteus* (Brunnich) common in the Indian peninsula excluding Himalayas. Those from Himalayan region are provisionally assigned to *P. g. leucociphalus.*

External, cranial and dental measurements (mm) of *Pteropus giganteus giganteus* from Pune city :

HB	293 – 315	ZB	40.5 – 44
HF	42.5 – 52.6	BB	25.6 – 27
FA	170 – 180	IC	11 – 11.9
WSP	850 – 1050	CM^2	28.6 – 31
E	35 – 40	CM_3	30 – 33
GTL	71 – 75,6	M	57 – 58
CBL	65 – 69.5		

HB : Head & body length, HF : Foot length, FA : Forearm length, WSP : Wingspan, E : Ear length, GTL : Greatest length of skull, CBL : Condylo-basal length, ZB : Zygomatic breadth, BB : Length of braincase, IC : Interorbital constriction, CM^2 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length

*n = 5

All five specimens are male. The head is dark brown to blackish brown in colour, neck and nape uniformly buffy brown to brown, lower shoulder and back blackish brown with some gray hair scattered uniformly, belly vary is colour from brown to light russet brown. The hair roots in this region are darker than the tips, which in particular are paler. The fur around genitalia is dark brown to brownish black in colour.

The baculum though is horseshoe shaped, vary in appearance and dimensions.

Ecological note : The flying fox (*Pteropus sp.*) is the most abundantly found genus in the study area. Four distantly placed colonies are located in the study area and all are in flourishing state. The largest and the oldest colony is at Sangam Bridge in Pune station area and of about 8,000 bats, the other is in Kothrud area in the premises of Kirloskar Kisan Co. Pvt. Ltd. And has about 4,000 bats, the one in Uttamnagar area near National Defense Academy is of about 2,000 and that near Aundh area has about 1,000 plus bats. All these but colonies are conserved by local people as well as owners of the premises. Their flourishing state also indicates abundance of food in the foraging ground. These bats prefer tall trees near river or canal. Trees like mango (*Mongifera indica*), Pipal (*Ficus religiosa*), black plum (*Syzygium cumim*), rain tree (*Albizia labbak*), tamarind (*Tamarindus indica*), cassurina (*Cassurina equisetifolia*) etc. are preferred for day roosting. The actual feeding behavior is not studied, it is noticed that they feed on tender leaves, flowers and ripen fruits of above mentioned plants and many more of wild types from nearby forest.

Genus (2) *Cynopterus* Cuvier, F., 1824

2. ***Cynopterus sphinx*** Vahl, 1797

Short-nosed Fruit bat

Vespertilio sphinx Vahl, 1797. Type-loc : Tranquelar, S. India

Diagnosis of species : The muzzle is shorter and relatively broader than that of *Pteropus* and with a deep emargination between the projecting nostrils. The ears have a well defined pale anterior and posterior border. Tragus and antitragus absent. The tail is short, half porjecting free from the interfemoral membrane. The interfemoral membrane not very extensive. Index finger with claw. Males with neck tufts comprised a semi-rigid ruff of hairs. Colouration varies from light brown to dark brown. The rostrum short and the ventral profile is almost straight. Unlike *Pteropus* the occipital region is not elongated. Skull is smaller than that of *Rousettus leschenaulti.* The upper canine bicuspid and crown of molar marked with longitudinal furrows.

Dental formula : $i\ \frac{-2\ 3}{1\ 2-},\ c\ \frac{1}{1},\ pm\ \frac{-2\ 3\ 4}{-2\ 3\ 4},\ m\ \frac{1-}{1\ 2-} = 30$

Distribution of species : All over India, Pakistan, Bhutan, Nepal Bangladesh, Sri Lanka and Northern Myanmar.

Systematic note : Specimens from northern India tend to be larger than those from the southern peninsula and Sri Lanka. Andersen (1912) provisionally referred the northern specimen under *C. s. gangeticus.* but Agarwal (1973) doubted the validity of this subspecies. The subspecies and their distribution reported in South-East Asia are as follows :

C. S. sphinx (Vahl)-Found in Indian subcontinent except Sumatra, Java, Lombok and Timor.

C. s. tithaecheilus Andersen-Java, Lombok and Timor.

C. s. angulatus Miller-Thiland, Malaya and Sumatra.

C. s. serasani Paradiso-Serasan Island, Indonesia.

C. s. major Miller-Nias Island, off Sumatra.

External, Cranial and dental measurements in mm of *Cynopterus sphinx sphinx* :

HB	95 – 104	GTL	33.8 – 35
T	11 – 15	CBL	28 – 29.5
HF	12.5–16	ZB	18–19
FA	73–75	BB	13–15
WSP	425–438	IC	6–7.7
5MET	43–46	CM^1	12–12.5
4MET	41–44	CM_2	13–13.5
3MET	44–45.6	M	25.5–27.5
E	18–20		

HB : Head & body length, T : Tail length, HF : Foot length, FA : Forearm length, WSP : Wingspan, XMET : Corresponding number of metatarsus, E : Ear length, GTL : Great length of skull, CBL : Condylo-basal length, ZB : Zygomatic breadth, BB : Length of braincase, IC : Interorbital constriction, CM^1 : Maxillary toothrow, CM_2 : Mandibular toothrow, M : Mandible length.

*n = 9.

About nine specimens are trapped from distantly located places in the city area. Of these four are female and five are male. The medium sized fruit bat is dark brown on forehead and neck, the back is grayish brown. In male the chin and chest are slightly orange, while female are tawny brown on neck, grayish on dorsal side and even paler tips on the ventral side. The membranes are uniformly dark brown with characteristically white fingers. The ears are simple with white ring on the margin of the pinna. The nostrils are projected forward on the short, broad and hairy snout.

The moderately long skull has robust and long zygomata. The postorbital processes are well developed. The skull axis is almost straight from nasals to lambda with a weak sagittal crest. The mandible is heavily built.

Ecological note : The short-nosed fruit bat *Cynopterus shinx sphinx* is another fruit bat, which again appears in abundance in small but a number of colonies scattered almost every nook and corner of the city. It prefers 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*), rain tree (*Albizia labbak*) and in the hollow inflorescence of the fishtail palm (*Caryton urens*). The feeding habit of this bat is almost similar to that of flying fox but its range of foraging ground appears naturally smaller and prefers trees of medium height of about 18 plant species.

The isolated young bats of *C. sphinx* 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 are also noticed to shift their roosting site in the same vicinity as per season. The lactating mothers are observed in November and April.

Suborder MICROCHIROPTERA

Family HIPPOSIDERIDAE

Genus (3) ***Hipposideros*** Gray 1831.

3. ***Hipposideros speoris*** (Schneider, 1800)

Schneider's Leaf-nosed bat

Vespertilio speoris Schneider, 1800. Type-loc : Tranquelar, India.

Diagnosis of Genus : The leaf-nosed bat with ears broad at the base and pointed at the tip. The ears are separate and without tragus. The long tail is included in the interfemoral membrane. The nose-leaf comprises an anterior leaf, central or intermediate leaf and the posterior leaf, all held horizontally and not vertically.

The skull has distinct but low sagittal crest. The tympanic bullae are small but the cochlea are moderately developed. The first upper premolar small, functionless, compressed and displaced from the tooth-row.

Dental formula : $i\ \frac{-2}{1\ 2},\ c\ \frac{1}{1},\ pm\ \frac{-2\ -4}{-2\ -4},\ m\ \frac{1\ 2\ 3}{1\ 2\ 3} = 30$

Diagnosis of species : The medium sized leaf-nosed bat with moderately smaller ears. The nose-leaf has three supplementary leaflets; the outer one is inconspicuous. The median emargination of the anterior leaf-nose is not prominent. The upper edge of the intermediate leaf is concave.

The posterior leaf is divided into four cells by vertical three septa and with slightly thickened upper edge.

Distribution : Confined to India and Sri Lanka.

Systematic note : Currently all specimens from the Indian subcontinent are referred to the race *H. s. speoris*.

External, Cranial and dental measurements in mm of *Hipposideros speoris* :

HB	46.6–52	4MT	36–38	GTL	18.5–19.5
T	23-29	3MT	37–40	CCL	16–17
HF	7.5–8	1ph3mt	13.8–15	ZB	10.2–10.5
TIB	19–23.5	2ph3mt	16–18	BB	8–9
FA	51.5–54	1ph4mt	11–12	PC	3–3.2
WSP	277–285	2ph4mt	9–9.8	CM^3	7–7.5
TIB	20–23	E	13.5–14	CM_3	7.5–8
5MT	31.6–34.7			M	13–14

HB : Head & body length, T : Tail length, HF : Foot length, FA : Forearm length, WSP : Wingspan, TIB : Length of tibia, XMET : Corresponding number of metatarsus, YphXmt; Corresponding numbered phalanx of corresponding numbered metatarsus, E : Ear length, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length

*n=9

The medium sized bats vary in pelage colour. Dorsally it is golden brown with grayish tips. The fur is soft and dense. The ventral side is pale with comparatively short fur. The golden tinge differs in shade from dark brown to orange brown. The young bats have dull grayish tinge. The broad funnel like pinna tapers towards the tip and ends into a blunt tip. The supplementary leaflets are three in number, the outer being incomplete and inconspicuous.

The male has a frontal sac just above the posterior leaf-nose, the female lacks this but has a tuft of long hair.

The fifth metacarpal is significantly shorter than fourth and third. The baculum is simple rod like and minute with blunt tip and slightly broad base.

Ecological note : The bats are roosting in a cave located on the slope of a hill among the range of Chatmshringi hills in Ganeshkhind area near Pune University. It is a narrow and deep cave, which is partially divided and each part is interconnected with others. The water tunnels on the floor keep the interior environment cool and moist. The cave is stinking due to the typical unpleasant smell of the urine, excreta and secretion of the frontal sac of males. About 500 bats are roosting, all adults and sub adults together, but separately by means of the curved claws hooked to the rough rocky cliffs. The bats thus hang freely and busy constantly exploring the surroundings with their vibrating big ears. They are used to emerge half an hour after sunset, just before dark.

The bats are observed flourishing for many years. But as the nearby area developed and new buildings came up, the human interference increased to such an extent that the entire colony temporarily shifted in the crevices of the nearby hills. The cave remained almost vacant for about a year or so and recently a small group of about fifty bats have returned to their original cave. The fate of the remaining bats is still doubtful.

The flourishing colony has a regular breeding cycle. Almost all females are conceived from October to November. A single foetus is carried in the left horn of the uterine cornu up to early May. The sucklings are observed from June to mid August clinged to their mother with one of the pelvic teats in their mouth.

Family MOLOSSIDAE

Genus (4) ***Tadarida*** Rafinesque

4. ***Tadarida aegyptiaca*** (E. Geoffroy)

Egyptian Free-tailed bat

Nyctinomus aegyptiacus E. Geoffroy, 1818 Type-loc : Egypt

Diagnosis of genus : Small to medium sized bats with downwardly facing ears and stout tail projecting beyond the interfemoral membrane. The fleshy ears on the forehead either joined or separate. The tragus is rudimentary but antitragus is large. The nostrils open on the pad, the upper lip is often wrinkled. The wings are long but narrow.

Dental formula : $i\ \frac{-2-}{1\ 2(3)},\ c\ \frac{1}{1},\ pm\ \frac{-2\ -4}{-2\ -4},\ m\ \frac{1\ 2\ 3}{1\ 2\ 3} = 30/32$

Diagnosis of the species : The medium sized molossid bat with the fleshy ears separated on the forehead. The tragus is squarish with a small angular projection. The antitragus is well developed. The skull is moderately long and the braincase is flattened. The median axis running from nasals to lambda is straight. The premaxillae are not co-ossified with palate.

Systematic note : In Indian subcontinent *T. a. thomasi* is the endemic subspecies and is also very common and not endangered.

External, cranial and dental measurements in mm of *Tadarida aegyptiaca* :

HB	63–69	GTL	19–20
T	35–44	CCL	17–18.5
HF	7–9	ZB	11–12.5
FA	47–49	BB	9–10
WSP	296–330	PC	4.5–5
5MT	28–30	CM^3	7–7.8
4MT	45–48	CM_3	7.9–8.3
3MT	47–50	M^3–M^3	8–9
E	14.5–20	M	13.5–14.2
TIB	13.5–15	RW	7–8

HB : Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length RW : Width of rostrum.

*n = 5

The pelage colour clove brown on the dorsal side and distinctly pale almost whitish brown on the ventral side. The fur in general is short-and soft, extends on the flanks. The membranes, ears and snout brownish black in colour. Prominent circular pad with middle depression on the sole as well as at the base of the thumb. The fleshy ear almost round but extends in an angle towards the tip. The earlobes erect and are held vertically on the forehead, but do not meet in the center. The trasus short, overlapped by the large rectangular antitragus. The small eyes are just in front of the ears. The foot large, with sharply curved powerful claws, covered with white, long and inwardly directed hair.

Ecological note : These bats are common in the study area. They are used to hide under the metallic signboards, and in the crevices under the roof and walls of old buildings. The night roosting places can easily be marked by the characteristic odour of excreta and urine. The urine marks on the wall, heavily shitted floor and shrilling voice even in day times make their presence sure in the vicinity. They emerge after development of dark, about 45 minutes or even late after sunset.

Immature males are observed in early July. The females in the same months are in early pregnancy with two embryos, one in each comu of the uterus. There is no sexwise segregation during this time.

Genus (4) ***Tadarida*** Rafinesque

5. ***Tadarida (Chaerephon) plicata*** (Buchannan, 1800)

Wrinkle-lipped Free-tailed bat

Vespertilio plicatus Buchannan, 1800

Type-loc. Puttahaut (According to Allen, 1938), Bengal, India.

Diagnosis of species : The smallest species of *Tadarida*. Forearm length averages 46.3mm, apparently similar to *T. aegyptiaca*, but unlike other species the ears are connected by a membrane across the forehead. The soft and dense fur is very short, usually dark clove brown and paler on the ventral side. The 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 supraorbital processes are present. The brain case is more rounded and not flattened above. The dorsal profile has convexities over both the postorbital region and posterior part of the skull. The coronoid process of mandible is weak, but the angular process is robust.

Disribution : This species is reported in India. Sri Lanka, Myanmar, southern China, Vietnam, Philippines and Indonesia.

Systematic note : All specimens from India are referred provisionally to *T. p. plicata.* But those from Sri Lanka are referable to *T. p. insularis* due to dark chocolate brown dorsal pelage (Hill, 1961). In Indian subcontinent the distribution of this species is probably restricted to a few colonies.

External, cranial and dental measurement in mm in *Tadarida plicata* :

HB	69–72	GTL	18.5–19.2
T	34–40	CCL	16–16.5
HF	8–9.5	ZB	11–11.2
FA	46.5–48.5	BB	9.1–9.3
WSP	325–330	PC	3.8–4
5MT	27.5–29	CM^3	6.5–7
4MT	44.5–46	CM_3	7–7.5
3MT	46–48.5	M^3–M^3	7.8–8.5
E	16–17	M	12–12.5
TIB	14–16	RW	6–6.5

HB : Head & body length, T : Tail length, HF : Foot length, FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest

length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : Postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length RW : Width of rostrum.

*n = 4

The dorsal pelage is clove brown, while the ventral fur is short, less dense and paler. The snout, ears and wings are blackish brown. The ears are round and facing downward.

Ecological note : A colony of about 70-80 bats are located in a century old building of a night school-Nanawada near well known Shaniwarwada, and is a busy place even during daytime being a famous cultural center in the heart of the city. About 10-11 groups of bats rest behind the wooden frames hanged on the stony wall of an open verandah, about 30-40 feet from the ground level.

The bat colony is flourishing since more than 20-25 years. But recently the building is renovated and the frames are removed from the wall. The disturbed colony is represented by hardly one or two bats in the crevices of the staircase.

Family VESPERTILIONIDAE

Genus (5) ***Scotophilus***

6. ***Scotophilus kuhlii*** Leach, 1821

Asiatic Lesser Yellow House bat

Vespertilio temminckii Horsfield, 1824. Type-loc. Java.

Diagnosis of Genus : Large sized evening bat with small ears. The tragus is crescent shaped and antitragus well formed. The narrow braincase showing prominent and projecting lambda. The second upper incisor is absent, the cheek teeth with outwardly displaced cusps. The third upper molar reduced.

Dental formula : $i\ \frac{-2-}{1\ 2\ 3},\ c\ \frac{1}{1},\ pm\ \frac{--4}{-2-4},\ m\ \frac{1\ 2\ 3}{1\ 2\ 3} = 30$

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

Distribution : Reported from India, Pakistan, Taiwan, Sri Lanka, Malaysia, Philippines and Indonesia.

Systematic note : In past the small *Scotophilus* was referred variously as *S. temminckii* and *S. wroughtoni*, following Hill and Thonglongya (1972), the tzxon *S. kuhlii* is considered to be correct. Spcimens from Indian subcontinent are provisionally referred to *S. k. wroughtoni.*

External, cranial and dental measurements in mm of *Scotophilus kuhlii* :

HB	60	GTL	20
T	35	CCL	18
HF	10	ZB	13
FA	46.6	BB	9.4
WSP	300	PC	5
5MT	43	CM^3	6.8
4MT	47	CM_3	7.8
3MT	48	M^3–M^3	8.5
E	11.6	M	14
TIB	20	RW	7

HB : Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length RW : Width of rostrum.

*n = 1

The present specimen of a mature isolated male is trapped in mid April. Though the closely related species of the genus *S. heathii* and *S. kuhlii* exhibit overlapping measurements, the present specimen represents the lower range of parameters and that helps to decide the species. The ventral pelage colour is quite different, brownish yellow in contrast to satin yellow of *S. heathii.*

Ecological note : This species seems to be not very common to the study area, as only one male bat is trapped in the survey of two years. A single mature bat is trapped from the open verandah of the first floor from Wadia College in Pune station area, hiding behind the wooden notice board. Nothing is known about the reproduction cycle or other details.

Genus (6) ***Pipistrellus***

7. ***Pipistrellus javanicus*** (Gray, 1838)

Javan pipistrelle

Scotophilus javanicus Gray, 11S Type-loc. Java.

Diagnosis of Genus : Small vespertilionid bat. The nostrils directed antero-laterally with a distinct inter-narial groove. The muzzle is glandular and nearly naked. The ears short and broad, the tragus about half the height of the ear, its anterior border is slightly concave and antitragus in

form of minute lobular projection. The first upper incisor I^2 is well developed and bicuspid. The second incisor I^3 smaller than the former one. The upper canine is short and usually bicuspid. The upper first premolar (pm^2) is small and usually intruded from the tooth-row. Pm^3 and Pm_3 both are absent.

Dental formula : $i\ \frac{-2\ 3}{1\ 2\ 3},\ c\ \frac{1}{1},\ pm\ \frac{-2-4}{-2-4},\ m\ \frac{1\ 2\ 3}{1\ 2\ 3} = 34$

Diagnosis of species : The medium sized bat with snout broad and flattened. The dorsal gland at the root of the tail is absent. 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, CBL < 13, CM^3 < 5.2 and the cranial profile is almost straight.

Distribution : The species is reported from Afghanistan, Pakistan, India, Myanmar, Indonesia, Philippines. Korea, Japan and New guinea.

Systematic note : Following Corbet and Hill (1992), the taxa *babu, peguensis* and *camortae* have been included in synonym of *javanicus*. Specimens from main land of Indian subcontinent are referred to *P. javanicus babu* and those from Nicobar Islands to *P. j. camortae.*

External, Cranial and dental measurements in mm *Pipistrellus javanicus* :

HB	42.7–52	GTL	14–14.6
T	29–33	CCL	13–13.2
HF	5–8	ZB	8–8.7
FA	34–36	BB	6.7–7.1
WSP	231–250	PC	3.9–4
5MT	30.5–32.8	CM^3	5–5.2
4MT	32–34	CM_3	5.3–55
3MT	32.5–34.6	M^3–M^3	6.5–6.8
E	10–15	M	10.7–11
TIB	13–15	RW	5–6

HB : Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull. CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length, RW : Width of rostrum.

*n=3

Pelage colour clove brown to blackish brown dorsally. Ventral paler fur with darker hair roots gives grizzled appearance. Fur in general soft and dense. Ears, membranes and snout uniformly dark brown. The ears are erect, broad at the base and blunt tip is little thick.

Ecological note : Not very common species in the study area, a single colony of about 20 adults and sub adults are located behind the metallic name-plate fitted about 7-8 feet from the ground level in Fergusson College premises. The females in early August have early pregnancy with 2 embryos in the womb.

8. ***Pipistrellus coromandra*** (Gray, 1838)

Coromandel Pipistrelle; Indian Pipistrelle; Little Indian bat.

Scotophilus coromandra Gray, 1838 : Type-loc. Pondecherry, India.

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

Distribution : It is found in Afghanistan, Pakistan, India, Southern China, Sri Lanka Nicobar Island, Thailand and Vietnam.

Systematic note : Specimens from throughout the Indian subcontinent are currently referred to the nominate race *P. c. coromandra.* Following Corbet and Hill (1992) those from north-east Pakistan and Afghanistan may be subspecifically distinct.

External, Cranial and dental measurements in mm *Pipistrellus coromandra* :

HB	38.5–42	GTL	12–12.4
T	22–28	CCL	10.5–11
HF	3.5–4.5	ZB	7.6–8
FA	26–30	BB	5.6–6.4
WSP	185–200	PC	3–3.4
5MT	25–27	CM^3	4–4.5
4MT	26–29	CM_3	4.2–4.8
3MT	26.5–28.7	M^3–M^3	5.3–6
E	7.5–8	M	8.2–8.4
TIB	11.5–12.5	RW	4.8–5.4

HB : Head & body length, T : Tail length. HF; Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull. CCL; Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase.

PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibulartoothrow, M : Mandible length RW : Width of rostrum

*n = 3

Small pipistrlle with soft, uniformly clove brown fur. 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 the interfemoral membrane on either side of the tail.

Ecological note : Two colonies are located in the study area, one comparatively large colony of about seventeen to twenty bats roosting behind the wooden boards fitted on the wall of open verandah at ground floor of an old building of Mahilashram in Hingane area. It is a mix colony of adults and sub adults observed in early March. The second colony is located behind the electricity board fitted on the wall of the first floor of an old building of S. P. College near Swargate area. The colony of about ten to twelve bats observed in late March includes adults as well as sub adults.

9. ***Pipistrellus tenuis*** (Temminck, 1840)

Least pipistrelle or Indian Pygmy bat

Vespertilio tenuis Temminck, 1840. Type-loc. : Sumatra (Tate,1942)

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

Distribution : It ranges from Afghanistan, India, Sri Lanka to Vietnam and Thailand.

Systematic note : All specimens from Indian subcontinent are referred to *P. t. mimus* (Sinha, 1980).

External, Cranial and dental measurements in mm *Pipistrellus tenuis* :

HB	33.5–40	GTL	11.4–12
T	25–32	CCL	9.8–10.6
HF	4–5	ZB	7.3–7.7
FA	27–30.5	BB	6–6.3
WSP	190–202	PC	3–3.7
5MT	25.2–26	CM^3	3.5–4
4MT	26–29.1	CM_3	4–4.5
3MT	27.5–30	M^3–M^3	4.5–4.8
E	8–9	M	8–8.3
TIB	11–12.5	RW	4.5–4.8

HB; Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, TIB : Length of tibia, XMET : Corresponding numbered metatarsus, E : Ear length, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length RW : Width of rostrum.

*n = 3

The pelage colour differed in different groups, and ranged from clove brown to blackish brown. Ventral fur paler with darker hair roots and buffy brown hair tips giving grizzled appearance. Ears, snout and membranes dark brown throughout. The head furry and bulbous, snout and nostrils turned upwards.

Ecological note : It seems to be a common species in the study area. A group of nine females in stage of early pregnancy roost in an open verandah of the first floor of stony old building of Wadia College. The group of bats is thought to be segregated from the mother colony during breeding season, as each female has two embryos in its womb in mid April. Two single adult males are trapped in late April.

The colony of about seven to eight bats in mid January is of mix kind, all adults and sub adults roost under the roof of the first floor of an old stony building of a hostel of Mahilashram, Karve's Institute in Hingane area.

10. ***Pipistrellus ceylonicus*** (Kelaart, 1852)

Kelaart's Pipistrelle

Scotophilus ceylonicus Kelaart, 1852 Type-loc. Trincomalee, Ceylon.

Diagnosis of species : FA > 35, CM^3 > 5.4, cranial profile is raised over frontal region. I^2 bicuspid and its crown area is equal to that of I^3 and pm^2, but I^3 is nearly half the height of I^2. pm^2 intruded and lies in the recess of pm4 and upper canine.

Distribution : It ranges from Pakistan, India and Sri Lanka to Myanmar, China Vietnam and northern Borneo.

Systematic note : According to Lal (1984), all specimens from India should b considered to *P. c. indicus* and those from Sri Lanka as *P. c. ceylonicus*.

External, Cranial and dental measurements in mm *Pipistrellus ceylonicus* :

HB	46–51.4	GTL	13.5–15.5
T	29–38.5	CCL	13–14
HF	6–8.5	ZB	9–10
FA	35–38.2	BB	7.7–8

WSP	227–252	PC	3.8–4.5
5MT	33–34.5	CM^3	5.4–6
4MT	34.4–35.8	CM_3	5.6–6.6
3MT	34.5–36.4	M^3–M^3	6.6–7.8
E	9.5–14	M	10.6–11.6
TIB	13.5–15	RW	5.5–7

HB : Head & body length, T : Tail length. HF : Foot length, , FA : Forearm length, WSP; Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull. CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase. PC : Postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow. M : Mandible length RW : Width of rostrum

*n = 7

The dorsal fur soft, long and silky. It appears clove brown to blackish brow dorsally, but paler with dark hair roots and pale almost gray hair tips. The snout, ears and membranes uniformly dark brown. The triangular ears are broad at the base bt narrowed at the apex into a blunt tip. Tragus inwardly curved with a shallow depression along the length.

Ecological note : It is the most common evening bat in the study area. Usually occurs in the crevices, roofs or behind the wooden shelter in old stony buildings, which are very common in the city area.

The bats collected in January are adult males and females living in the same colony. Segregated pregnant females are observed in mid February as well as in late September. The females carry two embryos in their womb. Isolated males are found in April-May as well as in December.

II. ***Pipisfrellus affinis*** (Dobson, 1871)

Chocolate Pipistrelle

Vesperugo (Pipistrellus) affinis Dobson, 1871. Type-loc. Bhamo, north-eastern Myanmar.

Diagnosis of species : Apparently similar to *P. ceylonicus*, but with larger FA. Braincase comparatively short and rostrum is elongated. Zygomata strongly built with prominent jugal eminence. The dorsal profile of the skull is straight, palate longer than its width. I^2 bicuspid and I^3 is well developed. pm^2 is equal to I^3 in crown area. Upper canine unicuspid and is not in contact with pm^4. pm_2 is situated in tooth row and little smaller than pm_4 in height and crown area.

Distribution : It is found in Sri Lanka, India, Nepal, Tibet and Myanmar.

Systamatic note : Specimens from Sri Lanka are referred to *P. mordax* (Phillips, 1980). According to Corbet and Hill (1992) *affinis* and *mordax* may prove to be conspecific. In this case, all specimens from the Indian subcontinent would be included in *mordax* as this is the prior name.

External, Cranial and dental measurements in mm *Pipistrellus affinis* :

HB	50–54.5	GTL	14.8–15.5
T	30.5–35	CCL	13.5–14
HF	7–8	ZB	9–9.2
FA	38.5–40	BB	7–7.3
WSP	220–243	PC	3.8–4
5MT	34–36.1	CM^3	5.5–5.8
4MT	36–37.3	CM_3	5.5–6
3MT	36.5–38	M^3–M^3	6–6.3
E	12–14	M	10.6–11.6
TIB	14–15.4	RW	5.5–5.9

HB : Head & body length, T : Tail length, HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic 1 breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillary toothrow, CM_3 : Mandibular toothrow, M : Mandible length, RW : Width of rostrum.

*n = 4

Pelage colour varies from light brown to dark brown on dorsal side. Ventrally the fur is paler with light buffy brown to whitish tips, and dark hair roots give grizzled appearance. Ears, snout and membranes are uniformly dark brown. Ears short and broad at the base with rounded tip. Tragus long, broad and inwardly curved.

Ecological note : This is the second commonly occurring species of evening bats found in study area, the first being *P. ceylonicus*. Four distantly placed colonies are located roosting in crevices in roof and other shelters in old buildings. Like other Pipistrelles the bats of this species also exhibit sex wise segregation during breeding seasons. The females in September are in stage of mid pregnancy with two embryos in limb bud stage, and those in April are in early pregnancy. The colony in March has both adult males and females living together under the same shelter.

Genus (7) ***Scotozous*** Dobson, 1875.

12. ***Scotozous dormeri*** Dobson, 1875.

Dormer's bat

Pipistrellus dormeri (Dobson, 1875) Type-loc. Bellary Hills, India.

Diagnosis of the Genus : A monospecific genus limited chiefly to India. On occasion referred to *Pipistrellus* as a subgenus on account of an apparent or supposed resemlance to the African

species, *Pipistrellus rueppellii. Scotozous* differs from *Pipistrellus* as its first upper incisor I^2 is large, massive, unicuspid and is in contact with canine, or nearly so. I^3 is minute like a spicule reaching hardly to the cingulum of I^2 and lying nearly laterally to this tooth almost outward to the toothrow. pm^2 intruded and its crown area is greater than half than that of I^2.

Distribution : It is confined to India and Pakistan.

Systematic note : One subspecies *S. d. caurinus* Thomas, 1915 from Gujarat is reported to be different from *S. d. dormeri* on account of the pelage colour, larger skull and longer toothrow. But according to Agarwal (1973), all specimens should be referred to the nominate race *S. d. dormeri.*

External, Cranial and dental measurements in mm *Scotozous dormeri* :

HB	47.7–52.4	GTL	13.7–14.7
T	27–35	CCL	12.8–13.7
HF	6.4–7.7	ZB	9.5–9.6
FA	36–37	BB	7.5–7.8
WSP	227–233	PC	4–4.2
5MT	33.5–34	CM^3	5.2–5.7
4MT	34–35	CM_3	6–6.2
3MT	35–35.7	M^3–M^3	6.4–7
E	10–12	M	10.4–11.4
TIB	14–14.2	RW	5.6–6

HB : Head & body length, T : Tail length. HF : Foot length, , FA : Forearm length, WSP : Wingspan, XMET : Corresponding numbered metatarsus, E : Ear length, TIB : Length of tibia, GTL : Greatest length of skull, CCL : Condylo-canine length, ZB : Zygomatic breadth, BB : Length of braincase, PC : postorbital constriction, CM^3 : Maxillae toothrow, CM_3 : Mandibular toothrow, M : Mandible length, RW : Width of rostrum.

*n = 3

Dorsal pelage uniformly dark brown with some pale tips, ventral fur is even paler. Ears, snout and wings blackish brown. Snout short, broad and thick. Ears short, broad and with rounded tip. Tragus short with slightly curved pointed tip and a projection on subterminal posterior border. Fleshy pads at the base of the first finger and on sole. Dorsal profile of the skull is almost straight with lambda as the highest part, palate concave and zygomata broad.

Ecological note : Three colonies are observed in study area. About 20 adult males and females are living together under the clay tiled roof of an old building at the first floor verandah of hostel in Mahilashram in Hingane area as observed in early June. Another colony of about 8-10 bats is observed living in the crevices of the stony wall of New English School, Tilak Road area roosting about 10m high from the ground level. The females in late September are with two embryos in

womb in late limb-bud stage. Single isolated mature males are observed in the dry days of mid April near the swimming pool of Loyala High School, Pashan Road.

SOME BATS OF PUNE AS REPORTED DURING 1998–2000

Sr. No.	Common Name	Scientific Name	IUCN Status
01	Indian flying fox	*Pteropus giganteus*	LR-nt/N
02	Short-nosed fruit bat	*Cynopterus sphinx*	LR-lc/N
03	Schneider's leaf-nosed bat	*Hipposideros speoris*	LR-nt/N
04	Egyptian free-tailed bat	*Tadarida aegyptiaca*	LR-nt/N
05	Wrinkle lipped free-tailed bat	*Tadarida plicata*	DD/N
06	Asiatic Lesser Yellow House bat	*Scotophilus kuhlii*	LR-nt/N
07	Javan pipistrelle	*Pipistrellus javanicus*	NE
08	Indian pipistrelle	*Pipistrellus coromandra*	DD/N
09	Indian pigmy bat	*Pipistrellus tenuis*	LR-lc/N
10	Kelaart's pipistrelle	*Pipistrellus ceylonicus*	LR-lc/N
11	Chocolate pipistrelle	*Pipistrellus affinis*	DD/N
12	Dormer's bat	*Scotozous dormeri*	LR-nt/N

NOTE

- DD/N—Data deficient nationally, Non-endemic
- LR-nt/N—Lower risk-near threatened nationally
- LR-lc/N—Lower risk-least concerned nationally
- NE—Not evaluated.

DISCUSSION

During the ecological study and faunastic survey of bats in the urban area of Pune city it is clear that the bat diversity is remarkable in. this area. The frugivorous megachiropterans though represented by only two genera, appear in abundance living successfully in their flourishing colonies. The green zones in and around the city are still rich to sustain them in large number.

The microchiropterans have genus and species diversity in the study area, but their existence seems doubtful due to high rate of urbanization. The old residential premises built in stone and wood are disappearing and replaced by cement concrete buildings. which definitely are not suitable to roost as they are dry. Similarly old ficus trees are removed from their original place and are replanted. But it takes years to provide preferable shelter to a large fauna of small animals including bats.

The bridges over the rivers running through the city are century old and the authorities are busy replacing them by constructing the new one. The caves on the slope of the hills are no more safe for colonization of bats.

During intensive study of two years, and occasional visits of the sites for two more years thereafter it is now clear that the deforestation around the city area, most probably have compelled this small mammals to shift from their natural habitats in wild to the urban area, where they might have sustained since some decades and now their existence is quite in danger. The evening bats particularly of genus Pipistrelus appear to exist in form of a number of species. It may be because of their adaptability to survive in form of small groups and feeding on small soft bodied insects, which in particular are abundant in the marshy places and heaps of garbage in the city area

One species of fruit bat *Rousettus leschenaulti* previously reported from Pune (Rookmaaker and Bergmans, 1981) is not reported in the present study. The site at the foot hills of Parvati is visited and found that the subterranean water tanks, where these bats were reported are now sealed by the wire mesh at its entrance. The site again is much disturbed due to human interference.

Two more species of the insectivorous bats *Myotis horsfieldii* and *Hesperoptenus tickelli* reported from the study area (Brosset, 1962c) are not observed in the present study.

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