INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 22, No. 1, p. 41-49, 2023
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

# The occurence of the least pipistrelle Bat, *Pipistrellus tenuis* (Temminck, 1840) (Chiroptera: Vespertilionidae) in Goalpara District, Assam, India

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Article published on January 07, 2023

**Key words:** Chiroptera, Morphometrics, Least pipistrelle, Vespertilionidae, Assam

**Abstract**

A recent survey identified a colony of *Pipistrellus tenuis* (n = 5) in Kanyakuchi Pahar village (26°00'32.8"N 90°53'29.0"E), a rural remote site situated at Goalpara district of Assam. This species, commonly known as the Least Pipistrelle, was previously reported by Hinton and Lindsay (1926), Sinha (1999), Ghosh (2008), Saikia *et al.* (2011) and Boro *et al.* (2018) from different parts of Assam. The Goalpara district of western Assam is encircled by the foothills of Meghalaya to the South and the Brahmaputra River to the North possesses a variety of flora and fauna due to the dense foliage of the high forest canopy. The climatic condition of the region along with its topography favours roosting of bat population. The distribution of the bat species *P. tenuis* in the surveyed area has not been previously recorded. For the purpose of taxonomic identification, morphometric parameters (external and cranio-dental measurements) were compared to standard literature by Bates and Harrison (1997). Captured bat specimens (n=3) were examined at the ZSI (Zoological Survey of India), NERC-Shillong, Meghalaya. The recorded mean body weight of captured specimens was 2.61g ± 0.160 (S.D) and the mean forearm length (FA) was 27.39mm ± 0.165 (S.D). This manuscript validates sightings of this bat species at the study location, compares its morphometric and cranio-dental traits to standard literature (Bates and Harrison, 1997) for identification, discusses its distribution as well as its ecological importance.

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**Introduction**

Bats are the only mammals that can fly for long periods of time, making them the second-largest order of mammals with over 1,400 different species. The two suborders of bats, Microchiroptera (echolocating bats) and Megachiroptera (Old World bats) make up the taxonomic group Chiroptera. 127 species of bats from India were listed by Talmale and Saikia (2018) and were categorised into 41 genera and 9 families. About 39 different bat species, divided into 16 genera, are found in Assam, including 34 Microchiropteran species and 5 Megachiropteran species (fruit bats) (Ali, 2022). The Himalaya and Indo-Burma Biodiversity Hotspot, which includes Northeast India, contains 74 species of the 127 species of bats that are known to exist in India (Saikia, 2019). There are nine families in the order Chiroptera that are represented in India: Pteropodidae, Megadermatidae, Hipposideridae, Rhinolophidae, Emballonuridae, Rhinopomatidae, Molossidae, Vespertilionidae, and Miniopteridae.

With 62 species, the family Vespertilionidae (commonly known as evening bats) is the most diverse and numerous family of bats found in India (Saikia 2019; Ali, 2022). The tiniest pipistrelle found in the Indian subcontinent belongs to the Vespertilionidae family and is known as the least pipistrelle (Figs. 2 and 3). The genus Pipistrellus has 51 species worldwide, including 12 species being found on the Indian subcontinent (Koopman, 1993). It's prevalent over the majority of Southeast Asia, Southeast China, and South Asia (Simmons, 2005). This species is found in Pakistan, Bangladesh, Afghanistan, India, Nepal, and Sri Lanka (Molur *et al.*, 2002; Das, 2003; Vanitharanie, 2006; Korad, 2007). This bat occasionally shares a roost with Indian Pipistrelles, but they don't interact with one another. They frequently form colonies of 1 to 25 individuals and are present in both woodlands and populated places and often prefer living in close proximity to human population. They build their nests in trees, leaf canopies, the ceilings or walls of buildings, and abandoned homes (Francis *et al.*, 2010). Seasonal variations in the species' diet are evident. It consumes a variety of insects and beetles during the monsoon and summer, and termites, cockroaches, wingless ants, and moths during the winter (Hamidullah *et al.*, 2019).

*P. tenuis* are categorised as insectivorous bats in terms of preferred diet and feeding habits. A typical pipistrelle bat can often consume one-third of its body weight in insects per night, significantly lowering the number of insects. They devour a lot of insects at night, which costs the US $3.7 billion in pest control every year. It has been shown, according to the Smithsonian Tropical Research Institute and the University of Michigan that places with insectivorous bat populations greatly reduce the amount of insects and plant damage (Kalka *et al.*, 2008). Recent study on the reproductive activity of the *P. tenuis* species indicate that there are two peaks between the months of July and August, and one between February and March. The greatest abundance of prey occurred during each of these times. In China and India, pregnant and nursing females have been spotted at all times of the year, proving that reproduction is possible all year long (Wilson and Mittermeier, 2019). Due to their nocturnal lifestyle and ecological diversity, bats are a fascinating group of animals as well as a difficult species to research.

A number of researchers from the Zoological Survey of India and other institutions have made significant contributions to the study of Indian bat taxonomy and geographic distribution in the post-independence era. Some of the most important revisions of the geographical range and taxonomy of Indian bats include Brosset (1962abc, 1963); Hill and Corbett (1992); Bhat and Kock (1994); Sinha (1970, 1973, 1999); Bates & Harrison (1997); Pradhan (2008); Das (2003); Csorba *et al.* (2003); Ramarkishna *et al.* (2003); Ghosh (2005, 2008); Srinivasulu (2001, 2006); Alfred, (2006). A monograph by Bates & Harrison (1997) listed 28 species of bats from Assam. Recently, there are only a few significant works on the study of different species of bats in the state of Assam by Sinha (1999), Ghosh (2008) and Boro *et al.* (2013; 2015; 2018), Ali (2010; 2022), Rahman and Choudhury (2017), Saikia *et al.* (2011; 2018; 2019; 2021).

Furthermore, little is known about the distribution and taxonomic status of bats, notably microchiroptera, in the Assam region. This article aims to investigate the distribution and current status of the Pipistrellus genus in Assam's Goalpara district. This paper on *Pipistrellus tenuis* occurence is the first at the study site (Fig. 1) and is based on measurements of morphometric features in comparison to current standard literature (Bates and Harrison, 1997).

**Materials & methods**

*Study area*

The present study was carried out at the village of Kanyakuchi Pahar in the Goalpara district of Assam, India (26°00'32.8"N 90°53'29.0"E). It is 52 kilometres from Goalpara, the district headquarters, and 12 kilometres from Dudhnai, the subdistrict headquarters. Only 86 families reside in the 936.11 hectares of the studied area (Fig. 1; Census 2011). Most of the study site is covered in Banana, Saal, Bamboo, and Teak trees.

The habitat of the study area were found ecologically suitable for the expansion of the bat population because of it's high dense forest and has few caves, and streams on the sides of hills. The area's climate is ideal for a humid subtropical region with dry winters (Classification: Cwa). The district receives yearly temperatures of 27.55 °C and precipitation totals of 82.07mm. The yearly rainfall ranges from 3805mm to 149.8 inches (Climate-data.org, 2022). Google Maps provided the locational map (Fig. 1) of the survey region.

*Survey method*

There has been plenty of evidences which reported that there were bats at the investigation site (26°00'32.8"N 90°53'29.0"E). The survey was conducted with the help of the villagers from 18:30 to 20:30 in the evening. In a small area of the ceiling of an abandoned house in the village, five bats were discovered to be nesting. With the aid of a modified butterfly net (59-inch extendable handle, a 14-inch net ring, and 0.8mm net holes), the bats were driven out of the narrow space. Only a small number (n=3) of bats were collected, immediately released, and while under anaesthesia in 70% ethanol for subsequent investigation, stored as taxonomic voucher specimens.

*Morphometric measurements and identification*

Multiple measurements of the characteristics required for precise identification had to be made during capture (n=3). Records of external body measures were made. Following that, morphometric characteristics were measured with a millimetre calliper (Zhart-150mm/6") with accuracy as close to 1mm as possible.

Every single specimen was measured, and measurements were recorded for comparison with available literature (Table 2). Cranio-dental measurements were recorded by dissecting and preparing the skulls of the same bats (n=2) for further taxonomic identification and confirmation of the species.

The acronyms of the different body and skull measurements (Table1; Table 2) are FA: Forearm length; TIB: length of tibia; T: Tail length; HB: Head and body length; Tr: Tragus length; E: Ear; 3mt: 3rd metacarpal, 1ph3mt: length of 1st phalanx to third metacarpal; 2ph3mt: length of 2nd phalanx to 3rd metacarpal; 3ph3mt: length of 3rd phalanx to third metacarpal; 4mt: length of the 4th metacarpal; 1ph4mt: length of 1st phalanx to fourth metacarpal; 2ph4mt: length of 2nd phalanx to 4th metacarpal; 5mt: 5th metacarpal; 1ph5mt: length of 1st phalanx to fifth metacarpal; 2ph5mt: length of 2nd phalanx to 5th metacarpal; HF: hind leg length; WSP: Total wingspan length. GTLi: Greatest length of skull including incisor; CCL: Condylo-canine length; GTL: Greatest length of skull; BB: Breadth of braincase; CBL: Condylo-basal length; ZW: Zygomatic width; MAB: Under the brain; M3 -M3: width across third molars; $CM^3$: maxillary tooth; $CM_3$: row of mandibular teeth; ML: Mandible length.

*Body mass (g), identification of the reproductive stage and sex*

A digital weighing scale (Range 0.1g-10kg) was used to measure the weight (g) of each specimen. Ossification of the phalanges acted as a marker for adult or juvenile reproductive stage, whereas the presence of external genitalia served as a sex distinguishing trait (Kunz, 1988). For further detailed identification and confirmation, the captured bat specimens were analyzed at the laboratory down to the species level at Zoological Survey of India (ZSI), NERC-Shillong, Meghalaya.

*Statistical Calculation*

Standard deviations were calculated to measure the deviation of raw data. A low standard deviation indicates that data points are generally close to the mean or the average value.

A high standard deviation indicates greater variability in data points, or higher dispersion from the mean. For n number of specimens (Table 1), the mean or the average value for the range of measurements is calculated first and later standard deviation is calculated using online software tool (calculator.net).

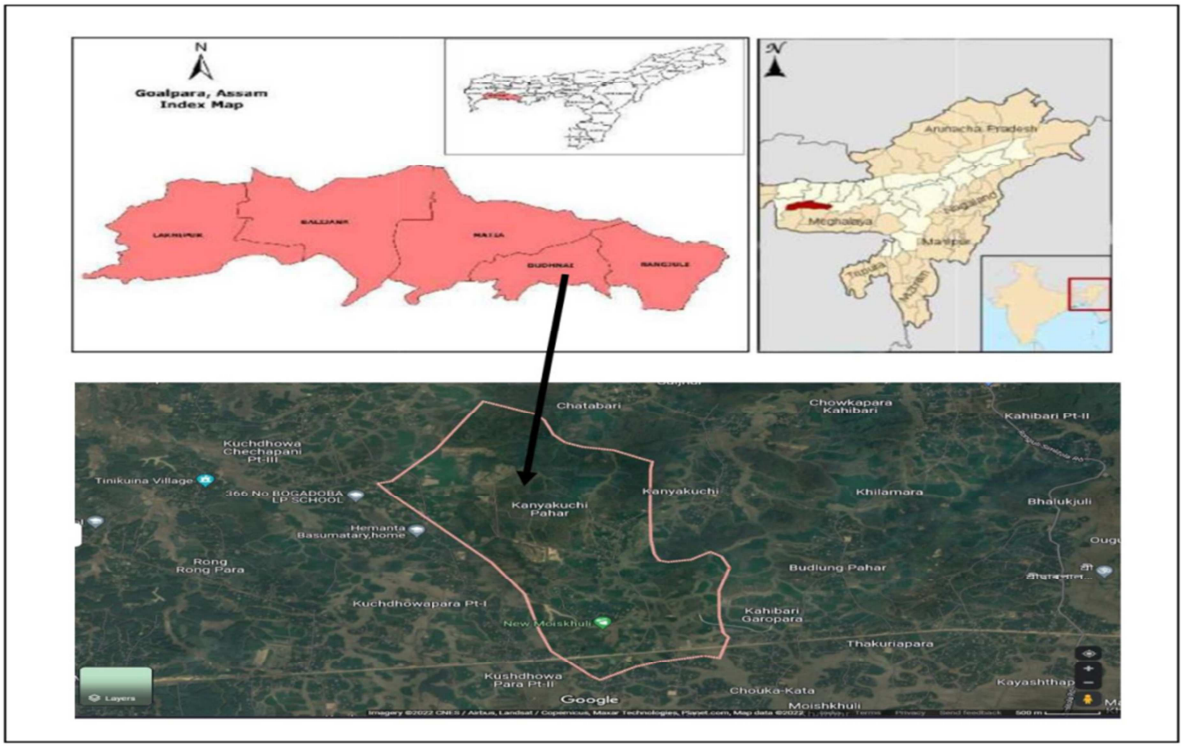


**Fig. 1.** Map indicating the location of the *P. tenuis* bat roost found in the Goalpara district of Assam (26°00'32.8"N 90°53'29.0"E).

**Results and discussion**

Morphologically, the upper portion of *P. tenuis* coat was medium brown in appearance. This specimen had a paler ventral surface. The ears were short and oval-shaped, with weekly folds along the back border. The end of the tragus is short and blunt. Similar traits have already been identified (Javid *et al.,* 2011; Saha *et al.*, 2015). The specimens(n=3) collected for this investigation had an average body mass of 2.61mm ± 0.160 g, head and body length of 42.53mm ± 2.336mm, and forearm length of 27.39mm ± 0.165mm. The average lengths of the 3rd, 4th, and 5th metacarpals were (25.85mm ± 0.623mm, 25.45 ± 0.82mm, and 24.66mm ± 1.312mm, respectively). The tail length was measured at 18.94mm 1.625mm, while the average wingspan was 147.133 33.987mm (Table 1).

Based solely on external characteristics, *Pipistrellus tenuis* is difficult to differentiate from its congeners (Bates and Harrison, 1997). This species' detailed skull measurements (n=2) revealed that the mean

GTL was 9.75mm with a standard deviation of 0.176, the braincase width was 5.68mm with a standard deviation of 0.042, and the jugular width was 6.39mm with a standard deviation of 0.332. Average CCL, CBL, and mandibular length (ML) were, respectively, 9.37mm 0.14 (SD), 9.38mm 0.254, and 7.51mm 0.011mm. It was noted that the dental pattern was 2123/3123=34.

The dissected skull's lateral aspect is shown in (Fig. 4).It varies from *Pipistrellus coromandra* in the following ways: its body is delicately formed; the CBL and $M^3$-$M^3$ are smaller in size (Korad *et al.,* 2004). According to morphometric data (Table 1) from the specimen used in this investigation and measurements of additional cranio-dental features, this species is primarily identified as *P. tenuis* (Fig. 2).

The systematic classification of the identified species is :

Phylum-Chordata
Class-Mammalia
Order-Chiroptera
Family-Vespertilionidae
Genus- *Pipistrellus*
Species-*Pipistrellus tenuis* (Temminck, 1840)

In comparison to members of the genus Myotis, members of the genus Pipistrellus have smaller muzzles and fewer teeth. They are plain-faced bats with typically tiny eyes, a simple, well-developed tragus, and a tail that is not completely free of uropatagium. The majority of them are brown, grey, or dark brown in colour (Elangovan, 2018).

*P. tenuis*, a member of the family Vespertilionidae, is the smallest bat that has been discovered in India. The average forearm length (FA) of this pipistrelle in India is 27.7mm (Bates and Harrison, 1997; Saikia *et al.*, 2011). They have been seen breeding near to human habitations in bamboo openings of huts and shelters, building roofs and crevices, and tree cavities where they reside in tiny groups (Molur *et al.*, 2002; Acharya, 2010).

Occasionally, this bat and the Indian pipistrelle cohabitate the same roost, but they don't interact. In its habitat, *P. tenuis* bats play a critical role in controlling insect populations.

This species typically hunts in close proximity to the ground and favours to consume tiny insects from many orders, such as the Coleoptera, Hymenoptera, Diptera, and Lepidoptera (Saikia *et al.,* 2021). It uses echolocation to find prey, and in a few rare instances, it has been seen catching prey with its wings before catching it with its jaws.

In Table 2, measurements from the current study were compared with the earlier records of Bates and Harrison (1997) and Saikia *et al.* (2011).

The mean values and its ranges of the collected specimens for morphometric parameters such as head and body length, ear length, forearm length, length of the third metacarpal, length of the fourth metacarpal, length of the fifth metacarpal, and tail length are in accordance with the findings of Bates and Harrison (1997). The similar outcome has been demonstrated for cranio-dental parameters such as mandibular length and braincase breadth. However, in certain instances, the measurements with Saikia *et al.* (2011) are fairly similar.

A low standard deviation of FA, TIB, Tr, GTL, $CM_3$, $CM^3$, and BB of the morphometric parameters (Table 1; Table 2) indicates that data points are generally close to the mean or the average value. This species does not appear to be under any significant long-term threats given the local abundance it possesses throughout its geographic range (Francis *et al.,* 2010).

This widely distributed and somewhat adaptable species of pipistrelle is not at high risk, although in some areas, it is threatened by localised hunting for both food and medicine (Molur *et al.,* 2002).

The behavioural, roosting, and feeding habits of *P. tenuis* are highly diverse.

**Table 1.** External, cranial and dental measurement (mm) of *Pipistrellus tenuis*.

| External body measurements (n=3) | (Mean / ± S.D) | Cranial & Dental Measurements (n=2) | (Mean / ± S.D) |
|---|---|---|---|
| HB | 42.53mm ± 2.336 | GTL | 9.75mm ± 0.176 |
| T | 18.94mm ± 1.625 | GTLi | 9.67mm ± 0.106 |
| TIB | 9.4mm ± 0.173 | CBL | 9.38mm ± 0.254 |
| FA | 27.39mm ± 0.165 | CCL | 9.37mm ± 0.014 |
| E | 6.72mm ± 0.530 | BB/BW | 5.68mm ± 0.042 |
| Tr | 3.56.mm ± 0.015 | MAB | 5.86mm ± 0.098 |
| Thumb | 3.61mm ± 0.127 | ZB | 6.39mm ± 0.332 |
| 3mt | 25.85mm ± 0.623 | $M^3$ -$M^3$ | 4.66mm ± 0.098 |
| 1ph3mt | 9.76mm ± 0.661 | $CM^3$ | 3.67mm ± 0.035 |
| 2ph3mt | 7.72mm ± 0.079 | $CM_3$ | 4.02mm ± 0.042 |
| 3ph3mt | 6.05mm ± 0.205 | ML | 7.51mm ± 0.001 |
| 4mt | 25.35mm ± 0.607 | | |
| 1ph4mt | 9.42mm ± 0.747 | | |
| 2ph4mt | 7.03mm ± 0.721 | | |
| 5mt | 23.66mm ± 1.312 | | |
| 1ph5mt | 5.73mm ± 1.001 | | |
| 2ph5mt | 4.11mm ± 1.028 | | |
| HF | 4.17mm ± 0.049 | | |
| Weight | 2.61 g ± 0.160 | | |
| WSP | 147.133± 33.987 | | |

*Mean and S.D (Standard deviation) is calculated for a range of "n" number of specimens.

**Table 2.** Body mass (g), external, and cranio-dental measures (mm) of several *P. tenuis* specimens were compared to previously published literature.

| External body Parameters | Bates & Harrison, 1997 | Saikia *et al.*, 2011 | Present Study ( n=3) |
|---|---|---|---|
| Body mass | --- | ----- | 2.61 ± 0.160 |
| Head and Body length | 39.1(33.0-45.0) | 37-37.5 | 42.53 ± 2.336 |
| Ear Length | 9.7(5.0-11.0) | 8.0-8.2 | 6.72 ± 0.530 |
| Tragus Length | --- | 3.4-4.0 | 3.56 ± 0.015 |
| Forearm | 27.7(25.0-30.2) | 27.5-28.5 | 27.39 ± 0.165 |
| 3rd metacarpal | 26.7(23.9-29.7) | ---- | 25.85± 0.623 |
| 4th metacarpal | 26.4(23.7-29.2) | ---- | 25.35± 0.607 |
| 5th metacarpal | 25.9(23.5-28.5) | ---- | 23.66± 1.312 |
| Tibia | ---- | 11.9-12.0 | 9.4 ± 0.173 |
| Tail | 28.9(20.0-35.0) | 29.0 | 20.35 ± 1.625 |
| Cranio-dental Parameters | | | Cranio-dental (n=2) |
| Breadth of braincase | 6.0(5.6-6.3) | 5.8-6.2 | 5.68 ± 0.042 |
| Zygomatic breadth | 7.4(7.3-7.6) | 7.4 | 6.39 ± 0.332 |
| Condylo-canine length | 10.2(9.3-10.7) | 10.3-10.5 | 9.37 ± 0.014 |
| Condylo-basal length | ------ | 10.8-11.0 | 9.38± 0.254 |
| Greatest length of skull | 11.5(10.7-12.1) | 11.2-11.4 | 9.75± 0.176 |
| Maxillary toothrow | ------ | 3.8-3.9 | 3.67± 0.035 |
| Mandibular toothrow | ------ | 4.0-4.3 | 4.02± 0.042 |
| Mandible length | 7.9(7.2-8.3) | 8.0-8.1 | 7.51± 0.001 |

*Mean and S.D (Standard deviation) is calculated for a range of "n" number of specimens. Bates & Harrison, 1997= (n=2), Saikia *et al.*, 2011= (range) and Present study=(n=3; n=2)


**Fig. 2.** *P. tenuis* (Female).


**Fig. 3.** Distinct ear with week folds.


**Fig. 4.** Lateral view of Skull *(P. tenuis)*.

## Conclusion

*P. tenuis* has probably expanded in its niche range throughout the Goalpara district, as evidenced by the colony of the species that can be found in the study area. The existence of this species has allowed the co-existence of other chiropterans that usually breed in Assam and other ecosystems of the region. If further in-depth investigation is conducted in the Assam, it may reveal more details about bat diversity. Ecologically, if this insect-eating bat (*P. tenuis*) vanishes due to varied anthropogenic pressure, the insect population will rise, resulting in crop failures and other economic harm across its habitat (ADW 2022; BCI 2022). Gathering information about *Pipistrellus tenuis* and analyzing its morphometric parameters and its distribution will provide a baseline data for future taxonomic studies.

## Acknowledgement

The Director of the ZSI in Kolkata has our deepest gratitude for allowing us to test the specimen at their regional facility at NERC in Shillong, Meghalaya. We also acknowledge Dr. Uttam Saikia (Scientist D) for his insightful counsel and persistent recommendations throughout the taxonomic identification procedure conducted at NERC, ZSI, Shillong. Greetings to Retd. Professor Mr. Trailokya Chandra Talukdar of Dudhnoi College for his unwavering support and for sharing his extensive knowledge of the Goalpara district's geographic scope and habitat type. Last but not least, I'd want to thank the villages for their assistance in carrying out the research.

## Conflict of interest

Both the authors declare that we have no conlict of interest.

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