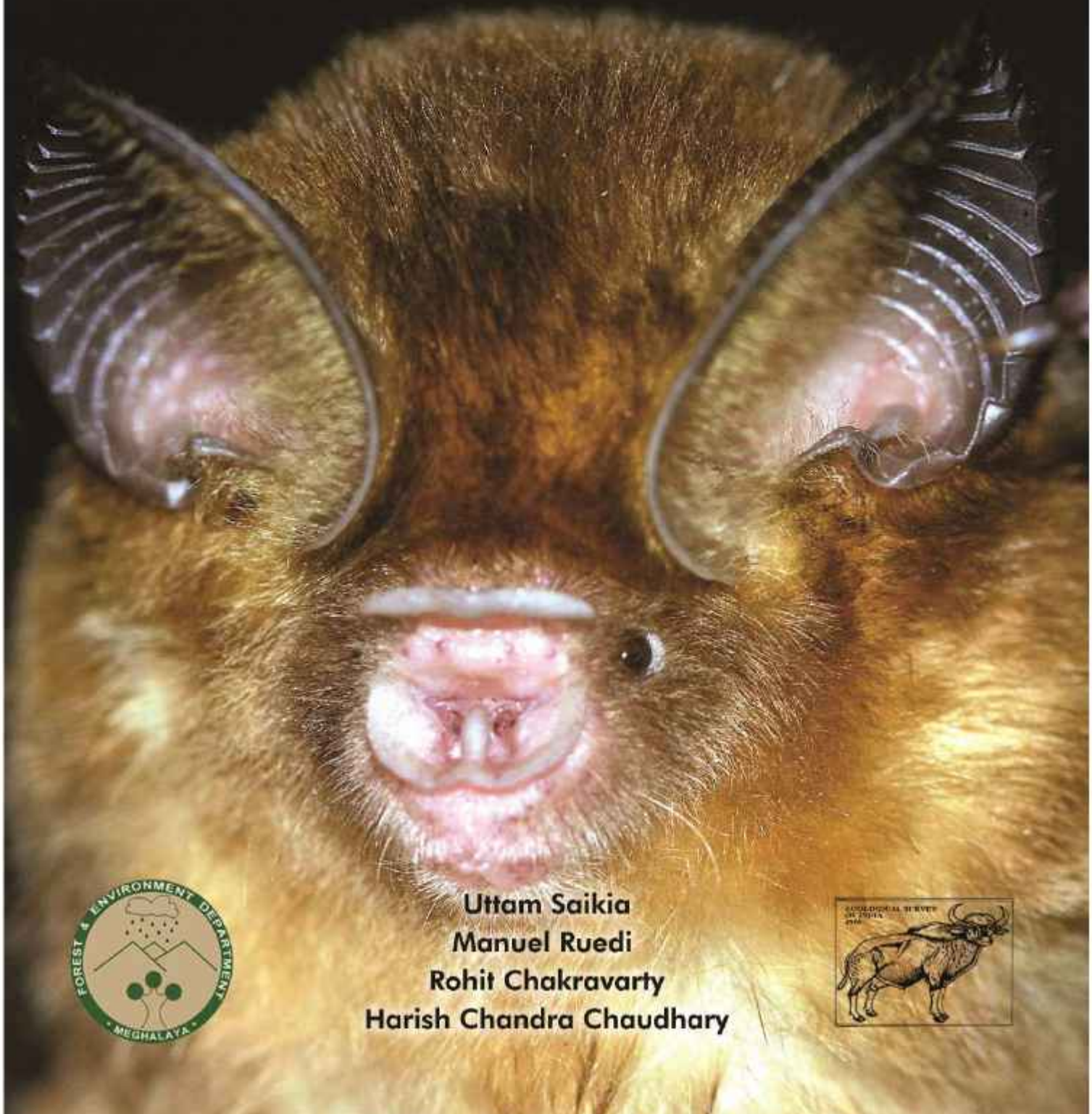
# BATS
## OF MEGHALAYA



Uttam Saikia
Manuel Ruedi
Rohit Chakravarty
Harish Chandra Chaudhary

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**Shri James P. K. Sangma**
Hon'ble Minister In-charge Forests and
Environment Department
Government of Meghalaya



## MESSAGE

Despite a smaller geographical area, Meghalaya is astonishingly rich in natural beauty and biological wealth. Meghalaya takes pride in the fact that it harbours the highest number of bat species in any Indian state. With recorded presence of at least sixty five species, the state harbours about half of the bat diversity in India.

Besides being a unique mammal, bats render several ecological and economic services to the humanity. They are important components of ecosystems for pollinating flowers and dispersing seeds. Many tropical plants depend entirely on bats for these services. Since time immemorial, bat guano has been mined from caves for use as fertiliser. Bats consume insect pests, reducing the need for pesticides and other insect management measures.

Unfortunately, bats do not occupy a place in common man's heart mainly because we know very little about them and hardly appreciates their positive values. Globally, bats are some of the most threatened animals. Misunderstanding and negative perceptions about bats in our societies are counter-productive to the efforts for conservation of these threatened creatures. It is therefore of the paramount importance that these animals should be brought out to the general public in true scientific light.

It gives me immense pleasure to learn that Wildlife Wing in the Forests and Environment Department, Government of Meghalaya and Zoological Survey of India have joined hands with leading experts on bats to document and place before the world the rich bat diversity of our State. I am sure the book will help in clearing common myths and misconceptions about bats that exist in the minds of a layman. I sincerely hope that this book will be a very significant scientific documentation of the rich faunal heritage of the State and will be useful for both the researchers and the common man.

I congratulate and compliment the authors for their efforts in compiling valuable information about the bats of Meghalaya.

(James P. K. Sangma)

**Shri D.P. Wahlang, IAS**
Addl. Chief Secretary to the Government of Meghalaya
Forests and Environment Department



## FOREWORD

Bats are a fascinating group of mammals that constitutes over twenty per cent of the mammalian species on Earth. Among mammals, they are unique by their capability of true flight. Because of this flight capability, bats could exploit resources that are normally out of reach for most other mammals. Besides being speciose, bats show great diversity in morphology, habit and various life history traits.

Inspite of being so abundant and also having significant ecological and economic importance, bats are some of the most misunderstood creatures on Earth. As, bats are nocturnal and flying, they are not easily observed or studied by common man or researcher, leading to a poor understanding of their life history.

I am very happy to learn that the Wildlife Wing in the Forests and Environment Department, Government of Meghalaya in collaboration with Zoological Survey of India has taken initiative to bring out this detailed publication on the Bats of Meghalaya. The book has combined the knowledge and experience of well-known bat researchers of India and abroad and will be useful for researcher community, park managers and common people. I am sure that the book will make the residents of Meghalaya aware of the rich diversity of the bats in the State and will motivate them to join hands with the Forests and Environment Department for conservation of the bats and their habitats.

I congratulate the Chief Wildlife Warden, Meghalaya and his entire team for taking initiative to publish this book.

(D.P Wahlang, IAS)

**Shri B.K. Lyngwa, IFS**
Principal Chief Conservator of Forests & HoFF
Meghalaya



# FOREWORD

The second largest order of mammals after rodents, with over one thousand four hundred recorded species, bats comprise about twenty percent of all classified mammal species worldwide. With their forelimbs adapted as wings, they are the only mammals capable of true and sustained flight. Flying with their very long spread-out digits covered with a thin membrane, bats are more manoeuvrable than birds.

Unfortunately, because of the lack of scientific understanding among common people, bats are often associated with darkness, malevolence, witchcraft, vampires, and death. Besides, perpetual misconceptions about bats that exist in several societies, undesirable portrayal in folklore and popular media contribute to this negative image of bats. Recent reports linking bats to the prevailing Covid-19 pandemic without definitive evidences have further strengthened these misconceptions. It is thereof of utmost importance that these hapless creatures are portrayed under true scientific light.

Since bats are one of the less studied mammalian groups, comprehensive diversity and distribution information is not available for most of the Indian states including Meghalaya which hampers formulating effective measures for conservation of the bats and their habitats.

I congratulate and express my sincere appreciation to the authors for their initiatives and efforts in publication of this highly useful and informative book. I am sure the book will help the Forest and Environment Department to plan and execute scientific measures for long term conservation of the rich bat population and their habitats in Meghalaya.

(B.K. Lyngwa, IFS)

# FOREWORD

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In the world of mammals, bats are a unique group having the ability to fly in the true sense. Thanks to this capacity, they are able to exploit resources that are usually inaccessible to other mammals and expand their range practically throughout the globe. They are also one of the most diverse group of mammals both taxonomically and in life history traits. New evidence is also emerging on the enormous economic and ecological benefits of bats. However, our understanding on their diversity, distribution, life history traits and ecological interactions lags far behind many of the more prominent mammalian groups. For a common human being too, bats are mysterious creatures without any obvious benefits; rather they are supposed to be responsible for many of our woes! Therefore, it is imperative that much more research is needed on these animals. It is also the responsibility of the bat researcher community to share their knowledge and enthusiasm so that any person understands their values and develops compassion for them. This will also contribute towards their conservation as bats are some of the most threatened animals on Earth.

Being a part of Indo-Burma Biodiversity Hotspot, the state of Meghalaya is very rich in biological wealth and bats are no exceptions. Fifty per cent of total bat species diversity in India are represented in the state. The present book provides descriptions of all the species recorded from the state supplemented by coloured photographs of each species. It is a valuable scientific contribution and a step forward in understanding the exceptional faunal heritage of the region. The authors of the book are well known bat researchers and they have put together their understanding on the bat fauna of the state. I believe that this book will effectively serve as a ready reference for bat researchers and wildlife officials and helps acquainting everybody with these little-known creatures and dispel some of the myths and misconceptions associated with them. It is my fervent wish that this book will inspire nature lovers and young researchers in the northeast India to take up research that will help unravel many unknown facets of the life of these animals.

Gabor Csorba PhD
Senior researcher

# PREFACE

It all started with a casual telephonic conversation between two of us, the first and the last authors. We had a discussion about the need and possibility to come out with a publication showcasing the extraordinary diversity of bat fauna of Meghalaya. In the next round of discussion, a formal blueprint for the book was prepared and we decided to rope in two of our fellow friends and bat researchers who have extensive experience in working with the bat fauna of India. The idea of producing this book was to put in place an up to date documentation of the rich bat fauna of the state and also to create some awareness about these misunderstood creatures among the masses. While the book was planned as a scientific document useful for the researcher community, it was equally intended to serve as a ready reference to the forest officials in biodiversity documentation and also for common people to appreciate the beauty of these creatures.

Bats are the largest group of mammals in Meghalaya with over 65 documented species, an envious number for any territory. This amazing opulence of diversity in such a small geographic area is unparalled in any other regions of the country, a fact that the state can rejoice for. However, this pride is marred by the fact that bats in Meghalaya are facing serious threat, mostly because of human actions. Although bats are facing existential threat throughout the globe, they are particlually threatened in the state due to continuous human encroachment in to their habitat, degradation of remaining habitat, killing and persecution etc. The rampant negative press about the suspected role of bats in many infectious human diseases does not help the matter either, people are more than eager to kill or evict them for their vicinity. In the face of everincreasing threat to their habitat besides unabated negative publicity, the future of these animals is all but bleak.

We feel that throwing some scientific light on these hapless and misunderstood animals could help in creating a positive perception about them among the common people. This in turn can go a long way in their conservation efforts. With this conviction, the researcher community and the Forest Department of Meghalaya has come together to produce this document. This book encompasses all the 65 species of bats reported from Meghalaya thus far. The pictures together with descriptions will help one to identify many of the bat species occurring in the state. Distribution information for all the species is also included. We sincerely hope that his book will be useful for researchers, park managers and common people and also sets an example on how the researcher community and the conservation managers can fruitfully come together to serve a common interest.

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The authors are grateful to Mr. James K. Sangma, Minister in-charge, Forests and Environment Department, Government of Meghalaya for his support and guidance in bringing out this book.

We appreciate and acknowledge the wholehearted administrative and institutional support received from Mr. D.P. Wahlang, IAS, Addl. Chief Secretary to the Government of Meghalaya; Mr. B.K. Lyngwa, IFS, Principal Chief Conservator of Forests and Head of Forest Force, Government of Meghalaya and Dr. Dhriti Banerjee, Director, Zoological Survey of India (ZSI), Kolkata in publication of this book.

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**Uttam Saikia, Manuel Ruedi, Rohit Chakravarty and Harish Chandra Chaudhary**

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# 1. An introduction to bats

## 1.1. What are bats?

Bats are a group of mammals which aredistinguished by the capacity of powered flight. Bats possess all the characters that define a mammal *e.g.* body covered by hairs, ability to maintain a constant body temperature and the females possessing mammary glands for nourishing the young one etc. However, the unique capability of powered flight sets bats apart from other mammals. Although a few other mammals such as the flying squirrels widely distributed in Asia, flying lemurs of Sunda islands and the Philippines, flying phalangers and feather-tailed possums of Australia etc. have also developed some flight capability, they are essentially gliders. Gliding is a form of passive flight over a relatively short distance and does not involve the use of body energy. A fold of skin spread between the fore and hind limbs in these gliding animals acts as an aerofoil helping them to generate significant lift and allowing directed and slowly falling horizontal movement. In contrast, bat flight is powered by wing membranes called patagium that develop between the limbs. Akin to birds, synchronous beating of the wing membranes in bats allows highly manoeuvrable and sustained flight. Development of wing in bats is also accompanied by extensive modification in the musculoskeletal system. These complex series of structural changes in the axial skeleton and pectoral girdleaid bats in their winged mode of life.

In scientific parlance, bats belong to a group called Chiroptera which is one of the twenty seven extant mammalian orders and constitutes a remarkable group from evolutionary and zoogeographic points of view. The term Chiroptera was coined by German naturalist Johan Friedrich Blumenbach (1752-1840), the Latin word meaning "hand winged" and indicating the uniqueness of bats. Physically, the presence of true wings at once distinguishes them from other mammals. Chiroptera represent one of the most species rich and ubiquitous orders of mammals with over 1400 surviving species and 200 genera.They constitute over twenty percent of all mammalian species in the globe and are only second to rodents in species richness. In addition to this significant species diversity, bats also exhibit great variations in size, the smallest one being Kitty's hog-nosed bat *Craseonycteris thonglongyai*, a pint-sized bat found in Thailand and Myanmar which weighs less than two grams,while the Indian flying fox *Pteropus medius*, a common species from the Indian Subcontinent,weighs up to 1.6 kg and a wing span of over 1.5 m.

Bats are nocturnal and usually spend the daylight hours roosting in caves, rock crevices, and foliage or in various manmade structures. Many of the bats are surprisingly adaptable creatures and can be seen flourishing in the human dominated landscape.Some bats are solitary while others are colonial and may comprise millions of individuals. Bats are known to exert considerable influence on ecosystem health and human economics. Insectivorous bats are largely responsible

for controlling bursting population of insects; many of which are agricultural pests or vector of human diseases. Bats spend all night participating in the ecology of an area with the same vigour as birds do during the day.Fruit bats are responsible for pollination and seed dispersal of many economically and ecologically significant plants. Bats are also a source of protein for indigenous people in many parts of the old world, for example, different species of bats serve as a major seasonal source of meat for Saur tribe in Madhya Pradesh or poor Chepang people in Nepal. On the negative side, bats are known to harbour significant number of viruses some of which are highly pathogenic like Hendra, Marburg, Nipah, Rabies etc. Fruit eating bats do some damage to economically important fruit cops. However, the immense ecological services rendered by these creatures far outweigh their negative roles. Bats are also being increasingly employed as subject of medical research including effects of drugs on blood vessels and also nerve and muscle generation. An anticoagulant extracted from saliva of vampire bats has shown promising results for treatment of stroke victims.

While bat species are numerous and tremendously varied in their ecological roles, they tend to be understudied by scientists. Because of their nocturnal and flying lifestyle, bats are difficult to study.Besides, bats are highly mobile creatures covering long distances between roosts and foraging areas and also known to exhibit seasonal geographical and elevational migration. Consequently,scientific knowledge on the diversity, distribution and life history traits of these obscure animals lags far behind that of other more conspicuous mammals. In fact, despite their ubiquitous nature, bats are one of the most misunderstood creatures on Earth. Negative portrayal of bats in folklores or popular media as creepy, blood-sucking creatures does not help the matters either. To add to the woes, bats are a globally threatened animal group, with many unique species facing the imminent threat of extinction. Therefore, it is of utmost importance that the scientific light is shone on the obscure world of bats so that the general audience appreciates the value of these highly beneficial creatures. The public goodwill thus generated can go a long way in helping conservation efforts of these threatened creatures.

### 1.2. Origin and evolution

Fossils of plants and animals preserved between layers of earth provide us a unique window to look in to the distant history of life on Earth.Unfortunately, unlike many other mammals,fossil records of bats are scattered and rather hard to find. Therefore, the issue of origin and evolution of bats has no definitive answer yet and bats are considered one of the greatest puzzles of evolution. Based on past geographic reconstructions, scientists tend to concur that bats originated inthe ancient land mass Laurasia, which represents present day North America, Europe and Asia. In fact, an Asian origin of the suborder Yinpterochiroptera which is confined to the Old World finds strong support in such ancestral reconstructions.

For the pan globally distributed suborder Yangochiroptera, zoogeography is less clear although an Asian or European origin is supported by some studies. During the 1960s, palaeontologists recovered a few excellently preserved fossils of a bat dubbed *Icaronycteris index* from the early Eocene deposits of green river formation in The United States. These fossils were dated back to about 52 million years ago and considered some of the earliest known bats till date. From the same formations later on, scientists described another bat species *Onychonycteris finneyi* exhibiting some more primitive characters.They weresimilar to modern microchiroptera in many aspects and forelimb anatomy indicated acapabilityof sustained flapping flight. Since these fossils represented fully-evolved bats, the vexed question is where and how did the bats come from?To the dismay of scientists and for reasons not fully clear, the intermediate stages in evolution of flight in bats were not documented in fossil records. Therefore, in the absence of any direct evidence, scientists speculated that the ancestors of bats could have existed during Paleocene or mid/late Cretaceous (some 70million years ago).These arboreal ancestors probably passed through a gliding phase aided by extended folds of skin akin to flying lemurs followed by development of patagium and flapping flight, but this evolutionary journey is far from being elucidated definitively. Why bats took to the wings is another puzzle scientists are yet to resolve. While some hypothesized that bats were driven to nocturnal guild by avian predators, others suggested that efficient movement in environment allowed for exploiting an unoccupied niche or taking advantage of abundant nocturnal food sources.

### 1.3. Phylogenetic relationship with other mammals

Traditionally, Chiroptera was considered as a monophyletic group, *i.e.* all the bats were supposedly derived from single common ancestor sharing specializations for flight. However, based on the fact that there are many significant morphological, behavioural and genetic differences between the pteropodids and microbats, some researchers suggested that Chiroptera might be diphyletic meaning originating from two distinct ancestors. They pointed out that the primary similarities between these groups *i.e.* flight specializations could be the result of convergent evolution *i.e.* a situation when two different organisms independently acquire similar traits. The most compelling evidences of diphyletic origin of the order Chiroptera sprung from the studies of neural traits by John D. Pettigrew, an Australian neuroscientist and his colleagues. These workers suggested that Pteropodids share a more close relationship to Primates and Dermoptera than to microbats. This novel hypothesis generated immense interest among mammalogists and ended up in a number of morphological and molecular studies. However, almost all of these subsequent studies found support for chiropteran monophyly.

Since fossil records of bats are incomplete, phylogenetic studies involving both morphological and molecular data offer the only means of determining the place of bats in the mammal family tree. The traditional morphological view is

that bats belong to the group Archonta together with Primates, Dermopterans and Scandentia. But recent molecular studies contradict this view, instead supporting the idea that bats belong to the superorderLaurasiatheria, which also includes Eulipotyphla, Carnivora, Cetartiodactyla, Perissodactyla, and Pholidota. In one of those exhaustive analyses, an early split of Eulipotyphla and rest of the Laurasiatherian orders was demonstrated and Chiroptera was fully supported as sister group to Ferungulata *i.e.* encompassing the orders Carnivora, Cetartiodactyla, Perissodactyla, and Pholidota.

**1.4. Classification**

Ever since the time of Edward Dobson (1848-1895), a pioneering bat taxonomist, bats were classically divided into two sub groups, megabats and microbats representing the suborders Megachiroptera and Microchiroptera, respectively. This distinction is presumably based on body size and also other characteristics including complex laryngeal echolocation in Microchiroptera and enhanced visual acuity in Megachiroptera. But this nomenclatural distinction of Megachiroptera as large and Microchiroptera as small species can be misleading since not all Megachiroptera are big and Microchiroptera are not necessarily small. In fact, statistical analyses have shown that there is considerable overlapping of size between these two groups. However, there are other profound morphological, anatomical and behavioural differences between the two suborders. Megachiroptera comprises a single family Pteropodidae and are inhabitants of Old World tropics. Microchiroptera comprises twenty families and are cosmopolitan in occurrence.

With the employment of large scale molecular data and powerful phylogenetic methodologies, bat systematics has undergone tremendous transformation in recent times. These molecular studies have found a different relationship between families of bats than the traditional view. These molecular reconstructions showed that Microchiroptera is an unnatural assemblage, with some microbat families sharing more affinity to megabats than to the rest of the microbats. These developments have led to the propositions of a new scheme of classifications of Chiroptera into two suborders: on one side the Yinpterochiroptera comprising the family Pteropodidae and the microbat families Craseonycteridae, Hipposideridae, Megadermatidae, Rhinolophidae, Rhinopomatidae and Rhinonycteridae; on the other side the Yangochiroptera including the rest of the microbat families. This new classification scheme is gradually gaining acceptance and replacing the traditional division of Megachiroptera-Microchiroptera.

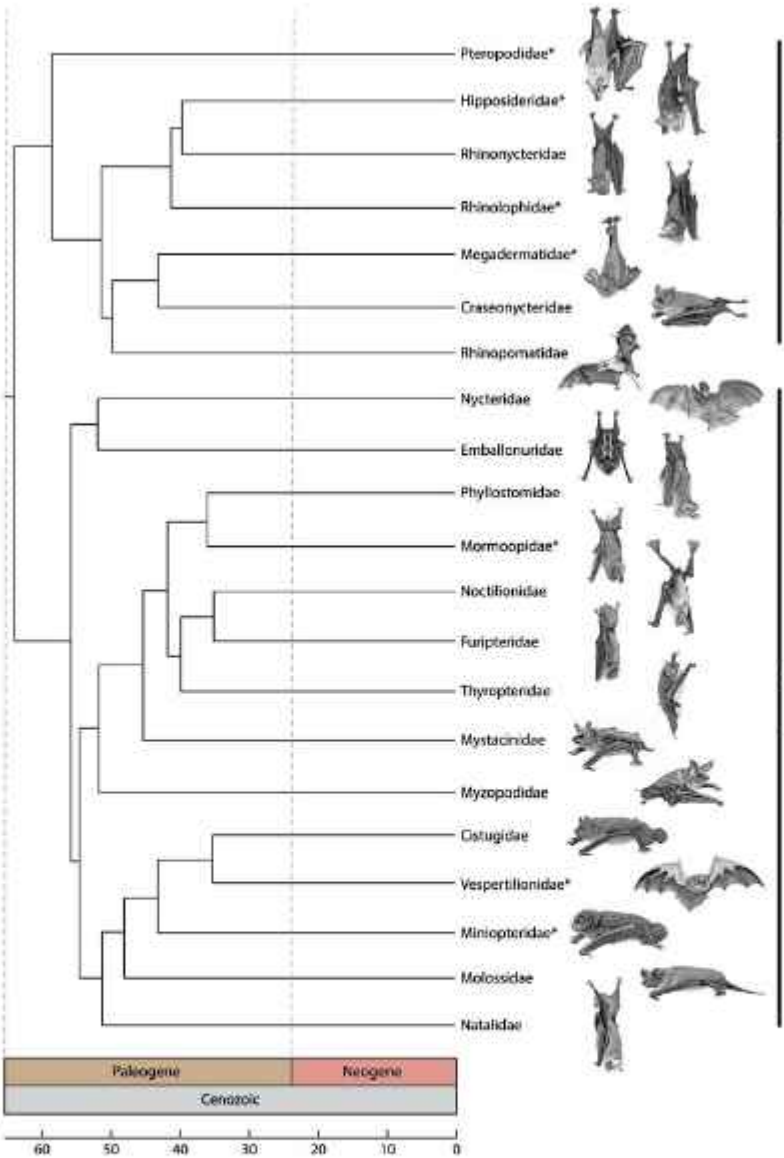



**Figure 1:** Phylogenetic relationships among families in the order Chiroptera. Adopted from Teeling *et al.* (2018)

### 1.5. Geographic distribution

Bats have been recorded from almost every country in the world, more abundantly in the tropics and warmer parts of temperate zones of both Hemispheres. However, bats are not known from the Arctic, Antarctic and certain oceanic islands. In the Northern Hemisphere, Palaearctic bats have been recorded as far north as 70° N while the southernmost limit of bats is south of Tierra del Fuego in Chile, at a latitude of 65° S.

### 1.6. Biology and ecology

Commensurate with species diversity, bats vary greatly in their life history and ecology. Breeding season also varies among species. Many temperate bats breed seasonally in order to coordinate reproduction with resource availability to support the new-borns. However, most tropical species do not show seasonal breeding as in tropics resources are less variable seasonally. Litter size is small in bats, usually one to two pups are born. In contrast to other animals of comparable body size, bats are surprisingly long-lived animals, the highest longevity record so far being a 41 year old Brandt's Myotis in Siberia. Although the exact molecular mechanism underlying this longevity is not understood yet, scientists speculate that bats are somehow able to prevent or repair damage to DNA caused by free radicals resulting in higher longevity.

Bats also exhibit a great variety of mating systems. However, they can be broadly categorized into three structural types with variations. The first mating system involves single male and multiple females which is the most commonly seen mating system in bats. Some species exhibiting this system maintain a harem year round with stable female composition; in some other species the female composition varies year round while in others, harems are formed seasonally. The second type of mating system involves formation of multi-male multi-female groups that may remain year round or formed seasonally. The third type of mating system is characterized by single male single female monogamous groups which is rare among bats.

During the long evolutionary period, bats had undergone trophic radiations to adapt to a variety of food habits. All Pteropodids are predominantly fruit eaters and also feeding on nectar, pollens, tender buds etc. and some species occasionally supplementing with animals. However, other bats are most diverse in dietary habits. Even though predominantly insectivorous, some species like false vampires,slit-faced bats and leaf-nosed bats of tropical America eat small rodents, lizards, frogs and even other bats. Several bat species like the greater bulldog bat, or few species in the genus *Myotis* including Rickett's big-footed Myotis found in certain caves of Meghalaya, are specialized fish eaters. To aid fishing, these bats have large claws for grabbing and holding fish and also wing morphology that allows low flight speed and reduced energy expenditures during

long trawling flight. Again, there are several bat species like the greater spear-nosed bat and Jamaican fruit-eating bat of Central and South America which are omnivorous sustaining on both plant and animal sources. Three species of extant bats commonly known as vampire bats found in Central and South America specialize on a diet of blood of mammals and birds.

Bats are considered as one of the most vociferous mammals using a large repertoire of sound and ultrasonic signals to communicate, navigate and for hunting. Using essentially high frequency sound waves well above the limit of human perception, bats navigate and hunt. This phenomenon called echolocation was discovered by American biologist Prof. Donald Griffin during the 1940s and opened up a new vista for studying animal sounds, a discipline called bioacoustics.

While hunting, bats send out their ultrasonic calls in all directions. The time duration between the outgoing sound and the incoming echo informs a bat about the objects in front of it. The time lag between the echo reaching one ear and then the other informs the bat of the position of the object, its target prey or predator. The echolocation calls of bats cover a range of frequencies from 5 kHz to 250 kHz. The species that call between 5 and 20 kHz are audible to most humans, whereas the rest can be recorded with specialised ultrasonic recorders called 'bat detectors'. Many different species call at different frequencies, so recording bats presents itself as an upcoming method of non-invasive study of bat diversity, ecology and population trends.

# 2. Significance and conservation issues

## 2.1. Ecological and economic significance

Compared to other so called charismatic and more visible mammalian groups, the life history traits, ecology and systematics of most of the bat species are still poorly known to researchers. But what we know for sure is that bats are one of the most ecologically and economically beneficial groups of mammal.Bats are very efficient pollinator sespecially in the tropical and desert environments. The direct roles of nectarivores in pollination of more than 500 species of plants worldwide have been well documented. Needless to say that without pollination, plants cannot produce seeds and reproduce. Among these plants pollinated by bats include a large number of socio-economically important species like columnar cacti, banana, guava, mango, agave, mahua etc. It has also been documented that bat pollination increases the yield and quality of an economically important cacti fruit pitaya,*Stenocereus queretaroensis* compared to pollination by other animals. Long-nosed bats of South America *Leptonycteris* spp. are almost exclusive pollinators for the Agave plant. Tequila, an alcoholic beverage made out of the fruits of agave plant, commands a multibillion dollar market globally. Likewise, Mahua *(Madhuca longifolia)*is a commercially important tree in Peninsular India; its flowers are rich in sugars and vitamins and traditionally been used for producing fermented beverages and also as sweeteners. The flowers also find uses for a number of ailments and many value added products are obtained from it.The Indian flying fox *Pteropus medius* and short-nosed fruit bat *Cynopterus sphinx* are two important pollinators and seed dispersers for this plant. The mangrove systems are one of the most productive ecosystems on Earth and a large number of unique plant and animal species thrive there. They also play an important role in protecting the coasts from sea surges and coastline erosion. Some of these mangrove plants especially of the genus *Sonneratia* are pollinated by fruit bats. Seed dispersal is a major pathway for forest regeneration and succession whereby seeds are deposited away from their place of origin. Frugivore bats in their long distance flight defecate seeds over a large area and are instrumental in regeneration of forest clearings. Many of the bat dispersed seeds belong to the hardy pioneer plants which can grow in harsh environment and sets the conditions right for growing of more delicate plants later. Besides pollination and seed dispersal, another very crucial ecological role that bats perform is to keep insect population under check. This has huge economic consequences as well since many of the insect species that bats consume are pests for agricultural crops. One well publicised research in the United States reports that insectivorous bats saves food crops of at least 23 billion US dollar every year through consumption of insect pests. Although no such economic quantification is available for India so far, we can assume that in agriculture based economy like India, this will be a monumental.

A number of bat species live in large colonies inside caves. Over time, they create thick piles of guano on the cave floor which is one of the major energy sources in resource-impoverished cave habitats in which a large number of invertebrates and their predators thrive forming a unique ecosystem. Bat guano has significant commercial value. In ancient times, bat guano was an important source of gunpowder. In many parts of the world, bat guano is commercially harvested. This practice of commercial guano extraction was also prevalent in the early 18th Century in the famous Siju cave in South Garo Hills. Bat guano is also an excellent fertilizer as it is rich in nitrogen, potassium and ammonia.

**2.2. Bats and public health**

Emergence of zoonotic diseases has been one of the most pressing public health concerns in recent times. Notwithstanding their crucial roles in maintaining the health of ecosystem and human economy, bats have been always viewed with fear and revulsion. This fear has been magnified manifold in view of the current Covid-19 pandemic that humanity has been grappling with. In fact, there has been a flurry of research focussing on animal origin of SARS-CoV-2, the pathogen for Covid-19. However, any definitive evidence of the virus originating in bats is still elusive. In fact, an exhaustive analysis of bat coronaviruses funded by the U.S. National Institute of Health also could not pin point the direct origin of the human SARS-CoV-2. They could only finda coronavirus in a horseshoe bat that has a sequence similarity of 96.2% to SARS-CoV-2, the closest relative yet found. This closer similarity only points towards phylogenetic affinities and not necessarily indicates a direct transmission to human. However, misinterpretation of the results of these scientific studies especially by the print media has created such a panic that people have resorted to mass killing of bats or evicting or destroying their roost sites. There is no denying that many viruses including coronaviruses have been discovered in several species of bats,partly because of disproportionately skewed virus hunting in bats compared to other animal groups. But merely presences of viruses do not indicate transmissibility, especially if we minimize contact with wildlife.Broadly describing "bats" as hosts of pathogens or emerging diseases rather than specifying certain species can be counterproductive in our efforts to understand disease ecology and also conservation of these beneficial creatures. Scientific evidences are conclusive that bats can be carrier for some of the fatal human viruses like Rabies, Nipah etc. However, the cases of bat to human rabies transmission are very rare (none reported from India so far) and an overwhelming majority of the human rabies cases are caused by stray dogs. Similarly fruit bats like *Pteropus* are known to harbour Nipah virus which can infect humans by way of contamination with saliva or urine. Just by avoiding consuming raw fruit juices like date palm or half eaten fruits contaminated by fruit bats, this disease transmission chain can be effectively contained. In Bangladesh, exclusion techniques like erecting a bamboo skirt around the sap collecting vessel to prevent access of bats to the palm sap has been effectively implemented in

containing Nipah outbreak. Without doubt, irresponsible human behaviour and our continuous encroachment into the wilderness have increased the chances of interaction between wildlife and human. So theoretically, there is possibility of some animal pathogens jumping to human and causing zoonosis. Even if it happens, we solely are responsible; bats are least to be blamed for.

On the contrary, bats may play a role in reducing vector-borne human diseases by way of consuming mosquitoes, flies etc. Since bats have exceptional longevity and a highly efficient immune system, they can serve as excellent models for studying human senescence and disease defence mechanism.Scientists speculate that elucidating the molecular basis of high longevity and also high tolerance to viral infections in bats could pave the way to alleviate human ageing and diseases in future.

**2.3. Threats and conservation**

Bats are some of the most threatened animal groups on Earth. All pervasive factors like global climate change, habitat loss, developmental activities and consequent roost destruction, emerging diseases like White Nose Syndrome are some of the greatest threats to the survival of bats. Besides, relatively localized stressors like hunting and persecutions, wind turbines etc. are also causing significant mortalities in bat populations in many parts of the world. The ill effects of global climate change on all life forms has become apparent in recent times, however for animals like bats already stressed out by other factors, the effects have been more severe. Heat waves and tropical storms are causing high mortality in bats throughout the globe. There are regular reports of bats dying in large scale especially the open tree roosting species like flying fox in various parts of India or Australia during summer. It is reasonable to believe that extreme environmental conditions is sure to have negative impact on survival and reproductive success of many bat species and this could be detrimental in endemic and restricted range species. Habitat loss is another global phenomenon whereby the original habitat, especially the forests, are exploited for resources and converted for human use. Many bat species are forest dwellers roosting and foraging exclusively inside forests. Hence, large scale destruction of tropical forests harbouring huge number of bat species are undoubtedly causing huge loses to diversity. Besides, human disturbances to caves and abandoned mines which serve as critical refugia for large populations of bats can lead to abandonment of the same. The case in point can be drawn to Meghalaya with numerous caves and caverns many of which holds large populations of a number of bat species. However, most of these known bat caves in the state now hardly harbour any significant bat population due to hunting and human disturbances. Human activities like construction of road and other linear infrastructures, urban development involves serious loss or modification of the original habitat that leads to loss of roosting sites which is one of the critical resources for bat survival. An emerging existential threat that bats of North America are facing is known as White Nose Syndrome. Caused by

a fungus, the infected bats show fuzzy fungal growth in the ears, nose and wings which results in early arousal of the hibernating bats and eventual starvation. This disease is spreading through most of the United States and some areas of Canada causing huge losses to bat populations including some federally endangered species. There is no cure for this disease yet and scientists consider it to be one of the greatest threat bats have ever faced. Besides these, hunting and persecution is another severe threat to bats in many parts of the globe. For example, it is not uncommon in north-eastern India to consume bat meat. In fact there are annual rituals of hunting bats like in Mimi village in Nagaland. However, the scales of hunting where thousands of bats are culled in two-three days for such slow reproducing animals are certainly leading to their decline. In Meghalaya also, consumption of bat meat is of common occurrence especially in the Jaintia Hills. It is common in the area to see improvised devices for bat catching set in front of cave mouths and sometimes dried bat carcasses find way to the local market as well. Persecution is another major threat to bats especially in India. Bats get so much of bad press which is not only unwarranted but detrimental to their existence. Due to fear and misplaced beliefs, bats are always seen with suspicion and revulsion. During the recent coronavirus pandemic, some yet unsubstantiated claims of bats being the culprit has caused more damage to their already dented image. Reports emerged from several places in India where large bat colonies in the neighbourhood which were existing for long time were either destroyed or chased away. With ever depleting non-renewable energy resources, the world is gradually drawn towards renewable sources like wind energy. Wind energy turbines are quite commonplace especially in North America and Europe. However, these eco-friendly energy producing techniques also have their fair share of environmental drawbacks. It is reported that only in the United States hundreds of thousand bats die at windfarms annually. Migratory bat species are the biggest victims of wind turbines. Besides these man-made causes, bats are inherently constrained by their biological bottlenecks. Among small mammals, bats have the lowest fecundity producing only one or two young annually. Therefore, in case of sudden declines in population for any reason, they are unable to recover fast. Further, many bats are colonial species with large populations concentrated in a single roost site. Therefore, they are much prone to environmental stochasiticity, any calamitous event to such roost sites can lead to irreparable damage to a species.

Out of over twelve hundred species of bats assessed by the IUCN in 2018, 18 percent were classified as Threatened whereas another 15 percent were recognized as Data Deficient. In a recent review of the global bat conservation issues, researchers have identified logging and harvesting of forests as the foremost threat followed by agricultural expansion and hunting as major threats to the globally threatened bat species.In view of the aforesaid threats, effective conservation of bats worldwide has been a big challenge. As some of the threats faced by bats like climate change are global in nature, mitigation measuresalso need to be global in scope which is a very complex issue. However, targeted local

actions can go a long way in mitigating other threats. For instances, based on high species richness, endemism and manifold threats, researchers have identified oceanic islands and underground habitats as two priority sites for conservation of bats globally. Subterranean habitats like caves and caverns support some of the largest and most diverse aggregations of bat species in the world. This is particularly significant for Meghalaya where numerous cave systems in the karstic belts provided refugia for large bat populations including some poorly known species. Studies have shown that over fifty percent of the bat species reported in Meghalaya are known to roost in caves. Unfortunately, most of the explored caves and their biota in the state are in imminent danger because of widespread mining activities and other forms of human pressure. Ensuring protection of these underground habitats could be a key conservation strategy for bat fauna of the state. Unlike Europe and America where all bat species are legally protected, legal protection is not afforded to bats in India. Two species namely Wroughton's free-tailed bat *Otomops wroughtoni* and Salim Ali's fruit bat *Latidens salimali* are highly protected under the elaborate Indian Wildlife (Protection) Act, 1972. All other fruit bats are included under schedule V of the Act which means they are considered pest and can be killed without impunity. There is urgent need to remove them from the list and despite some efforts by researcher community, this is yet to materialize. At a local scale, there is an urgent need to sensitize common people about the beauty of these hapless creatures and also to dispel the myths associated with bats. Needless to say that close collaboration between bat researchers, government agencies and conservation organizations can go a long way in attainment of the same.

### 2.4. Facts or fiction: Demystifying bats

Bats' relationship to humankind dates back to antiquity and it is no surprise that they feature prominently in many cultures, albeit mostly negatively. In Greek mythology, bats are associated with the underworld- Persephone and Hades.In ancient Mayan culture, bat was considered as the God of death. The famous fiction of Bram Stoker "Dracula" associatesbats with blood sucking vampires. In folklores of many native people, bats were considered as a double animal, a bird and a beast. But the world of these flying mammal is not as bad as we might think, our poor understanding of these animal is.

**Myth:Bats are blind**

**Fact:** Contrary to the common perception that bats are blind, bats have functional eyes. Their eyes are more tuned to low light situations and although they may not have full-fledged colour vision as humans, their visual acuity may be better than human during dusk and dawn. While fruit-eating Pteropodids majorly depend on eyes for orientation and finding food, resilience on eyes decreases in other, insectivorous bats, but still they use their eyes in detecting objects beyond their echolocation range and also during social interactions.

**Myth: Bats in our vicinity can be dangerous**

**Fact:** Bats have very good safety record of living with human. Bats have been living in human environment since time immemorial. It is not uncommon to have large bat colonies in our town or villages. People are living perfectly healthy with large roosts of flying foxes around or Pipistrelles living in the village huts. Many indigenous people throughout the world regularly hunt bats. In Meghalaya, the practice of eating bats is of common occurrence especially in Jaintia Hills. While there seems no ill effect from these contacts, it is always advisable to minimize contacts with wildlife including bats. Eminent bat biologist and conservationist Dr. Merlin Tuttle who has spent around 50 years of his life studying bats throughout the world points out "Bats have excellent safety record of co-existing with human; Historically, the world's greatest zoonotic pandemics have not come from bats", indeed the main source of zoonotic diseases are domestic animals such as pigs or chickens.

**Myth:Bats can attack and cause rabies**

**Fact:** Bats are not aggressive animals and will bite in self-defence only when handled. From the experience of bat researchers, it can be safely stated that even in the midst of thick clouds of bats within a confined space, no bats will attack and bite a human being. There is conclusive evidence that bats can harbour rabies viruses that cause fatal encephalitis in human. However, a very little percentage of the sampled bats have been found to harbour this virus. The chances of human transmission are even rarer and a vast majority of the cases are caused by dogs. Besides, rabid bats are not known to be aggressive to attack any animal. In India, so far no cases of bat-transmitted human rabies has been documented.In the Americas and Europe, where rabies is prevalent in bats, very few cases are known.

**Myth:Bats suck human blood**

**Fact:** Out of the about 1430 species of bats known worldwide,only three species namely the common vampire bat, hairy-legged vampire bat and white-winged vampire bat which are inhabitants of Tropical America are hematophagous *i.e.* relying on blood. Out of these three species, the common vampire bat feed primarily on blood of mammals, including humans and cattle, the other two primarily feed on blood of birds. And unlike blood-sucking vampires in fictions, these true vampire bats will make small incision on the victim's skin by their sharp incisors and will lick the fresh blood oozing out.

**Myth:Bat meat is beneficial in respiratory diseases**

**Fact:** There is a widespread belief especially in South Asia that meat especially of the larger fruit bats or their gallbladder has remedial properties for asthma or any chronic respiratory diseases. But, no scientific evidences exist to support this. However, one thing is clear: bushmeat, including from bats,is a potential source of zoonotic diseases.

# 3. Studying bats

## 3.1. Ethics to be followed

i) Obtain necessary permits from relevant authorities before initiating bat studies involving trapping. Although most species of bats are not legally protected in India yet, it is a good idea to intimate the authorities about any such studies.

ii) Unless absolutely necessary, do not catch or handle bats. Catching a wild animal causes extreme stress in it and is detrimental to its well-being.

iii) Handle a captured bat in a gentle manner and with gloves, especially during extraction from the net. Keep it calm inside a soft cotton bag after capture.

iv) After recording relevant data, release the captured bat as soon as possible at or near the capture site.

v) When it is necessary to retain a voucher, euthanize the animal following standard procedure causing minimum stress and pain.

vi) Never collect a pregnant or lactating female. Do not set mist nets or traps near a maternity colony if known in advance.

## 3.2. Field study methods

Bats are usually gregarious, non-territorial and are highly mobile and therefore, patchily distributed in space. Therefore, special sampling tools and techniques are required to study them. Capturing bats is the primary means of determining species presence and distribution in an area, obtaining demographic data or for studying migrations and is often indispensable in all bat studies. Besides, taxonomic characterization necessitates specimens in hand, often requiring retention of vouchers. Bats may be caught by a variety of techniques both at the roost site and in free flight. Mist netting and harp trapping are the two primary methods employed by bat researchers to obtain bat samples from the study. Throughout the world, mist netting is considered as a well-established research methods in bat studies. Introduction of mist netting has revolutionized bat studies. Mist nets are fine polyester or nylon nets of various mesh sizes and length that are suspended between two poles. They have loose shelves created by horizontal strings that allow bagging the animal in a more secure way. Mist nets can be set at ground level or even in the tree canopy depending on the species of interest. To maximize capture efficiency, nets are normally set across likely flight-paths such as forest clearings, gullies, and water sources or along ridges etc. Generally, nets are set before dusk and up to midnight depending on weather conditions. However, an open net should be regularly monitored at short intervals, as entangled bat can both harm itself and the net in a short period of time. Pteropodids, most Vespertilionids and Rhinolophids can be effectively caught by mist netting. Mist nets can also be put near the exit of small roosts for catching during evening emergence. However, in such situations, extreme care should be taken as a large number of bats coming out of the roost can get entangled; therefore this practice is not recommended for novice researchers.













**A.** A bat caught in a mist net. **B.** Bats trapped in a harp trap
**C.** A harp trap set in front of a cave entrance
**D.** A flap trap in action

Harp trap is another effective method for sampling bats. Invented by American veterinarian Denny Constantine in 1958, harp trap is essentially thin nylon strings perpendicularly tensioned between the upper and lower rods in a squarish metal frame. Bats striking the strings cannot maintain their angle of flight and drop safely into a collection chamber attached to the frame. There have been several modifications of this basic design in terms of number of banks and collapsibility. Generally, a two-bank harp trap is used representing an ideal balance between portability and capture success. Certain species which are difficult to catch in mist nets like small Rhinolophids or Bamboo bats can be effectively trapped with a harp trap. Compared to mist net, harp trap has the advantage that it does not need to be monitored regularly as there is no scope of entanglement and bats are safely collected and calm down in the cotton bag.

In certain situations, a portable flap net designed by Russian bat researcher Alex Borissenko is also helpful. It consists of a nylon net fixed to two lightweight poles forming a trapezium-shaped shallow scoop. The poles are held by the catcher under the arms and the bats passing within a close distance are scooped by sidewise movements of the net.

### 3.3. Bioacoustics

Bat calls can be recorded using hand held ultrasonic recorders called 'bat detectors'. The range of frequencies that detectors can record is variable, but is typically between 5 and 192 kHz, which covers a vast majority of the bat species. However, a few points are worth remembering while recording bats. Unlike all the audible animals, bats call at inaudible frequencies so it is most important to ensure that the detector is on and is indeed recording sound. An easy way to do a microphone check is by turning the speaker on and clicking or rubbing your fingers in front of it. The next important point to remember is that bats use their ultrasonic calls for navigation, orientation and foraging. This predisposes the call to variations with respect to environmental conditions. For example, a species of bat flying in an open space emits long calls because its targets/obstacles are few and far between. The same bat when flying in a forest emits short calls, spanning a wide range of frequencies, to keep track of the countless obstacles in its way. On a similar note, bats with low frequency calls can be recorded easily because their call travels longer distances. Therefore, it is good practice to make multiple recordings of the same species or individual flying in your vicinity to account for habitat-induced variation in the echolocation call. Once the bat calls have been recorded they need to be analysed using appropriate software and measured to inform species identification. The call is first viewed on a frequency vs time graph called 'spectrogram'. Initial identification is based upon the structure of the call. The call structures in bats can broadly be categorised into three types:

a) Frequency-modulated (FM): here, a sound pulse starts at a higher frequency and ends at a lower frequency. Depending on the genus, the pulse of the frequency drop can be steep (in a short time interval) or relatively gradual. All bat calls are FM to some degree, but the 'FMness' is most pronounced in Mouse-eared bats (*Myotis* spp.) and Tube-nosed bats *(Murina spp.)*.

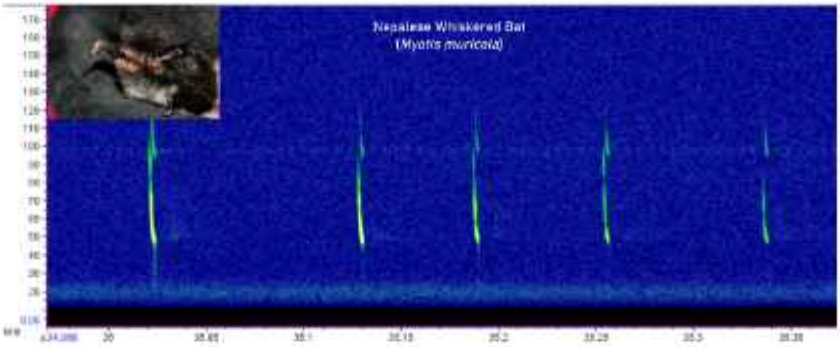



**Figure 2:** Highly frequency modulated (FM) calls of *Myotis muricola*

b) Constant-frequency (CF): as opposed to FM, a CF call maintains a constant frequency for much of its duration. FM components may precede and/or succeed the CF part. Examples of CF bats are Horseshoe (*Rhinolophus* spp.) and Leaf-nosed bats (family Hipposideridae). Horseshoe bats have an FM-QCF-FM call structure while Hipposiderids have CF-FM.

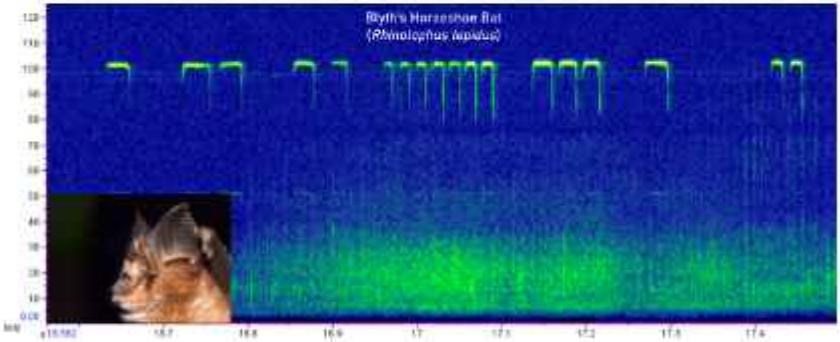



**Figure 3:** Constant frequency (CF) calls of *Rhinolophus lepidus*

c) Quasi-constant-frequency (QCF): in this case, the call shows a shallow frequency modulation, such that it appears largely CF. Free-tailed (family Molossidae) and Tomb bats (family Emballonuridae) use QCF calls. Many evening bats (Vespertilionidae) have calls that start in FM and gradually end as QCF.

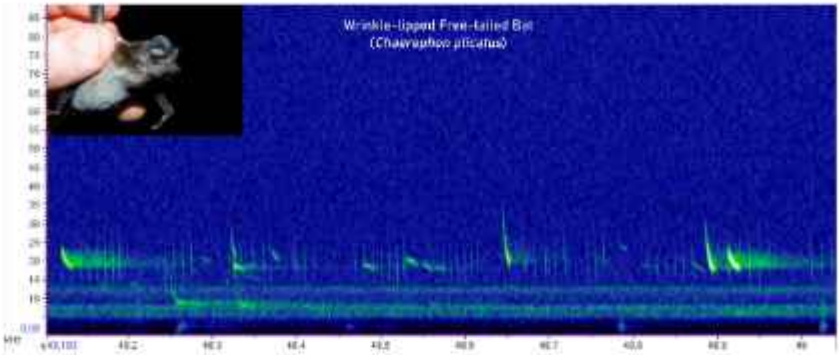



**Figure 4:** Quasi-constant frequency (QCF) calls of *Chaerephon plicatus*

After a bat call has been categorised into one of these three groups, the exact parameters of its call are measured on the spectrogram. The common measurements include starting frequency, ending frequency, peak frequency (the frequency at which the call is loudest)and duration of each pulse. The measurements are then matched to reference call libraries that are now available for many parts of the country.

**4.1.** Illustrations of the measurements

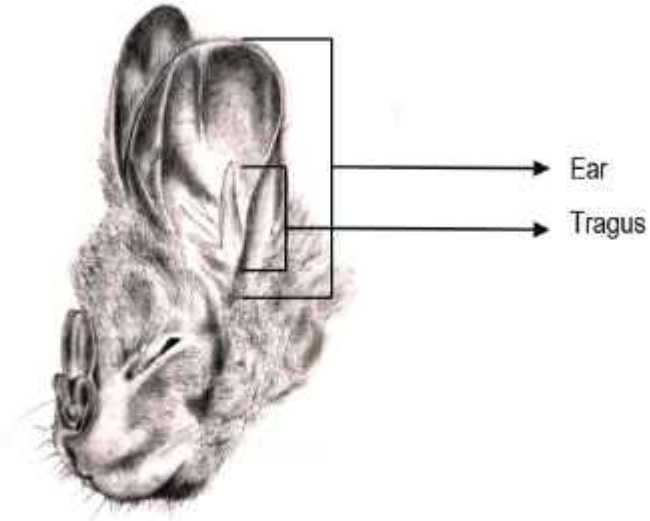



**Figure 5:** Side profile of a lesser false vampire bat *Megaderma spasma* showing the ear measurements

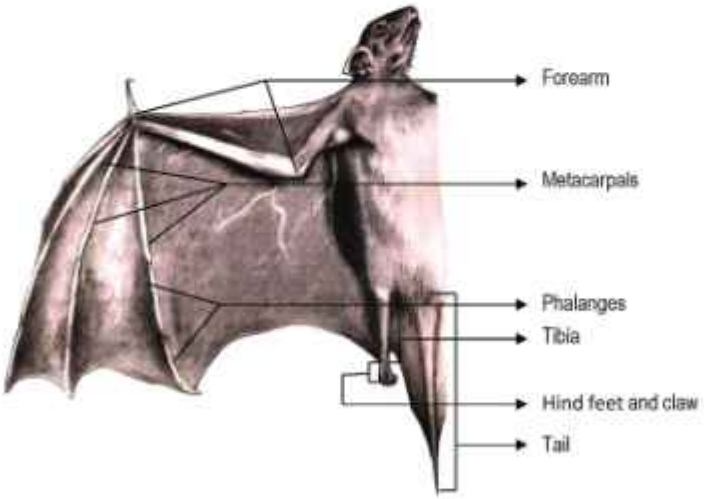



**Figure 6 :** Ventral profile of Greater yellow house bat *Scotophilus heathii* showing various body measurements

**Global conservation status**

Global conservation status of the species is given as per the International Union for Conservation of Nature (IUCN) Red List 2020.

**DD:** Data Deficient

**LC**: Least Concern

**NT**: Near Threatened

**VU**: Vulnerable

**Abundance status**

Abundance status of the species in the state are based the number of locality records for each species. However, it does not indicate population status.

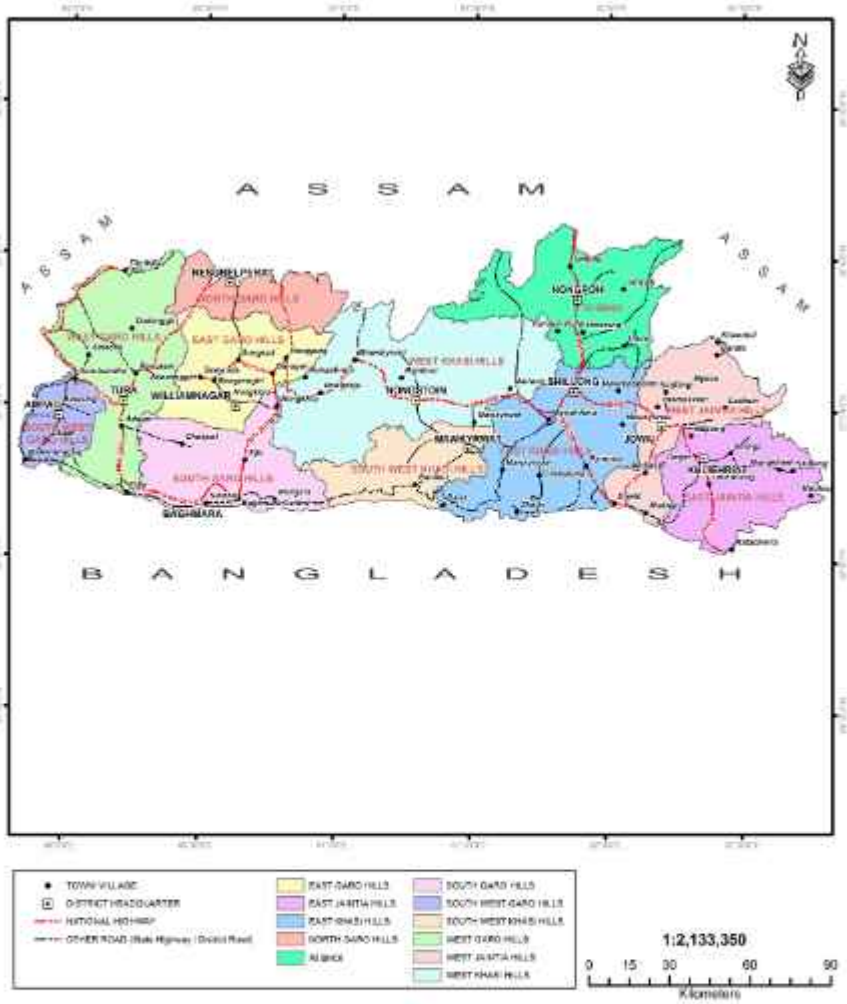
**Rare**: Single occurrence record in the state

**Uncommon:** More than one but less than five locality records in the state

**Common:** Five or more locality records from the state

**4.2. About the state of Meghalaya:** The state of Meghalaya is located in the northeastern part of India, bounded by Assam state to the North and northeast and by Bangladesh to the South and southwest. The state lies between latitudes 25°02' and 26°07' N and longitudes 89°49'and 92°50'E and covers an area of 22,429sq. Km. Three physiographic zones can be recognized in the state; the Central Plateau, the Southern slopes bordering Bangladesh and the Northern slopes bordering Assam. The state covers a broad elevation range from 60 m to 1960. The climate of the state varies depending on elevation and geographic relief; however humid subtropical climate and subtropical highland oceanic climate are prevalent in most of the areas. Most of the rains are received during the wet season of April to September due to southwest monsoon. Aptly known as the "Abode of Clouds", the state harbours some of wettest regions of the world; Mawsynram, a tiny hamlet west of Cherrapunji receives an average annual precipitation of 1165 cm, some of the highest in the world. According to the Forest Survey of India report 2019, the forest cover of Meghalaya is well over national average at about 76 percent out of which 43.5 percent consists of very dense to moderately dense forest. At least ten different forest types have been recognized in the state among which East Himalayan Moist Mixed Deciduous Forest and Khasi Sub-Tropical Wet Hill Forest dominate the state. Being a part of the Indo-Burma Biodiversity Hotspots, the state is extremely rich in biological wealth. Over 3500 flowering plants, 352 orchids, 40 bamboo species have been recorded from Meghalaya including about 40 endemic species like the famous Pitcher plant *(Nepenthes khasiana)* and Lakadong turmeric *(Curcuma longa)*. According to Zoological Survey of India, over10000 animal species are recorded from the state. This constitutes about ten per cent of the faunal species recorded from India in an area comprising less than one per cent of the total geographic area of the country.The state has two National parks, four Wildlife Sanctuaries and many Community Reserves covering 2.2 percent of the total geographic area. At present, the state is administratively divided in to 11 districts.

# POLITICAL MAP OF MEGHALAYA



### 4.3. Looking back: bat studies in Meghalaya

Meghalaya is one of the Indian states whose bat fauna has been studied relatively extensively as evidenced from the large number of species reported from the state. Our present knowledge on the diversity and distribution of bat fauna of the state is based on field studies spanning over more than one half century which is described briefly herein. As the capital of erstwhile Assam Province was based in Shillong, naturalists under the patronage of the British government conducted extensive faunal collections in the Khasi and Jaintia Hills area. In 1851, Edward Blyth, a British zoologist and curator of the museum of Asiatic Society of Bengal described the Harlequin bat *Scotomanes ornatus* which represents the first scientific study on the bat fauna of Meghalaya. In the early 1870s, based on the collections in the Indian Museum Calcutta, the famed British bat taxonomist Edward Dobson described several species of bats from Meghalaya including *Rhinolophus garoensis, Vesperugo (Vesperus) pachyotis* and *Pipistrellus austenianus* some of which were synonymized later. During 1911-1923, the Bombay Natural History Society organized a pan India Mammal Survey and as part of the survey, a large number of mammalian specimens were collected from Meghalaya. Survey results were reported subsequently which included several species like *Rhinolophus affinis, Rh. lepidus, Rh. luctus, Rh. pearsonii, Scotophilus kuhlii, Leuconoe sp. (Myotis* sp.*), Scotomanes ornatus* etc. The biospeleological study in Siju cave in South Garo Hills led by Stanley Kemp and his associates of Zoological Survey of India in 1922 was a landmark event in the faunal exploration of the state. Among over a hundred animals recorded, they reported *Cynopterus sphinx, Rh. subbadius* and *Hipposideros lankadiva* from the cave. In the early 1970s, researchers led by Gyorgy Topál from the Hungarian Natural History Museum conducted bat surveys in Khasi hills and reported species like *Ia io* and *Myotis laniger* from Cherapunji. Subsequently, Y.P. Sinha of Zoological Survey of India surveyed in various parts of Khasi hills and also in Siju cave and reported the occurrence of several species like *Eonycteris spelaea, Scotozous dormeri* etc. from Meghalaya. The comprehensive treatise on the bats of the Indian Subcontinent by Bates and Harrison of the Harrison Museum involved examination ofbat specimens from the region held in the major collections all over the world. This work included about fifty species of bats from Meghalaya, although several of these records are now considered extralimital and no longer referable to those species. In a surprising discovery in 2002, Adora Thabah, a researcher affiliated with Bristol University, reported a rare and highly protected bat *Otomops wroughtoni* from a cave in East Khasi Hills district, Meghalaya which was earlier known from a single population in Karnataka.

Subsequently working for her doctoral research, she also described a new species of leaf-nosed bat *Hipposideros khasiana* from Meghalaya. In recent times, Manuel Ruedi of the Natural History Museum of Geneva and his colleagues have sampled bat fauna in various parts of the state and described two new species of bats namely *Murina jaintiana* and *Mu. pluvialis* from Meghalaya, besides adding a few species to the bat fauna of India. As part of on-going bat explorations in the Himalayan region, Uttam Saikia of Zoological Survey of India and co-workers have reported on several lesser known bat species of the state besides reporting a few species e.g. *Mirostrellus joffrei*, *Myotis altarium* and *Eudiscopus denticulus* for the first time from the country.

**4.4. Checklist**

The latest compilation on the bat fauna of Meghalaya by Saikia and his co-workers in 2018 includes 65 species in seven families. However, in the years following the publication of the same, there have been significant revisions in bat systematics including species assignations and delineation of new geographic boundaries in their distribution. As a result, a few of the earlier bat species records from the state are considered no longer valid. Besides, there have been a few recent additions to the bat fauna of the state. The following checklist of the bat species of Meghalaya reflects the present state of knowledge on the same and includes 66 species in eight families, which represents fifty per cent of the total bat species recorded from India.

| Sl. No. | Family | Species | IUCN status 2020 |
|---|---|---|---|
| 1 | Pteropodidae | *Pteropus medius* Temminck,1825<br>Indian flying fox | LC |
| 2 | | *Cynopterus brachyotis* (Müller,1883)<br>Lesser dog-faced fruit bat | LC |
| 3 | | *Cynopterus sphinx* Vahl,1797<br>Greater short-nosed fruit bat | LC |
| 4 | | *Eonycteris spelaea* (Dobson, 1871)<br>Dawn bat | LC |
| 5 | | *Macroglossus sobrinus* K. Andersen, 1911<br>Hill long-tongued fruit bat | LC |
| 6 | | *Megaerops niphanae* Yenbutra & Felten, 1983<br>Ratanaworabhan's fruit bat | LC |
| 7 | | *Rousettus leschenaultii* (Desmarest, 1820)<br>Leschenaults' Rousette | LC |
| 8 | Rhinolophidae | *Rhinolophus affinis* Horsfield, 1823<br>Intermediate horseshoe bat | LC |
| 9 | | *Rhinolophus lepidus* Blyth, 1844<br>Blyth's horseshoe bat | LC |
| 10 | | *Rhinolophus macrotis* Blyth, 1844<br>Big-eared horseshoe bat | LC |
| 11 | | *Rhinolophus pearsonii* Horsfield, 1851<br>Pearson's horseshoe bat | LC |
| 12 | | *Rhinolophus perniger* Hodgson, 1843<br>Great woolly horseshoe bat | LC |
| 13 | | *Rhinolophus pusillus* Temminck, 1834<br>Least horseshoe bat | LC |
| 14 | | *Rhinolophus siamensis* Gyldenstolpe, 1917<br>Thai horseshoe bat | LC |
| 15 | | *Rhinolophus sinicus* K. Anderson, 1905<br>Chinese horseshoe bat | LC |
| 16 | | *Rhinolophus subbadius* Blyth, 1844<br>Little Nepalese horseshoe bat | LC |
| 17 | Hipposideridae | *Coelops frithii* Blyth,1848<br>Tailless leaf-nosed bat | NT |

| | | | |
|---|---|---|---|
| 18 | | *Hipposideros armiger* Hodgson, 1835<br>Great Himalayan leaf-nosed bat | LC |
| 19 | | *Hipposideros cineraceus* Blyth, 1853<br>Ashy leaf-nosed bat | LC |
| 20 | | *Hipposideros khasiana* Thabah *et al.*, 2006<br>Khasi leaf-nosed bat | DD |
| 21 | | *Hiposideros lankadiva* Kelaart, 1850<br>Indian leaf-nosed bat | LC |
| 22* | | *Hipposideros larvatus* s.l. (Horsfield, 1823)<br>Horsfield's leaf-nosed bat | LC |
| 23 | | *Hipposideros gentilis* Anderson, 1918<br>Anderson's leaf-nosed bat | LC |
| 24 | Megadermatidae | *Lyroderma lyra* (É.Geoffroy Saint-Hilaire, 1810)<br>Greater false vampire bat | LC |
| 25 | | *Megaderma spasma* (Linnaeus, 1758)<br>Lesser false vampire bat | LC |
| 26 | Emballonuridae | *Saccolaimus saccolaimus* (Temminck, 1838)<br>Bare-rumped sheath-tailed bat | LC |
| 27 | | *Taphozous melanopogon* Temminck, 1841<br>Black-bearded tomb bat | LC |
| 28 | Molossidae | *Otomops wroughtoni* (Thomas, 1913)<br>Wroughton's free-tailed bat | DD |
| 29 | | *Chaerephon plicatus* (Buchanan, 1800)<br>Wrinkle-lipped bat | LC |
| 30 | Vespertilionidae | *Arielulus circumdatus* (Temminck, 1840)<br>Black-gilded Pipistrelle | LC |
| 31 | | *Barbastella darjelingensis* (Hodgson, 1855)<br>Eastern Barbastelle | LC |
| 32 | | *Eptesicus pachyotis* (Dobson, 1871)<br>Thick-eared bat | LC |
| 33 | | *Eudiscopus denticulus* (Osgood, 1932)<br>Disk-footed bat | LC |

| | | |
|---|---|---|
| 34 | *Harpiocephalus harpia* (Temminck, 1840)<br>Lesser hairy-winged bat | LC |
| 35** | *Hypsugo savii* (Bonaparte, 1837)<br>Savi's Pipistrelle | LC |
| 36 | *Ia io* (Thomas, 1902)<br>Great evening bat | NT |
| 37 | *Kerivoula hardwickii* (Horsfield, 1824)<br>Common woolly bat | LC |
| 38 | *Kerivoula kachinensis* Bates *et al.*, 2004<br>Kachin woolly bat | LC |
| 39 | *Mirostrellus joffrei* (Thomas, 1915)<br>Joffre's Pipistrelle | DD |
| 40*** | *Murina aurata* Milne-Edwards, 1872<br>Little tube-nosed bat | DD |
| 41 | *Murina cyclotis* Dobson, 1872<br>Round-eared tube-nosed bat | LC |
| 42 | *Murina huttoni* (Peters, 1872)<br>Hutton's tube-nosed bat | LC |
| 43 | *Murina jaintiana* Ruedi *et al.*, 2012<br>Jaintia tube-nosed bat | DD |
| 44 | *Murina pluvialis* Ruedi *et al.*, 2012<br>Rainforest tube-nosed bat | DD |
| 45 | *Murina tubinaris* (Scully, 1881)<br>Scully's tube-nosed bat | LC |
| 46 | *Myotis altarium* Thomas, 1911<br>Szechwan Myotis | LC |
| 47 | *Myotis formosus* (Hodgson, 1835)<br>Hodgson's bat | LC |
| 48 | *Myotis horsfieldii* (Temminck, 1840)<br>Horsfield's Myotis | LC |
| 49 | *Myotis laniger* (Peters, 1871)<br>Chinese water Myotis | LC |
| 50 | *Myotis montivagus* (Dobson, 1874)<br>Burmese whiskered Myotis | DD |
| 51 | *Myotis pilosus* (Peters, 1869)<br>Rickett's big-footed Myotis | VU |
| 52 | *Myotis muricola* (Gray, 1846)<br>Nepalese whiskered bat | LC |
| 53 | *Myotis siligorensis* (Horsfield, 1855)<br>Himalayan whiskered bat | LC |

| | | | |
|---|---|---|---|
| 54 | | *Plecotus homochrous* Hodgson, 1847<br>Hodgson's long-eared bat | DD |
| 55 | | *Pipistrellus ceylonicus* (Kelaart, 1852)<br>Kelaart's Pipistrelle | LC |
| 56 | | *Pipistrellus coromandra* (Gray, 1838)<br>Coromandel Pipistrelle | LC |
| 57 | | *Pipistrellus javanicus* (Gray, 1838)<br>Javan Pipistrelle | LC |
| 58 | | *Pipistrellus paterculus* Thomas, 1915<br>Mount Popa Pipistrelle | LC |
| 59 | | *Pipistrellus tenuis* (Temminck, 1840)<br>Least Pipistrelle | LC |
| 60 | | *Scotophilus heathii* (Horsfield, 1831)<br>Asiatic greater yellow house bat | LC |
| 61 | | *Scotophilus kuhlii* Leach, 1821<br>Asiatic lesser yellow house bat | LC |
| 62 | | *Scotomanes ornatus* (Blyth, 1851)<br>Harlequin bat | LC |
| 63 | | *Tylonycteris malayana* Chasen, 1940<br>Malayan bamboo bat | LC |
| 64 | | *Tylonycteris fulvida* (Blyth, 1859)<br>Lesser bamboo bat | LC |
| 65 | Miniopteridae | *Miniopterus magnater* Sanborn, 1931<br>Large bent-winged bat | LC |
| 66 | | *Miniopterus pusillus* Dobson, 1876<br>Small bent-winged bat | LC |

*The taxonomy of *Hi. larvatus* species complex in northeastern India is unclear at present. Pending a comprehensive taxonomic reassessment on this group, the taxon *Hi. larvatus* s.l. is retained in this book which also includes *Hi. grandis* as recognized by Thabah et al. 2006.

**Dobson, 1871 described *Pipistrellus austenianus* from Cherrapunji area which has been doubtfully included in *Hypsugo savii*. Therefore, *Hy. savii* is included in the Meghalaya checklist with reservations until the exact status of *Pi. austenianus* becomes clear. Not detailed in the species account.

***The taxonomic status of *Murina aurata* in India remains uncertain. However, this species has been provisionally retained in this account until a taxonomic reassessment is available.

# 4.5 Families and species accounts

## Family: Pteropodidae

### Old world fruit bats



Jugal Kishore Kalita and Akshay Haloi

One of the families of the suborder Yinpterochiroptera, Pteropodidae consists of about 46 genera and 186 species distributed across the tropics of Asia, Africa and Oceania. Pteropodid bats can be instantly recognized by their dog-like pointed muzzle, large eyes and simple ears without tragus. Tails are mostly absent; when present it is short, rod-like in appearance. There is great variation in body size within this family, the largest being golden crowned flying fox *Acerodon jubatus* of the Philippines and weighing over 1.5 kg while the spot-winged fruit bat *Balionycteris maculata* of South-east Asia weighs merely over 10 g. As the common name implies, fruit bats primarily rely on fruits, nectar, flower and buds for nourishment although they may occasionally supplement their diet with

insects. These bats roost either in the open in large trees like the *Pteropus* species, or hidden under foliage like the *Cynopterus* bats or inside sheltered permanent roosts like *Rousettus, Eonycteris* etc. Since Pteropodids orient through visual acuity, they do not have sophisticated echolocation capability like other bats. Out of the 14 species of fruit bats reported from India, eight species are known in Meghalaya.

## *Cynopterus brachyotis* (Müller, 1838)

**English name:** Lesser dog-faced fruit bat

**Local names:** Do'bak Baduri (Garo); Labadur (Khasi); Labit (Jaintia)

***Descriptions:*** A small-sized fruit bat with an average forearm length of 60 mm. Nostrils are projecting sideways with a deep emargination in between. Ears are relatively small, dark brown in colour and without any pale margins as present in its bigger cousin *Cy. sphinx*. There is colour variation between sexes, the males have orange brown shoulders, chest, belly and thighs; russet brown head and nape, and the rest of the back is grey brown. In females, the belly is pale grey brown and the back has shades of light brown to grey brown. The wing membrane is dark brown with darker phalanges and digits. The thumb and the first finger in the wings bear a claw. The tail is short and stout and the terminal part projecting out of the tail membrane.

**Natural history note:** This species is known to roost under foliage especially palm trees. It feeds on a number of wild fruits, notably figs. It can be found in various forest types, including secondary forests and cultivated trees. This is a poorly known species in Meghalaya.

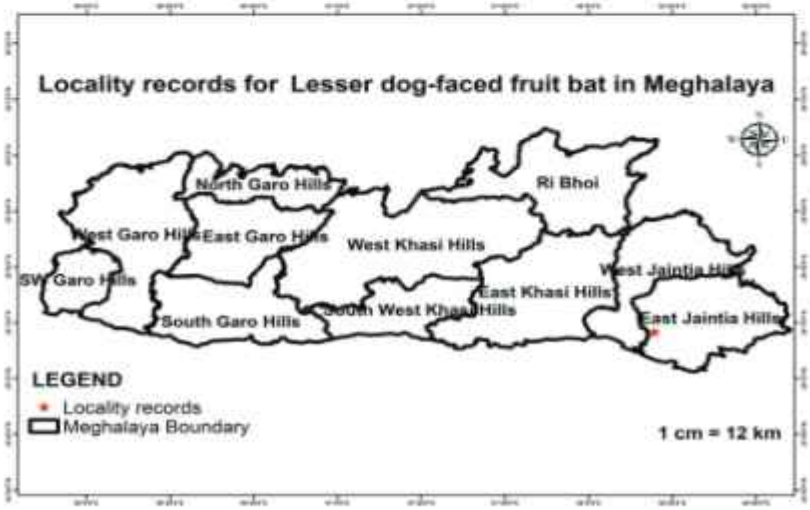
**Distribution:**In India,Lesser dog-faced fruit bat is distributed in Andhra Pradesh, Karnataka, Tamilnadu, Meghalaya, Mizoram, Nagaland and the Andaman and Nicobar Islands. In Meghalaya, reported from Umlyngsha in East Jaintia Hills.

**Abundance status:** Rare.

Body measurements in mm.The numbers within bracket indicate mean value. After Bates & Harrison, 1997 and specimen in ZSI

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 2.0-13.0 (7.2) | 14.5-18.0 (16.7) | 57.3-63.3 (60.3) | 24.3 | 11.0-15.0 (13.6) |


Rohit Chakravarty


Locality records for Lesser dog-faced fruit bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

### *Cynopterus sphinx* Vahl, 1797

**English name:** Greater short-nosed fruit bat

**Local names:** Do'bak Baduri (Garo); Labadur (Khasi); Labit (Jaintia)

**Descriptions:**This species is similar to the Lesser dog-faced fruit bat but is larger in size with an average forearm length around 70 mm. The muzzle is hairy, broad and short and the nostrils projects sideway so that there is a deep furrow in between. Ears are dark brown in colour and has characteristic pale white margins which is a useful character in distinguishing this species from Lesser dog-faced fruit bat. Pelage colour shows sexual variations and is essentially similar to Lesser dog faced fruit bat. The wing membranes are dark brown but the metacarpals and phalanges are pale white.Like Lesser dog faced fruit bat,the short tail remains enclosed within the interfemoral membrane except for the terminal tip.

**Natural history note:** In Meghalaya, this species has been recorded within an elevation of 290-1430 m asl.A very common fruit batin the state,they are knownto roost in small colonies under foliage of areca palm, beetle nut, coconut, banana, banyan etc. and rarely in shallow caves. It is known to modify its shelter by constructing tents out of the leaves or fruit pods. In Siju cave in Garo Hills, this bat was reported roosting in the twilight zone of the cave. They take any locally available ripe fruits, nectar, flowers etc. In Nongkhyllem Wildlife Sanctuary, they were observed drinking water from an open pond in the late evening. No information on breeding of this species in Meghalaya is available although in western India two periods of sexual activity was reported during September-October and February-March.

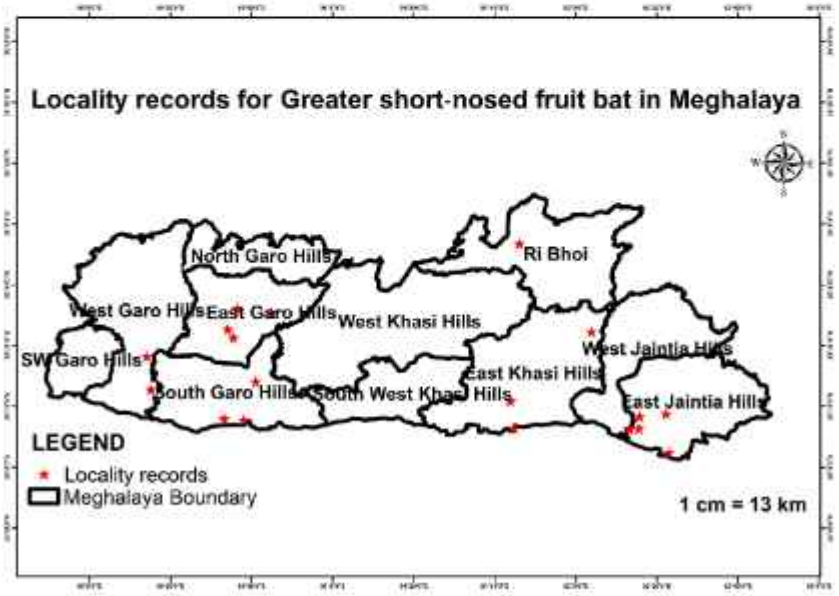
**Distribution:** In India, widely distributed across the country. In Meghalaya, it has been reported from a number of localities i.e. Kherapara and Tura in West Garo Hills; Williamnagar, Darugre, Rongrenggre and Songsak in East Garo Hills; Baghmara, Sibbari and Siju cave in South Garo Hills; Umkiang, Umlyngsha, Khannar, Kharkhana and Lama in East Jaintia Hills; Majai, Cherrapunji; Mawryngkneng in East Khasi Hills, Nongkhyllem Wildlife Sanctuary in Ri-Bhoi.

**Abundance status:** Common.

Body measurements in mm. The numbers within bracket indicate mean value. After Bates & Harrison, 1997 and specimens in ZSI

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 4.5-19.0 (11.3) | 17.0-24.0 (19.4) | 64.0-79.0 (70.2 | 25.7-27.6 (26.3) | 12.6-18.0 (15.8) |


Manuel Ruedi


Locality records for Greater short-nosed fruit bat in Meghalaya
N
W
E
S
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 13 km

## *Eonycteris spelaea* (Dobson, 1871)

**English name:** Dawn bat

**Local names:** Do'bak Baduri (Garo); Labadur (Khasi); Labit (Jaintia)

**Descriptions:** A medium sized fruit bat with an average forearm length of around 70 mm.w The pelage is short, dark brown above and grey brown below. Wing membrane is naked and dark brown. The muzzle is long and thin, ears are longish with rounded tips and dark in colour. The second finger does not bear a claw. In the wings, the fifth metacarpal is much longer than third metacarpal. The stout and short tail is enclosed within the tail membrane except for the tip. There are two kidney shaped glands on either side of the anal opening.

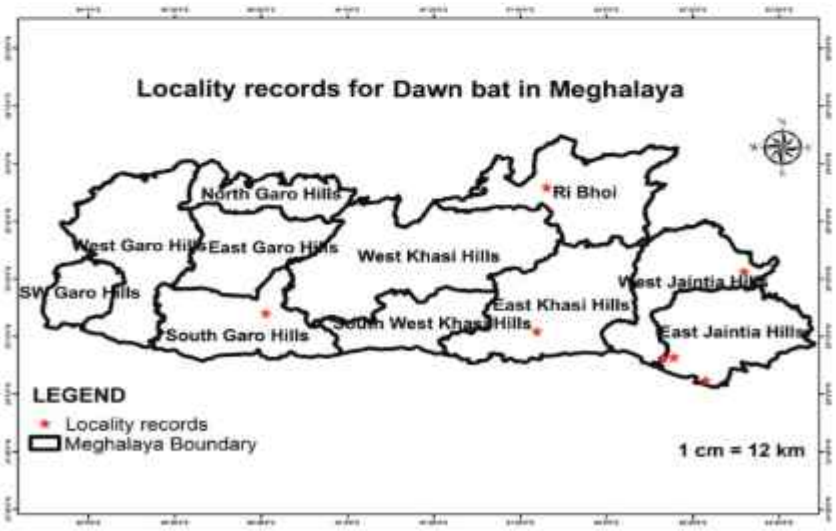
**Natural history note:** In Meghalaya, this bat has been recorded between elevations of 290-1430 m asl.It is a gregarious speciesthat roosts in caves and tunnels. It is known to roost in association with Fulvous fruit bats and horseshoe bats. In Siju cave in Garo Hills, a large colony of this bat has been existing for a long time in the high ceiling of inner chamber at approx. 150 m from the cave mouth, but numbers have considerably declined in recent years. In Mizoram, a huge permanent roosting colony was located in an underground tunnel of about 40 m length and water flowing through it. There, it shared roosting space with Fulvous fruit batand Chinese horseshoe bat. This fruit-eating bat is an important seed disperser.

**Distribution:** In India, Dawn bat is known from Andhra Pradesh, Karnataka, Uttarakhand, Sikkim, Assam, Meghalaya, Manipur, Mizoram, Nagaland and Andaman Islands. In Meghalaya, this species has been reported from Siju cave in South Garo Hils; Lailad Forest in Ri-Bhoi, Cherrapunji in East Khasi Hills and Lakadong in West Jaintia Hills and Umkiang, Kharkhana and Lama in East Jaintia Hills.

**Abundance status: Common.**

| Body measurements in mm. The numbers within bracket indicate mean value. Based on specimens in ZSI | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 15.3-18.8 (17.8 | 17.0-20.0 (18.0) | 64.9-74.6 (71.2) | 29.6-33.5 (32.4) | 17.0-20.0 (18.6) |


Uttam Saikia


Locality records for Dawn bat in Meghalaya
Ri Bhoi
North Garo Hills
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Macroglossus sobrinus* K. Anderson, 1911

**English name:** Hill long-tongued fruit bat

**Local names:** Do'bak Baduri (Garo); Labadur (Khasi); Labit (Jaintia)

**Descriptions:** This is the smallest fruit bat in India with an average forearm length of 47.7 mm. The muzzle is much elongated and slender which enable it to obtain nectar from flowers. As with other fruit bats, eyes are large and reddish brown in colour. Ears are medium sized with a small antitragal lobe. Pelage is soft, russet brown on the back and buffy brown on the belly. The wing membrane is light brownish and covered with hairs on both sides. In the wings, the third and fifth metacarpals are equal in length. The second finger bears a claw. Tail is absent in this species.

**Natural history note:** In Meghalaya, Hill long-tongued fruit bat has been recorded within an elevation of c. 100 -1160 m asl.Specimens were captured in orchards surrounded with secondary forests. This species typically feeds on the nectar of banana flowers (both wild and cultivated) and is thus an important pollinator.

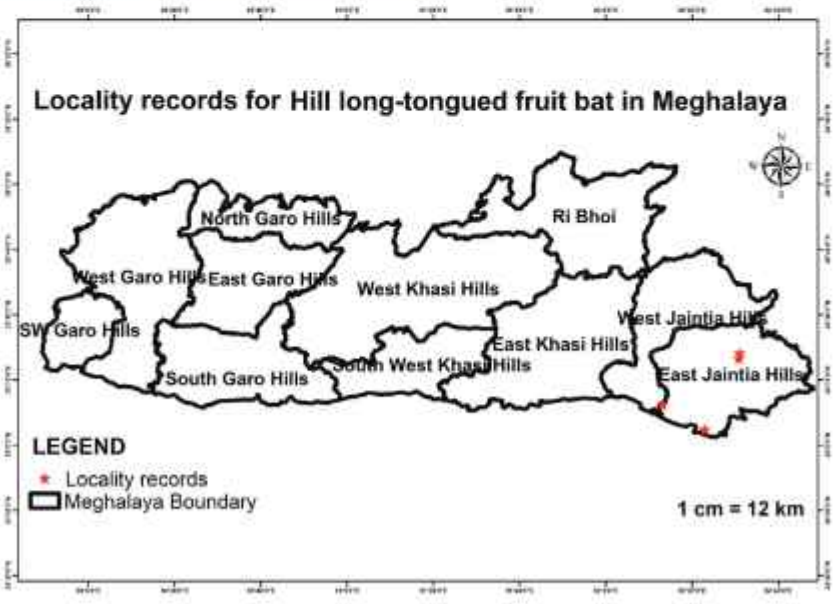
**Distribution:**In India, this species is restricted to the eastern part of the country and known from Sikkim, West Bengal, Arunachal Pradesh Meghalaya and Mizoram. In Meghalaya, it is reported from Tangsen, Kharkhana, Umkiang and Shnongrim in East Jaintia Hills.

**Abundance status:** Uncommon.

| Body measurement in mm. The numbers inside bracket indicate mean values. Based on Bates & Harrison, 1997 and specimen in ZSI | | | |
|---|---|---|---|
| Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 15.0-17.0 (16.3) | 44.0-52.0 (47.7) | 18.9 | 10-12.7 |



Manuel Ruedi



## *Megaerops niphanae* Yenbutra & Felten, 1983

**English name:** Ratanaworabhan's fruit bat

**Local names:** Do'bak Baduri (Garo); Labadur (Khasi); Labit (Jaintia)

**Descriptions:**A relatively small species with forearm length between 62.4-64.2 mm. The pelage is soft, uniform greyish brown both on the back and belly. The muzzle is very short and broad; tubular nostrils project slightly sideways. The ears are simple, brownish in colour without any pale margins. Wings and interfemoral membranes are light brownish. The second finger bears a claw. There is a small tail of about 10 mm which is entirely enclosed within the tail membrane. Presence of this short tail distinguishes this species from closely resembling Temminck's tailless fruit bat *Megaerops ecaudatus*, which is likely to be distributed in the easternmost corner of Arunachal Pradesh.

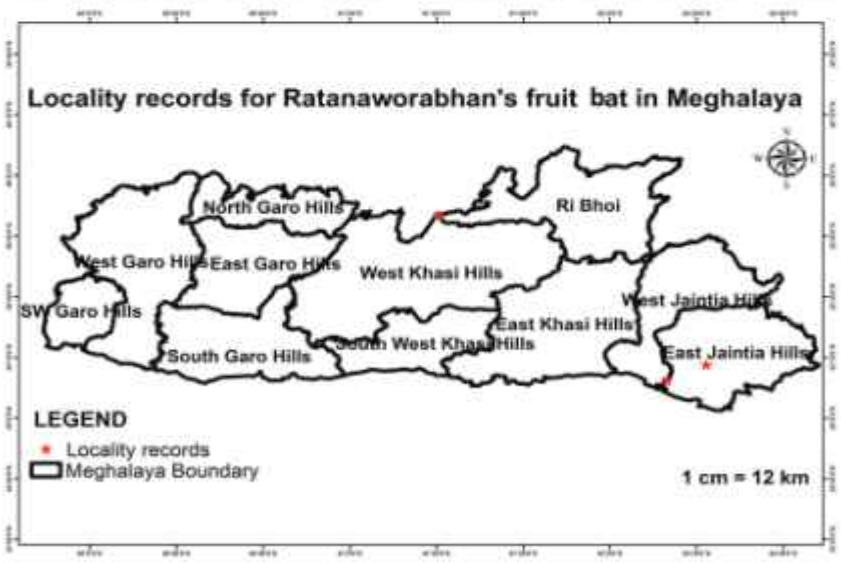
**Natural history note:** This is one of the least known bat species in India. In Meghalaya, this species has been caught in secondary forest with bamboos and also near human habitation between elevations of 100-1090 m asl. In Kyrshai, this species observed foraging on a fig tree. In South-East Asia, this bat has been was recorded between 140-240 m asl in a variety of habitats including pristine tropical forest and farmland adjacent to forests and orchards in urban setting. Animals caught during February in Meghalaya did not show any signs of reproduction.

**Distribution:** In India, this species is only known from the northeast Indian states of Meghalaya and Nagaland. Record of this bat from Namdapha National Park in Arunachal Pradesh most possibly belongs to *Me. ecaudatus*. In Meghalaya, this bat has been reported from Khannar,Kharkhana in East Jaintia Hills and from Kyrshai in West Khasi Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. Based on specimen in ZSI and released animal | | | | |
|---|---|---|---|---|
| Ear length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 11 | 18.4-19.5 | 62.4-64.2 | 24.2-25.9 | 14.2-14.8 |


Manuel Ruedi


Locality records for Ratanaworabhan's fruit bat in Meghalaya
Ri Bhoi
North Garo Hills
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
East Jaintia Hills
South Garo Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Pteropus medius* Temminck, 1825

**English name:** Indian flying fox

**Local names:** Do'bak Baduri (Garo); Labadur (Khasi); Labit (Jaintia)

**Descriptions:** A conspicuous species with very large size and bright pelage.The fur on thehead varies from chestnut to dark brown, on the nape it is yellowish or chestnut brown while that on the back is black. There is clear demarcation between the head and neck fur and that on the back. The fur colour on the belly is also variable from tan to bright orange or dark tan. Wing membranes are black and while at rest, it mostly covers its body giving an overall dark appearance to the body. Eyes are very large; ears are also large with pointed tip. The thumb bears a large claw and the second finger also bears a smaller claw. The wingspan may measure up to one and half meters in males. There is no tail in this bat.

**Natural history note:** Indian flying fox was recorded within an elevation of 350-1500 m asl in Meghalaya. It prefers to roost in open in large trees like Banyan, Fig, Eucalyptus, Mango etc. and can be seen hanging upside down in large colonies often near human habitations. They are known to use the same roosting tree for years, a phenomenon known as roost fidelity. After sunset, they can be seen heading to foraging ground and are known to travel several kilometres each night in search of food. A generalist feeder, they primarily sustain on ripe fruits and nectar and occasionally taking leaf, twigs, flowers or even insects. Generally one and occasionally two pups are born between February and May which are carried by mother till a few weeks. Pups attain sexual maturity at the age of about one and half year. Captive individuals are known to live for over 30 years of age. Since flying foxes roost in the open, they are vulnerable to environmental extremes. In order to prevent overheating, they can be seen fanning their wings which is a normal behaviour. During summer season, regular reports about mass dying of these bats emerge in various parts of the country which usually happens due to heat strokes and should not be mistaken as sign of disease.

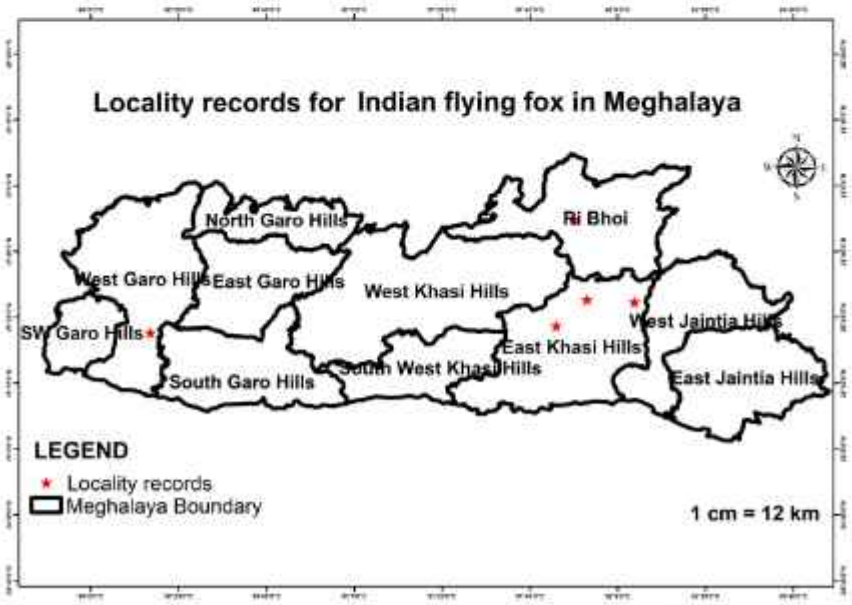
**Distribution:** Indian flying fox is widely distributed throughout India, becoming rare after an elevation of about 1500 m and totally absent in high altitude Ladakh region. In Meghalaya, roosting colonies have been reported from Shillong, Mawphlang, Mawryngkneng in East Khasi Hills; Nongpoh in Ri Bhoi and Tura in West Garo Hills. Note that this species has been mentioned commonly under the name *Pt. giganteus*, a junior synonym of *Pt. medius*.

**Abundance status:** Common.

Body measurements in mm. The numbers within bracket indicate mean value. After Bates & Harrison, 1997 and ZSI specimens

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 0 | 33.0-45.0 (39.8) | 152.0-183.0 (168.4) | 77.0-81.0 | 43.0-58.0 (48.6) |


Deepak Sharma


Locality records for Indian flying fox in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Rousettus leschenaultii* (Desmarest, 1820)

**English name:** Leschenault's Rousette

**Local names:** Do'bak Baduri (Garo); Labadur (Khasi); Labit (Jaintia)

**Descriptions:** A robust bat with an average forearm length of 77.7 mm. Muzzle is short and relatively slender; the nostrils are separated by a deep groove. Eyes are large, ears simple with weak antitragal lobe. The pelage is soft and fine, fulvous brown on the crown, back, flanks and throat while the belly is paler brown. Individual hair of the back appears white at base, greyish in the middle and yellowish at the tip. There are some variations in pelage colour between the sexes, in males the sides of the body is grey while in females, yellowish brown fur cover the whole body.

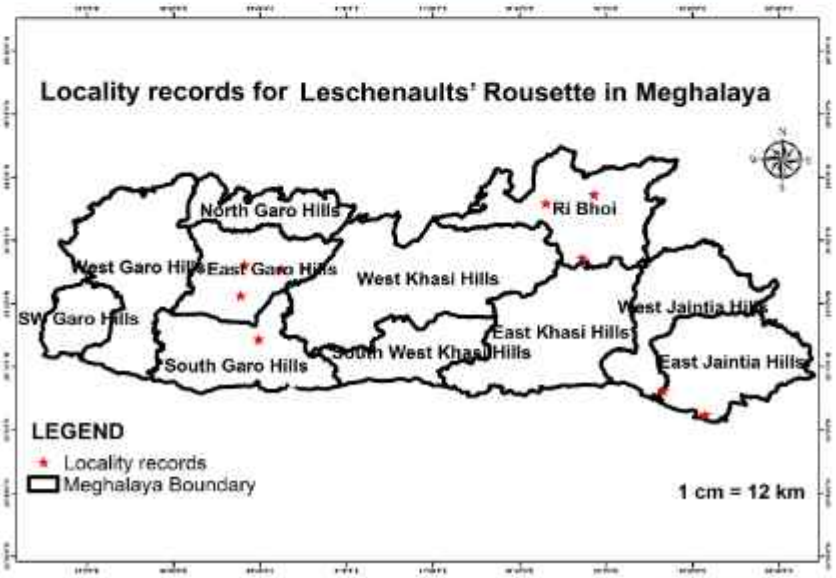
**Natural history note:**One of the most widespread fruit bats in India, this species occurs in a wide range of habitats from drier hot plains, humid forests to hilly areas. In Meghalaya, it has been recorded within an elevation of 60-600 m asl. A gregarious species, it often forms large colonies numbering thousands of individuals. They prefer to roost in dark and humid places like caves, tunnels or abandoned buildings where microclimate conditions remains relatively stable throughout the year. However, very small groups of two to three animals are also known to perch in semi-permanent roosts, like underside of palm trees. Among pteropodids, along with Egyptian rousette, this species exhibit a primitive echolocation capability by producing tongue clicks, whereas *Eonycteris spelaea*, *Cynopterus* spp. and *Macroglossus* spp. have been shown to produce clicks using their wings. The obstacle avoidance efficiency of its echolocation mechanismwas reported to be as good as that of other echolocating bats. Fulvous fruit bats primarily eat a variety of ripe fruits, nectar and flowers.

**Distribution:** This species is widely distributed throughout India. In Meghalaya, colonies of this bat have been reported from Darugre, Songsak, Williamnagar in East Garo Hills; Siju cave in South Garo Hills; Lailad, Sumer and Pahamshken in Ri-Bhoi district and Umkiang and Kharkhana in East Jaintia Hills.

**Abundance status:** Common.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 15.5-17.5 (16.5) | 17.9-19.6 (18.5) | 71.2-80 (77.7) | 71.2-80 (77.7) | 18.4-21.3 (20.0) |

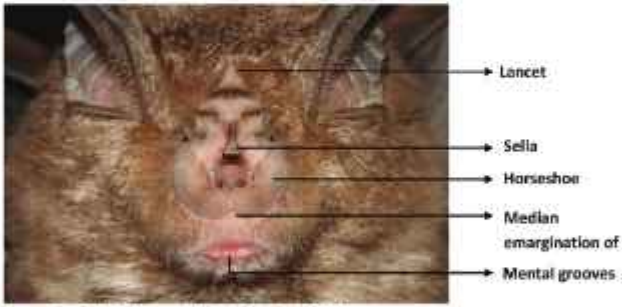

Uttam Saikia


Locality records for Leschenaults' Rousette in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
West Jaintia Hills
SW Garo Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

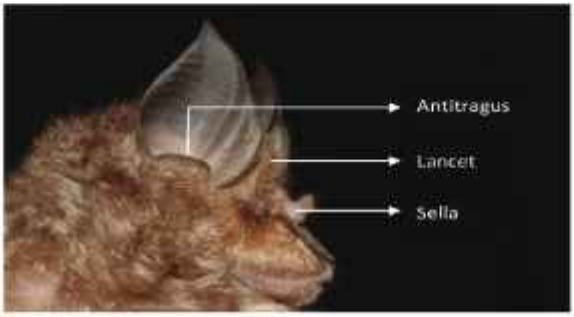
# Family: Rhinolophidae

## Horseshoe bats

Rhinolophidae is a diverse and widespread family consisting of over 100 species spread across the Old World of Europe, Africa, Asia, Australia and Oceania. Members of this family are characterized by a very short muzzle and complex facial structures called noseleaf. The noseleaf consists of an erect upper triangular projection called lancet, a median portion consisting of an upright thickened portion called sella and a lower horse-shoe shaped disc of naked skin with a deep notch on the lower margin. They have a well-developed tail which is completely enclosed within the interfemoral membrane. Ears are medium to large size with pointed tips and a lobe called antitragus. Horseshoe bats have very sophisticated echolocation capability and the nose-leaf structures play an important role in focussing the sound beam. They produce long (> 10 ms ) essentially constant-frequency calls (CF). The call frequencies of different species are usually well-segregated, allowing some to be identified from acoustic records. Horseshoe bats roost in permanent structures like caves, mines, tunnels, abandoned buildings etc. The family consists of a single genus *Rhinolophus* comprising 14 species in India out of which nine species are represented in Meghalaya.




Portraits of *Rhinolopus affinis* showing facial structures




Side profile of *Rhinolophus lepidus*

## *Rhinolophus affinis* Horsfield, 1823

**English name:** Intermediate horseshoe bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:**Intermediate horseshoe bat isa medium sized bat with an average forearm length of about 54 mm in Indian specimens. The pelage is variable in colour ranging from buffy brown to orange; females are darker than males. In the wing, the third metacarpal is sub equal to the fourth and the fifth metacarpal. The first digit of the third metacarpal is shorter however; the second phalanx is very long reaching about three-quarters the length of the metacarpal.

**Natural history note:** In Meghalaya, this species was recorded between elevations of 577-1490 m. A primarily cave roosting species and also found in man-made tunnels and in forests. In Himachal Pradesh, they reportedly live in small colonies of up to 10 Individuals inside caves. In a large cave in Mussoorie in Uttarakhand, they reportedly shared roosting space with *Rh. ferrumequinum, Rh. sinicus* and *Hipposideros armiger* without any apparent spatial segregation between the sexes or species. In Himachal Pradesh, the peak frequency of their echolocation call has been recorded at 80-82 kHz, and at 87 kHz in Uttarakhand. In Uttarakhand, their call frequency overlaps with the sympatric Rh. sinicus.

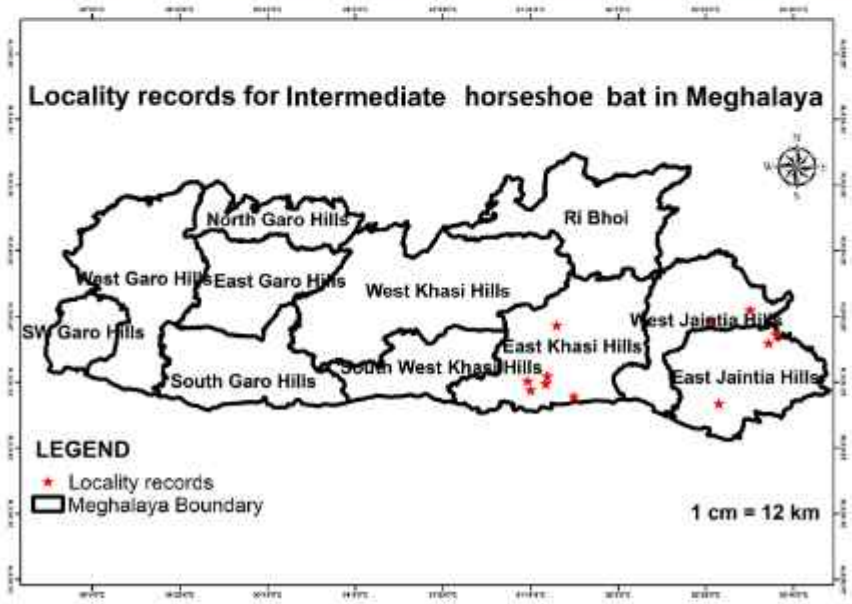
**Distribution :** In India, this species is reportedly distributed in the Himalayan belt in Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Arunachal Pradesh, Meghalaya, Nagaland and Andaman & Nicobar Islands. In Meghalaya, it has been reported from Krem Arwah in Sohra, Krem Mawsyrwait, Mawphlong, Mawsmai cave, Cherrapunji, Laitkynsew and Umnuih Tamar in East Khasi Hills; Khonshnong and Shangpung, West Jaintia Hills; Krem Bylliat, Krem Labit Kseh and Krem Umlawan in East Jaintia Hills.

**Abundance status :** Common.

Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI and released individuals from Meghalaya and Himachal Pradesh.

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 23-43 (29.3) | 17.7-23.8 (20.7) | 48.8-54.7 (51.7) | 23.2-26.8 (24.9) | 9.4-13.0 (10.8) |


Manuel Ruedi and Uzoma Saikia


Locality records for Intermediate horseshoe bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Rhinolophus lepidus* Blyth, 1844

**English name:** Blyth's horseshoe bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is a small horseshoe bat with an average forearm length of about 38 mm. Externally, it is similar to *Rh. pusillus,* but the forearm length is smaller in the latter. The pelage is soft and silky, grey brown dorsally and slightly paler ventrally. The wing and tail membranes are dark brown, essentially hairless. The connecting process of the sella is triangular but its tip is slightly rounded off when viewed laterally. In front profile, the base of the sella has a rounded outline, the lancet in the Himalayan individuals is broadly rounded off with straight sides.

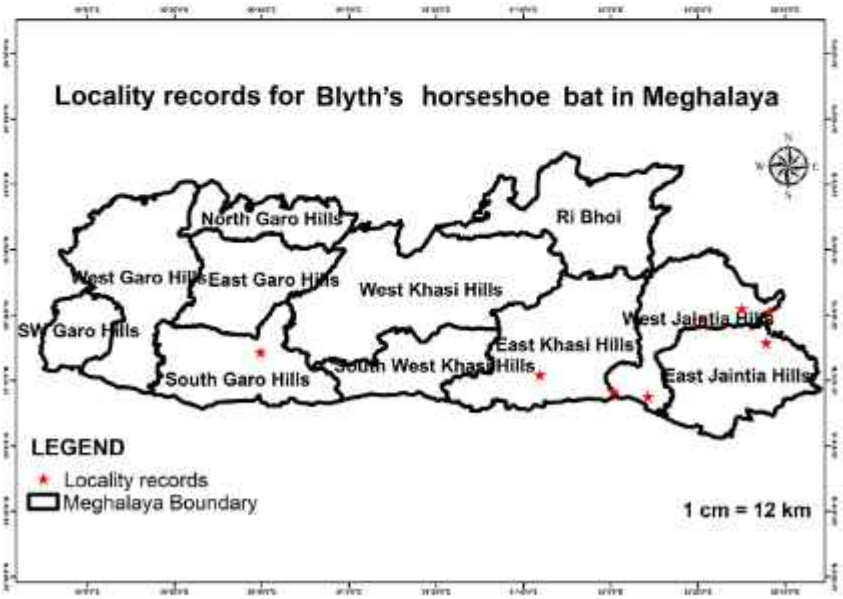
**Natural history note:** In Meghalaya, this species has been recorded within an elevation range of 290-1490 m asl. It typically roosts in caves and abandoned buildings. In Siju cave, a single specimen was mist netted at the cave mouth during February and in Krem Arwah, a roosting individual was collected at about 100 m inside along with Rh. sinicus. Its echolocation call peak frequency ranges from 95-105 kHz and is distinguishable from that of *Rh. affinis, Rh. sinicus* and *Rh. pusillus*

**Distribution:**This is a widely distributed species throughout India occurring in both dry and wet forests. In Meghalaya, this bat is reported from Krem Arwah in East Khasi Hills; Khandong dam site, Syndai, Khonshnong, Shangpung and Shnongpdeng in West Jaintia Hills; Krem Khung in East Jaintia Hills; Siju Cave in South Garo Hills.

**Abundance status:** Common.

| Body measurements in mm.The numbers within bracket indicate mean value. Based on ZSI specimens and released individuals from Meghalaya and Himachal Pradesh. | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 16.3-22.0 (18.9) | 14.5-18. (16.1) | 36.1-38.9 (37.5) | 14.8-16.2 (15.6) | 5.6-7.6 (6.5) |


Manuel Ruedi and Uttam Saikia


Locality records for Blyth's horseshoe bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
West Jaintia Hills
SW Garo Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Rhinolophus macrotis* Blyth, 1844

**English name:** Big-eared horseshoe bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is a small species of horseshoe bat with an average forearm length of 43 mm in Indian specimens.Compared to the body size, ears are very large and are translucent in colour. The pelage is beige brown on the back while the belly is lighter. The horseshoe is broad covering the muzzle and with a distinct median notch. There are smaller accessory leaflets on the sides of the horseshoe although they are not visible in frontal view. The sella is long and directed upward, in lateral view, the superior connecting process of sella is broadly rounded off and the inferior surface runs parallel to the sella. The lancet has convex margins with a tapered tip. The lower lip has three mental grooves.

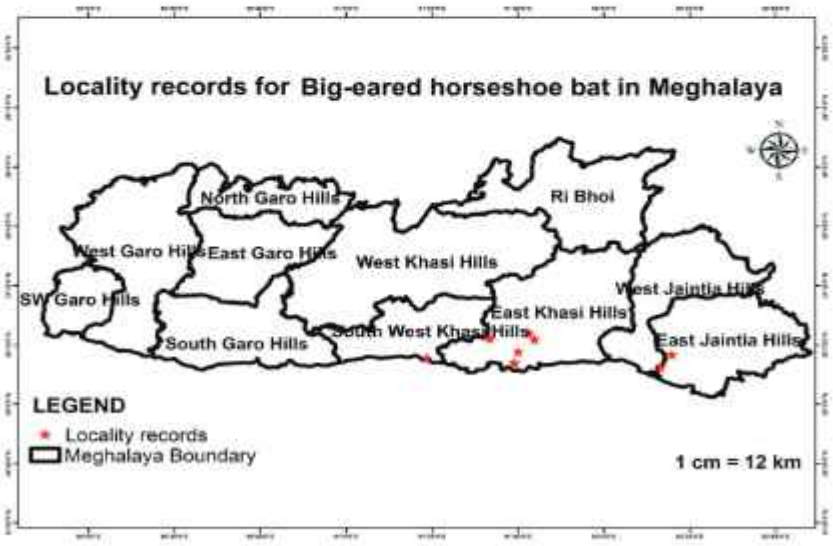
**Natural history note:** In Meghalaya, this species has been recorded within an elevation zone of 60-1490 m asl. A typical cave dwelling bat,reported to be associated with slightly higher elevation areas in India. They roost singly or in small numbers. The echolocation call peak frequency is around 60 kHz and overlaps with the sympatric *Rh. pearsonii*.

**Distribution :** In India, this species is distributed in the Himalayan region of India including Uttarakhand, Darjeeling area of West Bengal, Arunachal Pradesh and Meghalaya.The reported localities in Meghalaya includeKrem Arwah, Krem Madury, Mawsmai cave, Shella, Cherrapunji and Laitkynsew in East Khasi Hills; Phut-jaut in South West Khasi Hills; Kharkhana and Umlyngsha in East Jaintia Hills.

**Abundance status** : Common.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens and released individuals from Meghalaya | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 22-25 (23.5) | 19.5-25.4 (22.0) | 42.2-43.8 (43.1) | 17.8-18.2 (18.0) | 7.2-8.5 (7.8) |


Manuel Ruedi and Uttam Saikia


Locality records for Big-eared horseshoe bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Rhinolophus pearsonii* Horsfield, 1851

**English name :** Pearson's horseshoe bat

**Local names :** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** A medium sized horseshoe batwith an average forearm length of 52.5 mm in Indian specimens. The pelage is long and woolly, dorsally chestnut brown, slightly paler on the belly. Ears are very long compared to the body size. The nose-leaf is similar to the Great woolly horseshoe bat but without the circular basal lappets in the former. The horseshoe is broad covering the entire muzzle and has a wide and deep emargination. When viewed laterally, the superior connecting process of the sella is rounded, deflected downward but the inferior surface is almost straight. The lancet is triangular with a relatively pointed tip. The lower lip has single mental groove. The tail membrane is characteristically covered with hairs on the upper surface.

**Natural history note:** In Meghalaya, this species has been recorded between 60-1220 m asl. It roosts singly or in small numbers, about eight individuals were seen roosting near the entrance of Krem Sunrang Labit. It feeds in forest clearings by perching at a branch and launching sallies after flying insects. Its echolocation peak frequency of 60 kHz overlaps with that of the sympatric *Rh. macrotis*.

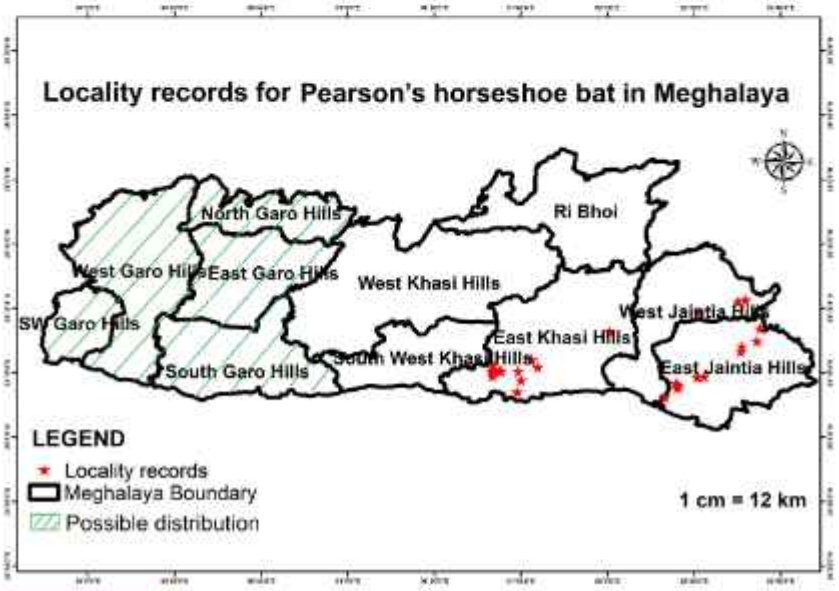
**Distribution :** In India, distributed in the Himalayan region including Uttarakhand, Darjeeling area of West Bengal, Sikkim, Meghalaya and Mizoram. In Meghalaya, this is one of the most widespread species of horseshoe bat and recorded from Krem Puri, Umtong near Mawkynrew, Mawsmai Cave, Cherrapunji, Laitkynsew, Krem Mawsyrwait, Shella, Krem Pamskey in Mawlongbna, Krem Tylong Kobah, Krem Puri, Krem Mawphun, Krem Lumshken and Krem Lew Long in East Khasi Hills; Khonshnong, Lakadong and Shangpung in West Jaintia Hills; Krem Synrang Labit, Krem Labit Mynlin, Krem Lumjingtep, Krem Lymke, Krem Khung, Kren Lymbait, Krem Sahiong, Kharkhana, Tangsen and Umlyngsha in East Jaintia Hills and "Garo Hills".

**Abundance status :** Common.

| Body measurements in mm. Based on ZSI specimen and released individuals from Meghalaya | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 19.3-26.0 (22.1) | 22.0-27.5 (24.5) | 50.4-53.8 (52.5) | 25.4-27.7 (26.7) | 9.4-12.6 (11.1) |



Uttam Saikia



## *Rhinolophus perniger* Hodgson, 1843

**English name :** Great woolly horseshoe bat

**Local names :** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** The largest of all horseshoe bats globally, the average forearm length of Indian specimens measures about 70 mm. It is easily recognizable from its long woolly fur which is dorsally dark brown to black with lighter tips in some hairs giving a frosted appearance. Ventral fur is little lighter, but in some individuals this is not noticeable. Horseshoe is broad, extending beyond the margins of upper lip. There is a deep median emargination on the horseshoe dividing it in to two halves. The sella base has pronounced circular basal lappets on either side. The connecting process of the sella is rounded off downward and forward. The lancet is broadly rounded off. The lower lip has only one mental groove.

**Natural history note:** This is a forest dwelling species although occasionally found near human habitations and mostly inhabit in the hilly region. They roost singly, in pairs and rarely in small groups inside caves, rock shelters, and abandoned buildings or inside tree holes. In Saipung area in East Jaintia Hills, a group of about ten individuals were observed roosting in a rock overhang. In Himachal Pradesh and Uttarakhand, they were observed to roost singly in abandoned buildings and rock shelter and reported to give birth in the month of June. The peak frequency of its echolocation call is about 30 kHz, which is the lowest among all horseshoe bats found in South Asia.

**Distribution:** In India, this species is primarily restricted to the Himalayan region from Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Assam, Meghalaya and Nagaland. There is a single report from Madhya Pradesh in Central India. Widely distributed in Meghalaya including Mawphlong and Mawryngkneng in East Khasi Hills; Nongnah in South West Khasi Hills; Krem Labit Mynlin, Krem Lymke, Saipung, Pynurkba, Kharkhana, Umlatdoh, Krem Lymbiat Lakadong, Krem Sahiong I and Krem Khung in East Jaintia Hills; Khonshnong in West Jaintia Hills.

**Abundance status:** Common.

Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens and released individuals from Meghalaya and Himachal Pradesh.

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 45-54 (49.3) | 33-41 (38.7) | 64.5-75.3 (71.9) | 37.8-40.0 (39.1) | 15.5-19.0 (17.3) |


Manuel Ruedi and Uttam Saikia


Locality records for Great woolly horseshoe bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Rhinolophus pusillus* Temminck, 1834

**English name:** Least horseshoe bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A small species, the forearm length averages 35 mm. Pelage is fine and soft, dorsally cinnamon to dark brown and the belly is lighter brown with a greyish tinge. The horseshoe is wide, the median emargination is shallow. In lateral view, the connecting process is acutely triangular in shape. This shape is a distinguishing feature of this bat from very similar *Rh. lepidus* which has a slightly tapered connecting process. The lancet is thick, elongated and the tip is rounded off. The lower lip has three mental grooves.

**Natural history note:** In Meghalaya, this species has been recorded between c.120-1500 m asl.It is known to roost in small numbers incaves or even in houses in forested areas. In Meghalaya, most of the records are from caves, although a few were also netted inside forests. In Krem Umadoh, a small roosting colony was observed which it shared with Hi. gentilis. In Assam, a small roosting colony was located in the ceiling of a human dwelling in a semi-urban area. In Uttarakhand, its call has been recorded with a peak frequency of 110 kHz which is higher than similar looking *Rh. lepidus.*

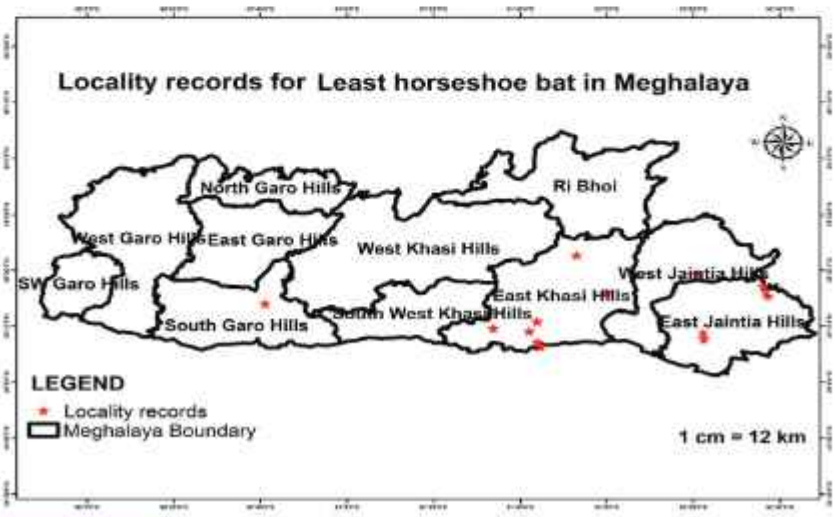
**Distribution:** In India, this species is reportedly distributed in Andhra Pradesh, Karnataka, Kerala, Uttarakhand, West Bengal, Sikkim, Assam, Arunachal Praddesh, Manipur and Meghalaya. In Meghalaya, recorded localities include Khulbolmaggre and Siju cave in South Garo Hills; Cherrapunji, Shillong, Krem Pam Skey near Mawlongbna, Mawshamok, Majai, Sohbar in East Khasi Hills; Shangpung and Krem Lymbit in West Jaintia Hills; Krem Byliiat, Krem Shalong, Krem Umadoh in Lumshnong, Krem Poh Lakhar and Khannar in East Jaintia Hills.

**Abundance status:** Common.

Body measurements in mm. The numbers within bracket indicate mean value. Based on Bates & Harrison, 1997

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 13.5-26.0 (20.4) | 15.5-17.5 (16.5) | 34.9-37.8 (37.0) | 14.2-16.3 (15.2) | 6.6-8.2 (7.2) |


Uttam Saikia


Locality records for Least horseshoe bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Rhinolophus siamensis* Gyldenstople, 1917

**English name :** Thai horseshoe bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** It is a relatively smaller horseshoe bat with average forearm length of 42 mm. Externally, this species is very similar to the Big-eared horseshoe bat except for the slightly smaller forearm length. Like its bigger cousin, the horseshoe is broad covering the muzzle and has a secondary nose-leaf on either side but obscured by the horseshoe. There are three mental grooves on the lower lip. It is practically impossible to differentiate between the two based on external morphology. However, on the basis of higher frequency of their echolocation calls (64 kHz against 49 kHz in *Rh.macrotis*), they can be differentiated.

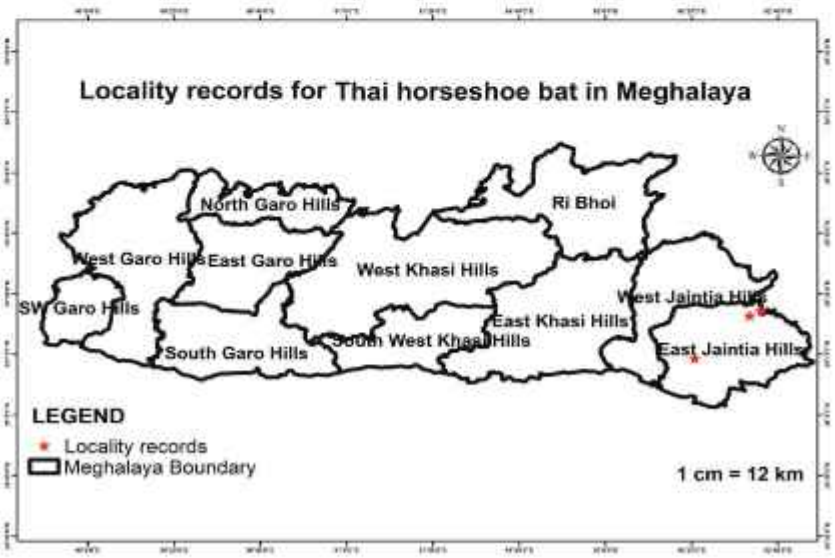
**Natural history note:** Not much information is available on the ecology of this species globally. It was caught in a few caves and also trapped in a forest adjacent to cave in Jaintia Hills indicating its roosting preference. In southern China too, this species reportedly roosts in caves and mines in small numbers. The echolocation calls recorded in Meghalaya individuals had a peak frequency of 64.2 kHz corresponding to the range of 60-69 kHz reported from China.

**Distribution :** In India, this species is so far only reported from Meghalaya. The localities include forests near Krem Labit Kseh, Krem Bylliat and Krem Dieng Jem in East Jaintia Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens and released animals from Meghalaya | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 18.2-20.0 (19.2) | 20.4-22.4 (21.4) | 40.7-43.1 (42.0) | 17.2-18.1 (17.7) | 6.4-7.9 (7.2) |


Adora Thabah


Locality records for Thai horseshoe bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Rhinolophus sinicus* Anderson, 1905

**English name:** Chinese horseshoe bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** It is a medium sized bat with average forearm length of 48 mm. The dorsal pelage is bright buffy brown, slightly lighter ventrally. The nose-leaf does not cover the entire muzzle and has a shallow median emargination. On both sides of the horseshoe, a well-developed secondary leaflet is present. The lancet is hastate and in the examined Meghalaya individuals, the apex is shorter. When viewed laterally, the connecting process of the sella appears rounded and directed downward.

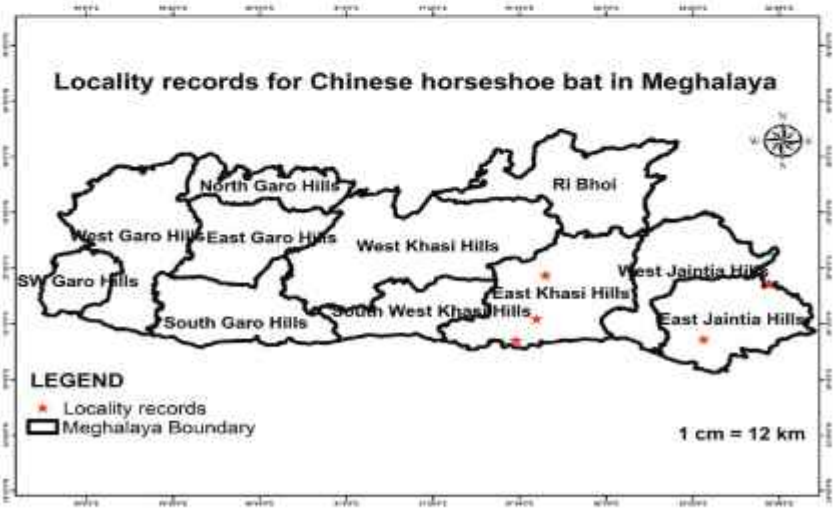
**Natural history note:** In Meghalaya, this species has been recorded within 65-1430 m asl mostly from cave roosts. In Himachal Pradesh and Uttarakhand, it has been netted and recorded inside and at the edge of oak forests. The peak call frequency has been recorded on around 85 kHz in Uttarakhand and Himachal Pradesh. In Uttarakhand, this frequency overlaps with *Rh. affinis* but in Himachal Pradesh, *Rh. affinis* calls at around 80 kHz.

**Distribution :** In India, it is distributed inHimachal Pradesh, Uttarakhand, Sikkim, West Bengal, Arunachal Pradesh, Manipur, Meghalaya and Nagaland. In Meghalaya, it is known from Cherrapunji, Mawphlang and Shella in East Khasi Hills; Krem Shnong and Krem Bsein in East Jaintia Hills.

**Abundance status:** Common.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on specimens in ZSI from Himachal Pradesh | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 26-30 (27.3) | 17.6-19.1 (18.1) | 45.1-50.2 (48.3) | 18.1-20.4 (19.5) | 8-10 (9.0) |


Manuel Ruedi and Uttam Saikia


Locality records for Chinese horseshoe bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

### *Rhinolophu subbadius* Blyth, 1844

**English name:** Little Nepalese horseshoe bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

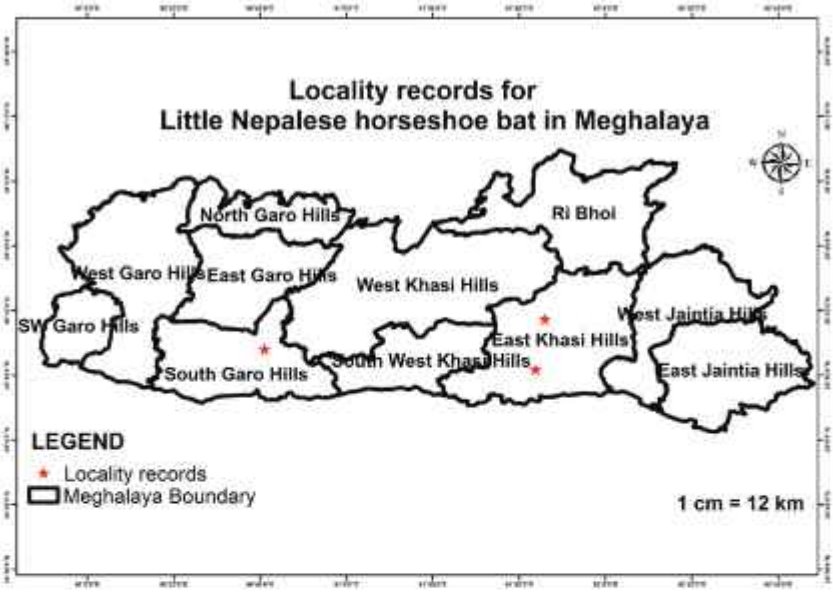
**Descriptions:** This is the smallest horseshoe bat species in the world. According to Sinha (1999a), the forearm length of two Meghalaya specimens range between 34-37.3 mm. Pelage is cinnamon brown with lighter base and brownish tips, underparts are slightly lighter. The connecting process of sella ends in a slender sharply pointed tip. The lancet is triangular. The lower lip has three mental grooves. The tail is comparatively shorter at 16 mm.

**Natural history note:** Nothing is known about biology of this species in India. According to Kemp (1924), one individual was shot in the entrance of Siju cave (290 m asl) during dusk and it is a solitary species.

**Distribution:** In India, this species is reported from the northeastern states of Arunachal Pradesh and Meghalaya. In Meghalaya, it is known from Siju Cave in South Garo Hills; Mawphlang and Cherrapunji in East Khasi Hills.

**Abundance status:** Uncommon. No recent reports.

| Body measurements in mm. Specimens from Meghalaya, based on Sinha, 1999a | | | |
|---|---|---|---|
| Tail length | Forearm length | Tibia length | Hind feet length with claw |
| 16.0 | 34.0-37.3 | 12.6-13.5 | 6.5-7 |


Locality records for
Little Nepalese horseshoe bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

# Hipposideridae

## Old World leaf-nosed bats

Closely allied to horseshoe bats, the Old World leaf-nosed bats globally consist of over 70 species distributed through the tropics of Africa, Asia and Australia. Like horseshoe bats, these bats possess a short muzzle with elaborate modifications of facial muscles and skin. These facial structures consist of a horizontal horseshoe sometimes with accessory leaflets, an intermediate and a posterior leaf although the extent and nature of these modifications varies with different genera. Sella and lancet as seen in Rhinolophidae are absent in this family. The tail is well-developed and enclosed in the interfemoral membrane. The echolocation calls of leaf-nosed bats are about 10-30 ms long and the shape is described as CF-FM, resembling an inverted hockey stick. Like horseshoe bats, the peak frequencies of different species are fairly well-segregated, thereby making acoustic identification possible. They are gregarious and a few species roost solitary in caves, tunnels, abandoned mines and concrete structures like bridges etc. Among the 16 species known from India, seven species are reported in Meghalaya.




Close up view of *Hipposideros armiger* showing noseleaf structure

## *Coelops frithii* Blyth, 1848

**English name:** Tailless leaf-nosed bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A small bat with an average forearm length of 40.3 mm. The pelage is long and soft, dull light brown dorsally and greyish white on the ventral aspect. The ears are large and roundish and possess a large antitragal lobe, covered with hairs on both the sides. Tail is rudimentary and barely visible and the interfemoral membrane is also poorly developed.These characters easily distinguish this bat from other leaf-nosed bats. The anterior portion of the nose-leaf is divided in to two halves by a deep emargination and possesses two elongated supplementary leaflets on the basal part. The posterior leaf is subdivided in to five cells. The sides of the nose-leaf are covered with long hairs.

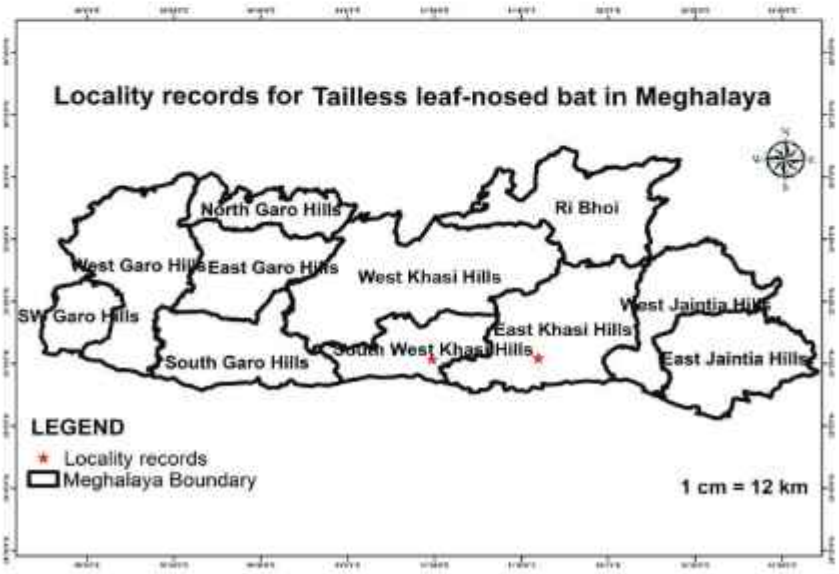
**Natural history note:** No ecological information about this bat is available from Meghalaya. A forest species and known to roost in small groups in caves and tree cavities.

**Distribution :** *Coelops frithii* is a rare bat in India and known by a single record from Darjeeling in West Bengal and two from Meghalaya. In Meghalaya, two recorded localities include Cherrapunji in East Khasi Hills and Nongnah in West Khasi Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. The numbers within bracket indicate mean value. Specimens from Meghalaya, based on Sinha, 1999a | | | |
|---|---|---|---|
| Tail length | Forearm length | Tibia length | Hind feet length with claw |
| 11.5-15.0 (13.1) | 37.8-42.0 (40.3) | 16.5-18.5 (17.4) | 5.3-9.0 (6.9) |


Vu Dinh Thong


Locality records for Tailless leaf-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Hipposideros armiger* (Hodgson, 1835)

**English name:** Great Himalayan leaf-nosed bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** One of the largest species of leaf-nosed bats in India, the average forearm length is 89 mm. The pelage is long and dense and is dark brown dorsally and uniform grey brown ventrally. The ears are larger averaging about 31mm in NE Indian specimens, it is densely covered by hairs on the outer side and on the anterior margin of the inner side. The nose-leaf has four supplementary leaflets, the fourth one is much reduced. The anterior leaf does not possess a median emargination, distinct narinal lappets are present. The upper surface of the median leaf is wave shaped and dotted with whiskers and there is a prominent median process. The posterior leaf is divided into four cells. During breeding season in males, a very prominent fleshy elevation develops behind the posterior leaf.

**Natural history note:** In Meghalaya, it has been recorded within an elevation of 65 -1430 m asl although it is known to be restricted to relatively higher elevation areas in the Himalayas. In Meghalaya, it was observed roosting in caves, abandoned houses and inside a tunnel in a hydroelectric dam. One male individual caught in December from Nongkhyllem WLS showed signs of sexual activity. In Himachal Pradesh, this species was recorded from inside a cave and an ancient mine in small numbers which it shared with a few horseshoe bats. In Uttarakhand this species has been observed roosting in caves in dry, scrub-covered hills or pine forests up to 2000 m asl and also been netted in secondary oak forests close to human habitation.

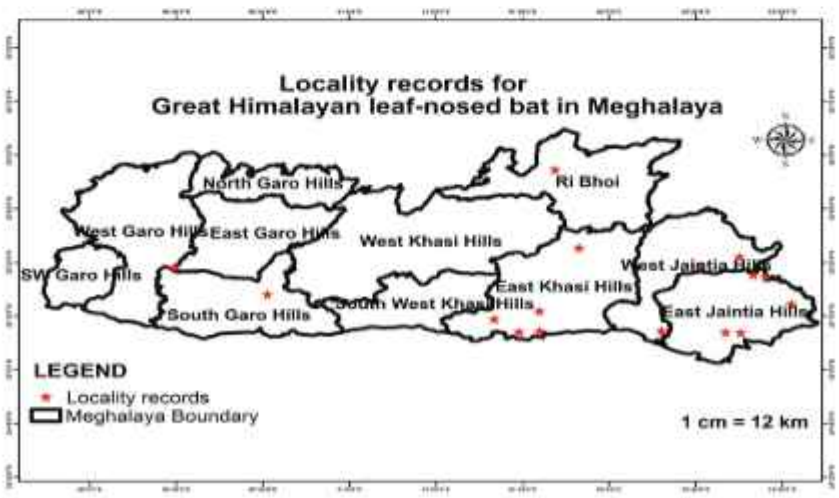
**Distribution :** This species is distributed in the Himalayas and its foothills in Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Assam and Meghalaya. Widespread in Meghalaya, the reported localities in the state include Krem Pamskei Lawbah; Cherrapunji, Sohbar, Shella and Shillong in East Khasi Hills; Nongkhyllem WLS in Ri-Bhoi, Khulbolmagri, Siju cave and Durabanda in South Garo Hills; Khonshnong, Krem Pdeng Laphiang, Shangpung in West Jaintia Hills; Khaddum cave, Krem Labit Kseh, Vatesuandung Bakhur (near Saipung), Krem Lakhon and Piel Klieng Pouk in East Jaintia Hills.

**Abundance status:** Common.

Body measurements in mm. The numbers within bracket indicate mean value. Specimens from Meghalaya, based on Sinha, 1999a

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 50.0-59.0 (54.0) | 23.7-29.4 (25.7) | 82.8-94.8 (88.5) | 36.8-41.5 (38.9) | 15.7-16.3 (16.1) |


Uttam Saikia
Manuel Ruedi


Locality records for
Great Himalayan leaf-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Hipposideros cineraceus* Blyth, 1853

**English name:** Ashy leaf-nosed bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** One of the smallest leaf-nosed bats, the forearm length averages 36 mm. The pelage is variable in colour, dorsally reddish brown to medium brown and the ventral aspect is ginger brown to creamy white. The ears are large and broad with sub acutely pointed tips and possess about 10 horizontal ridges; the inner side especially the anterior border is covered with hairs. The nose-leaf is simple, the basal leaf is undivided and without any supplementary leaflets. A prominent internarial septum is present. The posterior leaf is divided in to two halves by a median septum.

**Natural history note:** In Meghalaya, this species has been recorded within an elevation zone of c. 70 – 1430 m. A small colony of this bat was observed roosting near the entrance of Krem Labit Lumshnong. It was also collected from inside a tunnel of hydroelectric dam in Ri-Bhoi which was shared by several other species like *Hi. gentilis, Hi. armiger* and *Mi magnater.* A deft flyer, it was observed easily avoiding mist nets set in front of the cave mouth.

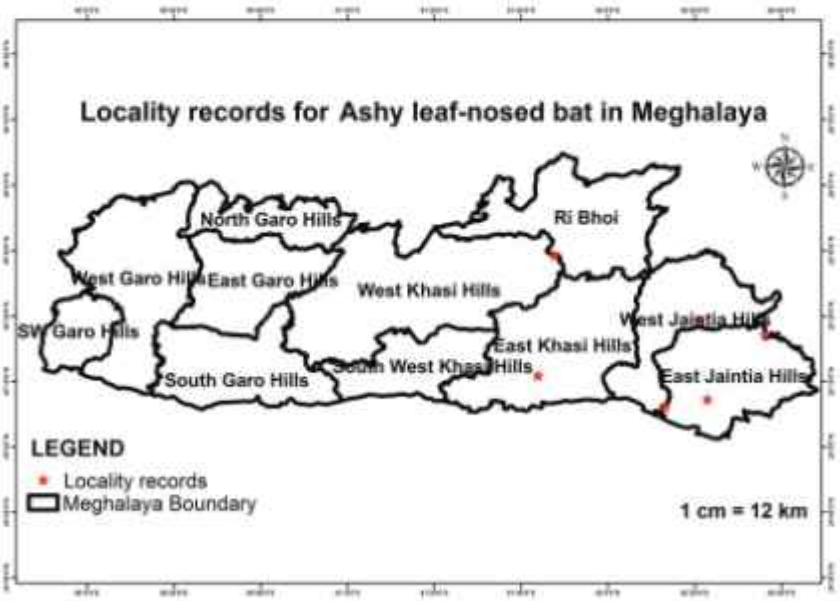
Distribution:Ashy roundleaf bat is distributed in Uttarakhand, Hilly region of West Bengal, Assam, Arunachal Pradesh and Meghalaya. In Meghalaya, reported localities include Cherrapunji in East Khasi Hills; Shangpung in West Jaintia Hills; Krem Labit Lumshnong, Krem Bylliat and Kharkhana in East Jaintia Hills; Umiam Umtrew stage III dam site in Ri-Bhoi.

**Abundance status:** Common.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on released bats from Meghalaya | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 25-31 (28.2) | 14.4-16.4 (15.7) | 33.9-37.0 (35.8) | 14.4-16.4 (15.7) | 5.2-7.3 (6.2) |



Manuel Ruedi



### *Hipposideros gentilis* K. Anderson, 1918

**English name:** Anderson's leaf-nosed bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is a small sized bat with a forearm length of 41 mm. The dorsal pelage varies from light brown to dark brown with lighter hair roots. The ventral surface is lighter. The ears are very large, broad with a prominent antitragal lobe. The nose-leaf is simple, broadly rounded in shape and covered with long vibrissae on the margins. The anterior nose leaf is without any supplementary leaflets and bears a prominent internarial septum. The narial lapets are small in size. The posterior leaf is divided in to four indistinct cells.

**Natural history note:** In Meghalaya, this bat has been recorded between c. 60-1500 m asl. It was recorded in small colonies mostly from inside caves and also inside a tunnel of hydroelectric dam and observed to share roosting site with Hi. cineraceus. In Andaman Islands, this species has been observed roosting in limestone caves and bunkers in colonies of up to 200 individuals inside forests or along the seashore. In the Andaman Islands and southern China its calls were recorded with a peak frequency between 120-125 kHz. In contrast, in Thailand the peak frequency was recorded between 140-145 kHz.

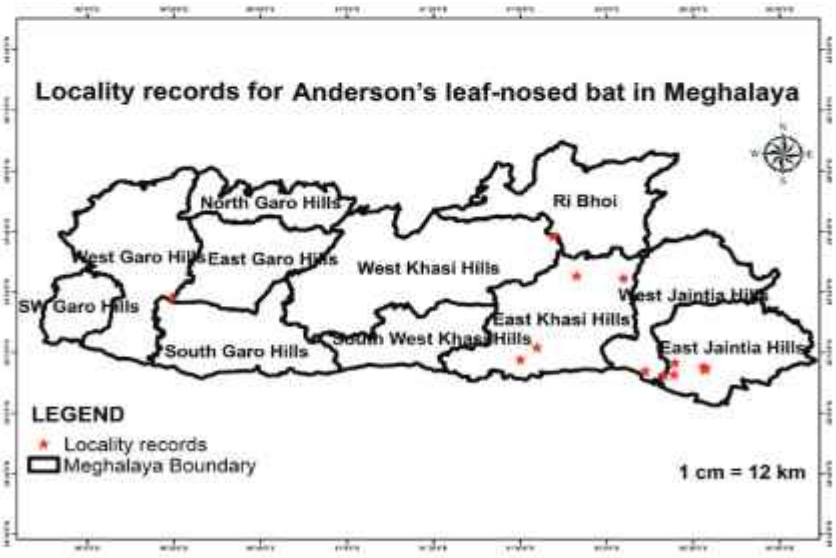
**Distribution :** In India, reported distribution includes West Bengal, Sikkim, Arunachal Pradesh, Assam, Meghalaya, Nagaland and Nicobar Islands. In Meghalaya, it is known from Shillong, Cherrapunji, Laitkynsew and Mawryngkneng in East Khasi Hills; Umiam-Umtrew stage III dam site in Ri-Bhoi; Krem Hartali in West Jaintia Hills; Krem Umadoh, Krem Labit Lumshnong, Lama, Lumshnong, Kharkhana and Umlyngsha in East Jaintia Hills and Durabanda in South Garo Hills.

**Abundance status :** Common.

Body measurements in mm. Numbers in bracket indicate mean value. Data from ZSI specimens and released animals from Meghalaya.

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 29.8-33.0 (32.4) | 26.1-28.1 (27.1) | 40.3-42.5 (41.2) | 35-36.5 (35.7) | 13.3-15.8 (14.5) |


Manuel Ruedi
Uttam Saikia


Locality records for Anderson's leaf-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Hipposideros khasiana* Thabah et al., 2006

**English name :** Khasi leaf-nosed bat

**Local names :** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

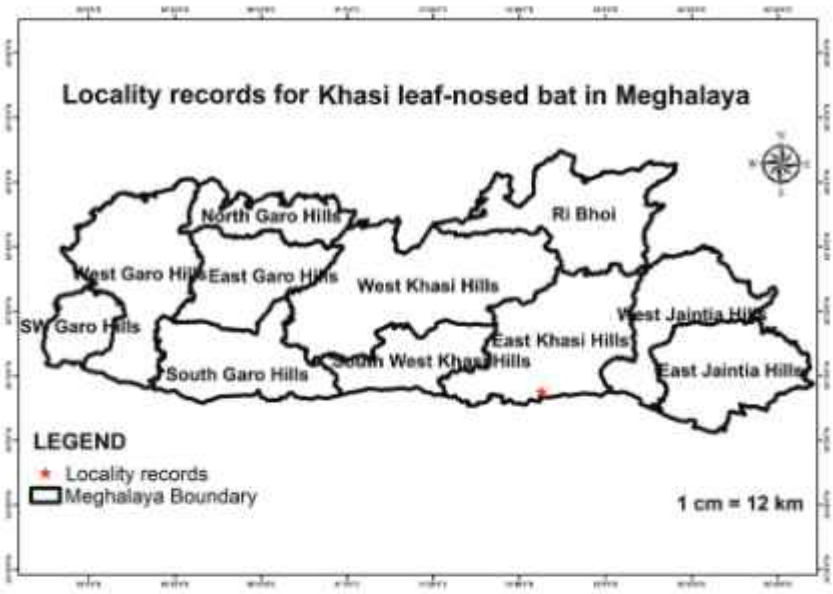
**Descriptions :** Externally identical to *Hi. larvatus* (detailed below) except for slightly smaller body measurements and it is generally not possible to discriminate between the two in the field. This species was recognized on the basis of distinctive echolocation call frequency and genetic uniqueness.

**Natural history note:** This bat was reported from a cave which was located in a betel nut grove and served as a temporary roost prior to the onset of the monsoon. This species and *Hi.* cf. *larvatus* (*Hi. grandis* in Thabah et al. 2006) shared the same roost site without any apparent resource partitioning. This species was described primarily on the basis of distinctive echolocation call with a median peak frequency of 85 kHz and genetic distinctiveness. In Meghalaya, the diet of this species reportedly consists primarily of beetles although moths and termites also constitute relatively minor portions seasonally.

**Distribution:** The only published locality for this species so far is Tem Dibai cave in Sohbar in East Khasi Hills although it is likely to be distributed in other parts of Khasi Hills.

**Abundance status:** Rare.

| Body measurements in mm. Data from Thabah *et al.* 2006 | |
|---|---|
| Ear length | Forearm length |
| 19.3-21.2 | 62.8-64.2 |


Locality records for Khasi leaf-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Hipposideros lankadiva* Kelaart, 1850

**English name:** Indian leaf-nosed bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** Similar in size to *Hi. armiger* with average forearm length of 89.9 mm. The fur is short, dense and variable in colour from medium brown to ginger brown. The hair tips are lighter giving a silky appearance. The ventral fur is slightly lighter. Compared to *Hi. armiger,* ears are relatively smaller with bluntly pointed tips, the anterior inner margin is covered with hairs. The nose-leaf structure is somewhat similar to *Hi. armiger* but the overall profile is slightly elongated compared to the squarish profile in the former. The number of supplementary leaflets is three in almost all the examined specimens from Northeastern India although there may be a very minute fourth leaflets in some individuals.

**Natural history note:** In Meghalaya, this species has been recorded between c.70-1500 m asl. It roosts in small to large colonies in caves and abandoned buildings or monuments and tunnels. In Siju cave, a huge colony of this bat existed not long before although the colony size has reduced significantly in recent times. The echolocation peak frequency is around 75 kHz which differentiates it from *Hi. armiger* which is of similar size.

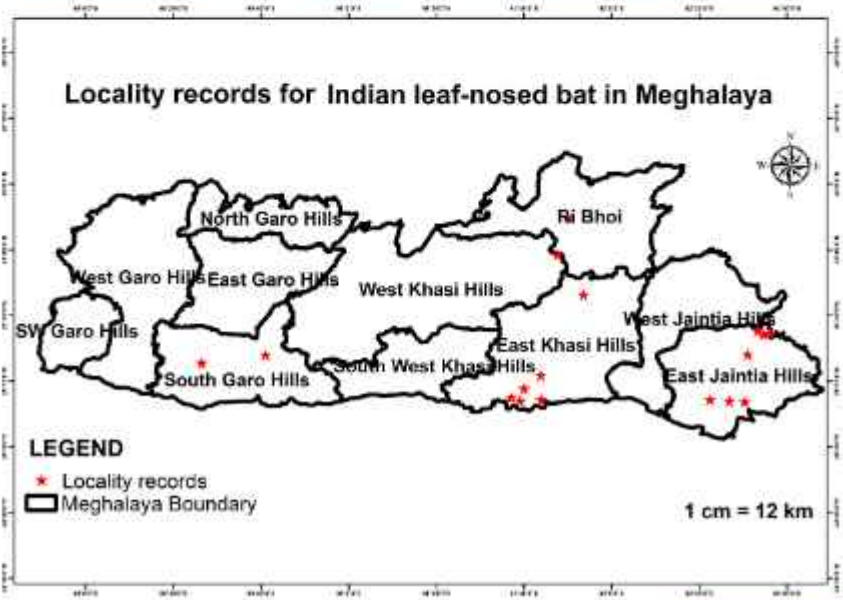
**Distribution :** In India, Indian roundleaf bat is reported from Rajasthan, Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh, Odissa, West Bengal and Meghalaya. In Meghalaya, it has been reported from a large number of localities *i.e.* Cherrapunji, Laitkynsew, Shella, Sohbar, Shillong city and Phrang Karuh cave in East Khasi Hills; Nongpoh, Umiam Umtrew stage III dam site in Ri-Bhoi; Krem Labit Kseh, Krem Dieng Jem, Krem Shnong in Lumshnong, Krem Lakhon, Piel Klieng Pouk, Shnongrim and Khaddum in East Jaintia Hills; Siju cave and Chokpot in South Garo Hills.

**Abundance status:** Common.

Body measurements in mm.The numbers within bracket indicate mean value. Based on ZSI specimens

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 48.8-55.5 (52.9) | 21.3-25.2 (22.8) | 88.4-92.6 (89.9) | 34.9-36.5 (35.8) | 15.8-18.2 (17.5) |


Uttam Saikia


Locality records for Indian leaf-nosed bat in Meghalaya
N
W
E
S
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Hipposideros larvatus* s.l. (Horsfield, 1823)

**English name:** Horsfield's leaf-nosed bat

**Local names:** Do'bak Gamikgri (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A medium sized bat with a forearm length of 63 mm. The pelage colour is variable, in some individuals the dorsal fur is bright golden brown with orange or chestnut tinge in the forehead while in others it is lighter brown. The ventral pelage varies from lighter brown to beige. The ears are large and broad, there is a concavity on the posterior margin just below the tip. The nose-leaf has three supplementary leaflets, the anterior leaf has a shallow median emargination and the narial lappets are well developed. The posterior leaf is divided in to four cells.

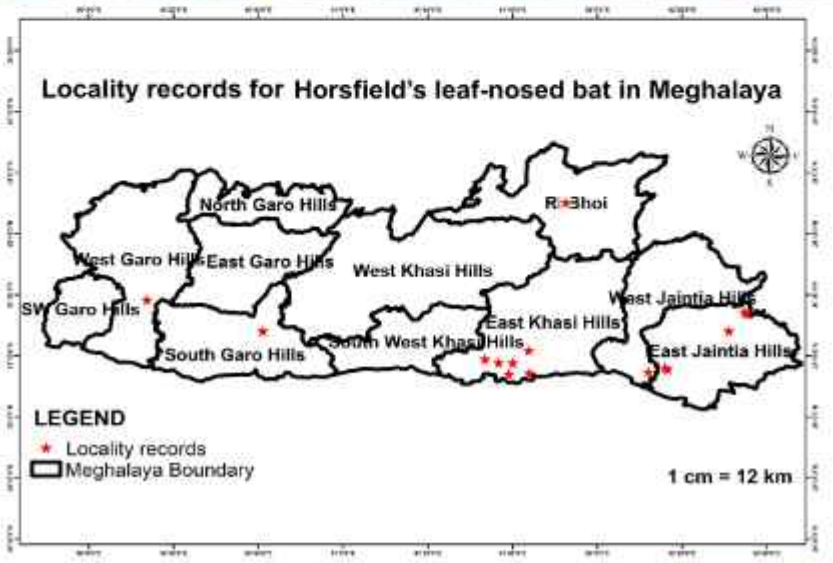
Natural history note: In Meghalaya, this bat has been recorded between elevations of c. 70 -1430 m asl.Predominantly a cave-roosting species, it forms colonies ranging up to a few hundred individuals. In Siju cave, this bat was observed roosting in small groups deep inside (beyond 1000 m from entrance) during February. In Krem Tem Dibai in East Khasi Hills, this species was reported to live in sympatry with *Hi. khasiana* and apparently without any resource partitioning. Beetles contribute the largest chunk of its food spectrum followed by moths. Its echolocation peak frequency is between 95-100 kHz which helps to distinguish it from other sympatric *Hipposideros* spp.

Distribution: Restricted to the northeastern part of India. In Meghalaya, reported across the state from Siju cave in South Garo Hills; Tura in West Garo Hills; Cherrapunji, Laitkynsew, Shella, Nongtrai, Krem Pamskei in Lawbah and Sohbar in East Khasi Hills; Nongpoh in Ri-Bhoi; Umlatdoh, Thangsah, Krem Labit Mynlim, Krem Pdiem Dharai, Krem Dieng Jem and Shnongrim in East Jaintia Hills and Thangsah in West Jaintia Hills.

**Abundance status:** Common.

| Body measurements in mm.The numbers within bracket indicate mean value. Based on ZSI specimens | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 38.0-42.6 (40.26) | 21.6-24.2 (22.5) | 60.7-63.8 (62.5) | 25.2-28.1 (26.2) | 11.2-12.0 (11.7) |




Locality records for Horsfield's leaf-nosed bat in Meghalaya
North Garo Hills
Ri-Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## Family: Megadermatidae
### False vampire bats



The family Megadermatidae commonly known as false vampire bats represents the basal clade in the superfamily Rhinolophiodea and distributed in Central Africa, South Asia and Australia. The members of this family are distinguished by a suite of characters i.e large oval ears joined over the forehead, a bifid tragus, simple erect nose-leaf and absence of tail. The second finger characteristically possesses only one phalanx instead of usual two. Megadermatid bats are carnivorous and they use their large ears to listen to the sounds made by their prey. Their echolocation calls are soft and multi-harmonic. In India, this family is represented by two genera and species, i.e.*Lyroderma lyra*, the Greater false vampire bat and *Megaderma spasma*, the Lesser false vampire bat, both of which occur in Meghalaya.

## *Lyroderma lyra* (É.Geoffroy Saint-Hilaire, 1810)

**English name:** Greater false vampire bat

**Local names:** Do'bakchil (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** The larger of the two false vampire bats, the average forearm length stands at 67 mm. The ears are very large which joins medially at around half of their height. The tragus is tall and bifid with the posterior process taller than the anterior one. The nose-leaf is erect, longish and slightly convex at the sides and has a prominent median ridge. The tip of the nose-leaf is abruptly truncated with a flat profile and the base is rounded. The pelage is long and silky, uniform grey with streaks of light brown on the back while the throat and belly is whitish.

**Natural history note:** In Meghalaya, this species has been reported within elevations between c. 60-550 m asl. Known to roost in a variety of places like caves and mines, abandoned man-made structures like temples, houses, forts, godowns etc. Colony size varies from a few individuals to numbering in hundreds, but can also be found roosting singly. It is a carnivorous bat known to hunt a variety of animals like small birds, bats, fishes, frogs, lizards, mice and shrews. Besides, depending on the seasonal abundance, it also preys upon beetles, termites etc.

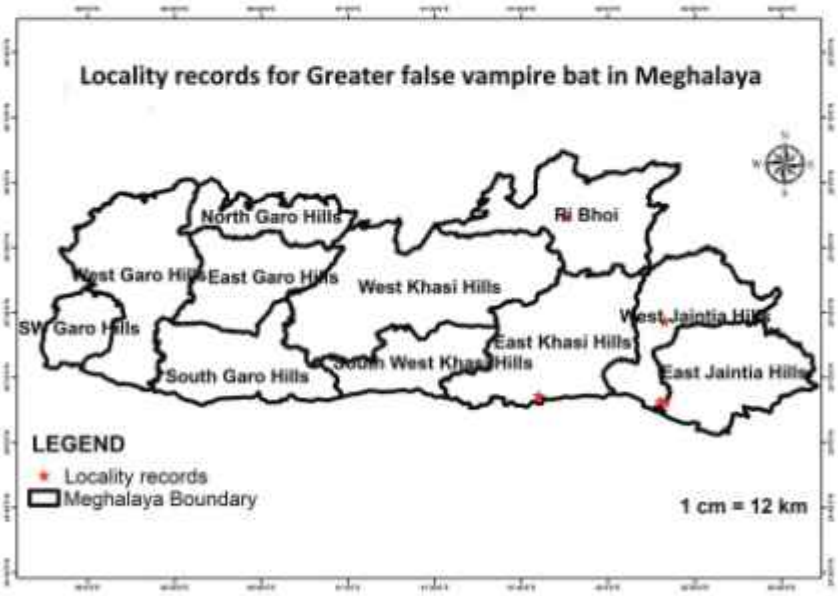
**Distribution :** One of the most widely distributed bat species in India and found across deserts, coastal region to hills. In Meghalaya, it is known from Kherapara in West Garo Hills; Nongpoh in Ri Bhoi; Sohbar in East Khasi Hills; Krem Hartali in West Jaintia Hills and Kharkhana in East Jaintia Hills.

**Abundance status:** Common.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on released animals from Meghalaya. | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 31 | 34.2-38.5 (35.6) | 64.5-68.0 (66.9) | 33.7-35.8 (34.7) | 14.9-18 (16.9) |


Rohit Chakravarty


Uttam Saikia


Locality records for Greater false vampire bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Megaderma spasma* (Linnaeus, 1758)

**English name:** Lesser false vampire bat

**Local names:** Do'bakchil (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** Externally similar to the Greater false vampire bat to some extent, this is much smaller than the former with an average forearm length of 56.9 mm. The ears join medially much closer to the forehead compared to *Ly. lyra*. The posterior part of the tragus is narrowly pointed and much longer than the anterior part. The nose-leaf is shorter with convex sides with a rounded tip, has a median ridge with a heart shaped basal portion. The back is uniform dark grey while the throat and belly is light grey.

**Natural history note:**In Meghalaya, this species has been recorded between 210-1500 m asl. Its natural roost include caves although can become adapted to a variety of man-made structures. In Nongkhyllem WLS, a medium sized colony was observed roosting for several years inside the hole of a dead *Ficus* tree and also in nearby abandoned houses. Juveniles were observed in the colony in early July indicating parturition in end of May of early June. Diet reportedly consists of large insects like grasshoppers, moths and butterflies, beetles but unlike its larger cousin, does not prey upon vertebrates.

**Distribution:** In India, Lesser false vampire bat is widely distributed in Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Goa, Maharashtra, Kerala, Tamil Nadu, Odissa, West Bengal, Assam, Meghalaya, Mizoram and the Andaman and Nicobar Islands. In Meghalaya, this bat has been reported from Nongkhyllem Wildlife Sanctuary in Ri Bhoi; Narpuh Widllife Sanctuary in East Jaintia Hills and Shillong city in East Khasi Hills.

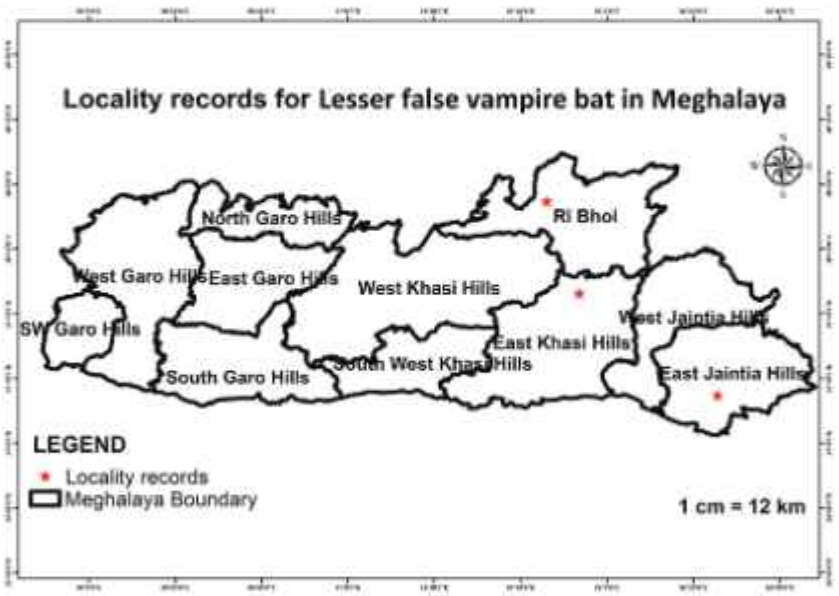
**Abundance status:** Uncommon.

Body measurements in mm. The numbers in bracket indicate mean values. Based on Bates & Harrison, 1997 and ZSI specimens

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|---|
| 40 | 33.0-40.0 (36.9) | 16.2, 17.0 | 54.0-62.0 (56.9) | 34.4-35.5 (34.7) | 13.0-17.0 (15.9) |


Uttam Saikia


Rohit Chakravarty



## Family: Emballonuridae

### Sheath-tailed bat

The family Emballonuridae is a group of diverse and geographically widespread bats distributed in the tropical and sub-tropical regions of the world. In these bats, a portion of the tail characteristically protrudes out from the upper surface of the tail membrane. In certain members in this family, a glandular sac is present in each side of the wings. The wings are long and narrow indicating their strong flight capability, the second digit in each wing is without any phalanges. These bats have a simple pointed muzzle without any nose-leaf, ear possesses a tragus. As mostly open-space foraging bats, sheath-tailed bats produce echolocation calls in the range of 20-30 kHz. Their calls are multi-harmonic and the second harmonic is typically the loudest (dominant harmonic). Among the six species of Emballonurids found in India, two species are reported from Meghalaya.



Rohit Chakravarty

## *Saccolaimus saccolaimus* (Temminck, 1838)

**English name:** Bare-rumped sheath-tailed bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A medium sized bat with an average forearm length of 65.5mm. On the upper surface, the pelage is dark brown to black with small irregular patches of white hairs giving a spotted appearance. Underpart is greyish brown. A pouch of skin called gular sac is present in the chin area which is more prominent in males. The lower lip has a deep furrow, ears are comparatively smaller, triangular shaped and the tragus is mushroom shaped. The wing attaches to the ankle. The half of the tail is loosely enclosed within the interfemoral membrane while the other half protrudes out.

**Natural history note:**The Bare-rumped sheath-tailed bat is a widespread species and its habits differ across its range.In South India, it is known to roost in small colonies in the hollow trunks of kitul *(Caryota urens)* and areca nuts *(Areca catechu)*, and it forages in clearings, or above the canopy in wet forests and swampy habitat. In Southeast Asia, it is not uncommon in human-modified habitats such as urban settlements and agricultural fields. In Assam, specimens were caught roosting under dry areca palm leafs. Its echolocation calls are around 10-15 ms long and are of low frequency (often sliding into the audible range). The end frequency of the second harmonic (the dominant harmonic) is usually between 18-22 kHz. In peninsular India, this overlaps with the calls of *Taphozous theobaldi* and *Ta. nudiventris*. In the absence of these species in Meghalaya, it may be possible to identify *Sa. saccolaimus* from acoustic records.

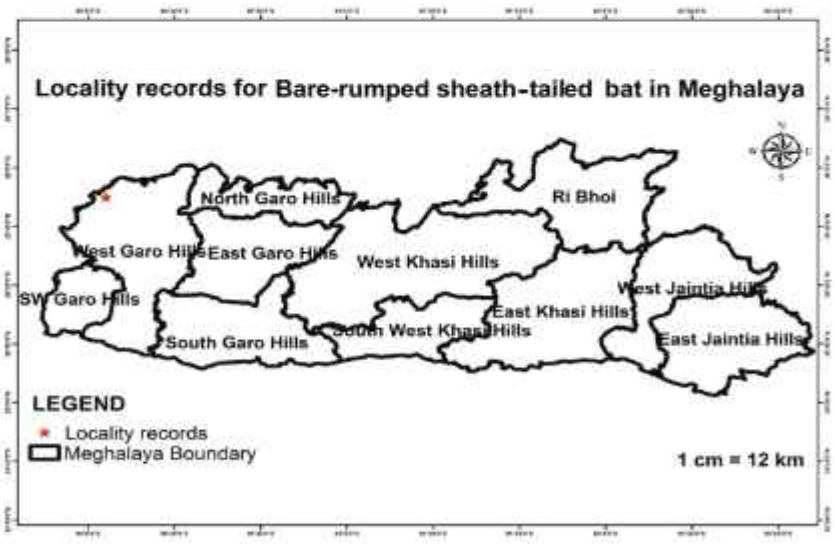
**Distribution:**In India, reported from Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, Madhya Pradesh, West Bengal, Assam, Meghalaya and the Nicobar Islands. In Meghalaya, there is a single record of this species from Phulbari in West Garo Hills.

**Abundance status:** Rare.

Body measurements in mm. The numbers in bracket indicate mean values . Based on Bates & Harrison, 1997 and ZSI specimen

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|---|
| 21.0-35.0 (25.5) | 16.0-20.0 (18.7) | 5.5 | 63.0-68.2 (65.5) | 28.0 | 12.0-17.0 (14.6) |


Ananda Ram Boro


Locality records for Bare-rumped sheath-tailed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Taphozous melanopogon* Temminck, 1841

**English name:** Black-bearded tomb bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This species is comparable in size to *Sa. saccolaimus* with an average forearm length of 64.6 mm. The dorsal pelage is greyish brown and the ventral fur is slightly paler. As the common name suggests, the adult males grow a darker coloured tuft of hairs in the chin area akin to beard. No gular sac is present. The ears are small and the tragus is mushroom shaped. In the wings, the radio-metacarpal pouch is well developed. The wing attaches to the tibia. The protruding portion of the tail is laterally compressed.

**Natural history note:** *Ta. melanopogon* is widespread in India and Southeast Asia in dry and open country. It often roosts in caves or abandoned forts in large colonies containing thousands of individuals. In Assam, this species was frequently observed to roost inside the dry leaves of areca palm. Males and females roost in separate colonies after mating. Pups are usually born in June and July in peninsular India. It hunts in clearings in dry forests, agricultural fields or over the sea (in Andaman Islands).Its echolocation call has an end frequency (at the second harmonic) around 24-28 kHz, which is higher than *Sa. saccolaimus*. In other parts of South Asia, its call overlaps with Ta. longimanus.

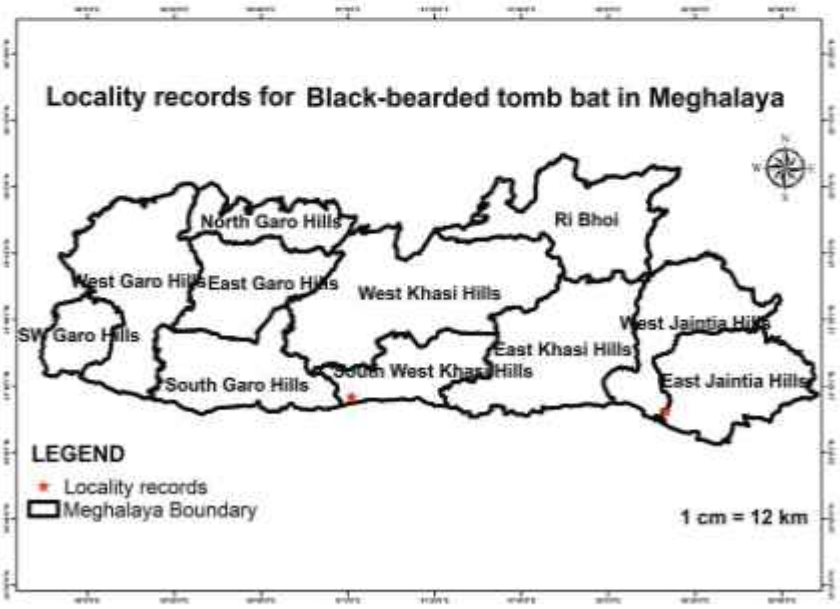
**Distribution :** In India, reported from Delhi, Rajasthan, Gujarat, Maharashtra, Goa, Karnataka, Andhra Pradesh, Kerala, Tamil Nadu, Madhya Pradesh, Odissa, Andaman and Nicobar Islands, Assam and Meghalaya. In Meghalaya, this bat is reported from Mondil Kol in South West Khasi Hills and Kharkhana in East Jaintia Hills.

**Abundance status:** Uncommon.

Body measurements in mm. The numbers in bracket indicate mean values . Based on Bates & Harrison, 1997 and ZSI specimens

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|---|
| 20.0-32.0 (24.5) | 16.5-22.0 (20.0) | 5.8-6.1 | 60.0-68.0 (64.6) | 25.2-25.9 | 8.2-14.2 (11.4) |


Uttam Saikia


Locality records for Black-bearded tomb bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

# Molossidae
## Free-tailed bats




Molossidae is a large family of bats comprising over 110 species and distributed worldwide. Members of this family are characterized by a stout tail projecting out of the small interfemoral membrane, long and narrow wings that offer them a strong flying ability and wrinkly snout projecting over the lower lips. The ears are fleshy, lying low over the head and sometimes join over the forehead. The tragus is rudimentary, but antitragal lobe is well developed. They produce low frequency calls (often audible) of long duration. Unlike Emballonurid calls, the calls of Molossids are not multi-harmonic. Among the four species of Molossids reported from India, two are known to be distributed in Meghalaya.

## *Chaerephon plicatus* (Buchanan, 1800)

**English name:** Wrinkle-lipped bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is the smallest free tailed bat in India with average forearm length of 46.3 mm. The pelage is short, dark brown dorsally and greyish white ventrally. The muzzle projects well beyond the upper lip, it is covered with vibrissae along the rostral region, lip margins are dotted with short hairs. The nostrils are circular and open laterally, the upper lip is wrinkled. The ears are large, fleshy and join over the forehead, the tragus is minute but antitragal lobe is large. The wings are long and narrow with significantly shorter fifth metacarpal, the wing and tail membranes are naked.

**Natural history note:** In Meghalaya, this species was reported between altitudes of 350-1430 m asl.It is a highly gregarious species, across the range it roosts in limestone caves in colonies containing thousands of individuals although such large colonies have not yet been reported from India. In China, their diet primarily consist of beetles and moths while in Thailand, it is reported to predominantly consume mosquitoes and planthoppers. They are reported to feed over rice fields where they consume pest insects such as leaf hoppers. Their evening exodus makes for an appealing sight that attracts a lot of tourists. The echolocation calls have an end frequency around 18-20 kHz and with a distinctive peak frequency above 21 kHz.

**Distribution:** In India, it is distributed in Punjab, Rajasthan, Maharashtra, Goa, Tamil-Nadu, Madhya Pradesh, Uttar Pradesh, Uttarakhand, West Bengal and Meghalaya. In Meghalaya, it is reported from Tura in West Garo Hills and Cherrapunji in East Khasi Hills.

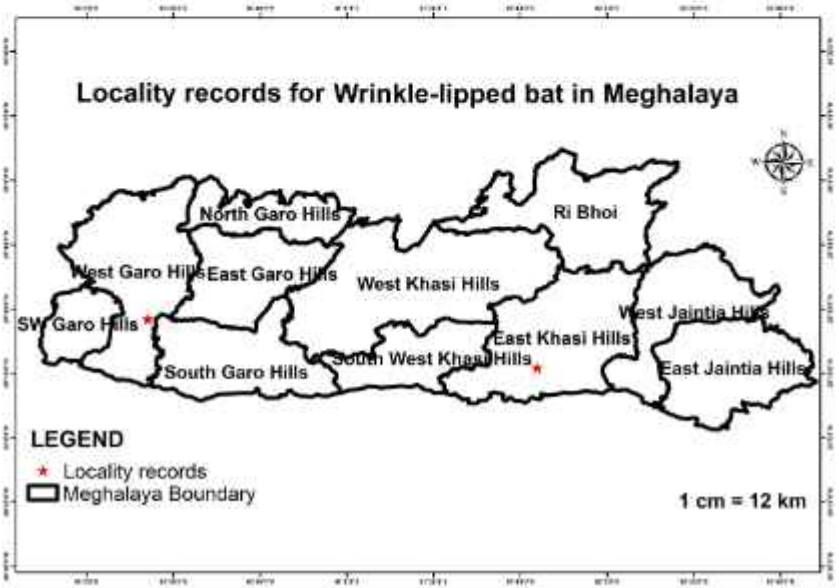
**Abundance status:** Uncommon.

Body measurements in mm.The numbers within bracket indicate mean value. After Bates & Harrison, 1997

| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
|---|---|---|---|---|
| 30.0-44.0 (39.1) | 16.0-21.0 (19.5) | 43.1-50.2 (46.3) | - | 9.0-11.3 (10.2) |


Rohit Chakravarty


Pratt Solsbak


Locality records for Wrinkle-lipped bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Otomops wroughtoni* (Thomas, 1913)

**English name:** Wroughton's free-tail bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** It is a robust species with a forearm length of about 67 mm. An unmistakable bat with a glossy dark chocolate pelage on the back, grey white hairs over the shoulders and nape and a buffy brown ventral surface with greyish collar. The dorsal and ventral pelage is demarcated by a thin whitish border. Ears are large that join over the forehead, tragus is triangular in shape and very small. The nostril pad projects well beyond the lower lip and the nostrils open sideways. The mouth opening is wide with fleshy borders. A gular sac is present in both the sexes. Tail is stout and greatly projects beyond the interfemoral membrane.

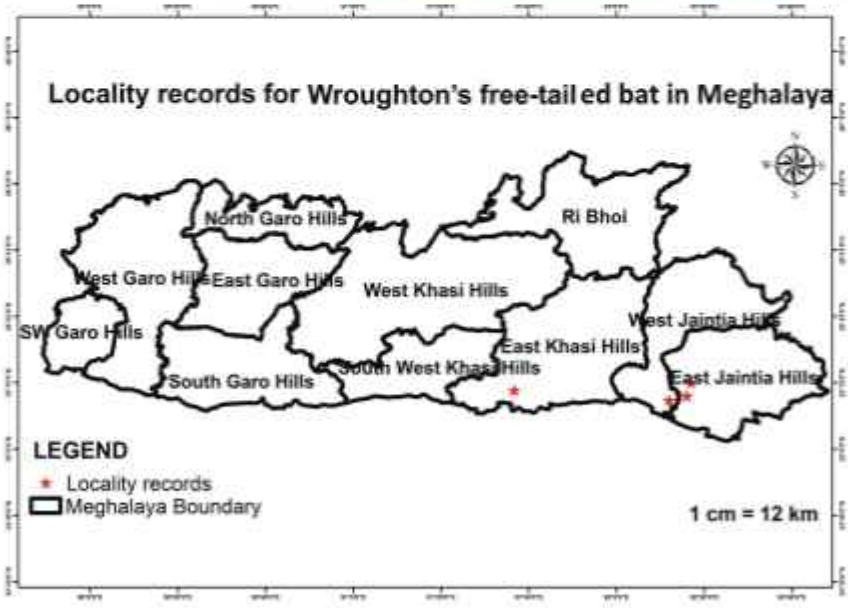
**Natural history note:** Meghalaya holds about half the global population of this rare bat. Three colonies were reported from three large, collapsed doline cavities (caves) with very wide and high entrances in Jaintia Hills region. The population size in these caves was estimated to be around 100 individuals roosting in several small to medium sized clusters. In Karnataka, this species is known to give birth in the winter months but two male individuals examined during February in Meghalaya did not show any signs of reproductive activity, nor any young individuals were located during this time. The echolocation calls are audible; the calls of two released males in Meghalaya were brief with relatively short inter-pulse intervals and frequency-modulated sweep. The frequency with highest energy was emitted at about 15.3 kHz.

**Distribution :** In India, reported from Karnataka and Meghalaya. In Meghalaya, three breeding colonies have been recently reported from caves in Pynurkba, and Umlatdoh in East Jaintia Hills; Thangsah in West Jaintia Hills besides one individual record from Nongtrai village in East Khasi hills.

**Abundance status:** Uncommon.

| Body measurements in mm. After Ruedi et al. 2014 | | | | |
|---|---|---|---|---|
| Tail length | Ear length | Forearm length | Tibia length | Hind feet length with claw |
| 49 | 26.9, 34.3 | 67.0, 67.4 | 20.0, 20.3 | 12.3, 13.5 |


Manuel Ruedi


Locality records for Wroughton's free-tailed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

# Vespertilionidae
## Evening bats

Bats of the family Vespertilionidae represent the largest radiation in Chiroptera containing over 500 species. They are present virtually across the world, in all sorts of habitats. There are no particular attributes that characterize this family. They do not possess any derived appendages like nose-leaf, but special modifications like greatly enlarged ears or the presence of adhesive pads or disks on the hand and feet are found in a few lineages. The tail is well developed and mostly enclosed in the interfemoral membrane except for the tip. Ears are usually separate from each other with well-developed tragus. Out of the 64 species of Vespertilionids reported from India so far, 33 are known from Meghalaya.


Manuel Ruedi

## *Arielulus circumdatus* (Temminck, 1840)

**English name:** Black-gilded Pipistrelle

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A large species of Pipistrelle with an average forearm length of 42.4 mm. The fur colour is very distinctive; it is a mix of ferruginous red and black on the back. Most of the hairs on the back are black with glossy chestnut-brown tips, giving it an overall rufous appearance mottled with black; the ventral surface is a uniform brown, distinctly paler than the back. The ears are typical of Pipistrelles in shape, dark brown but with pronounced pale borders. The fifth metacarpal is about equal in length to the third and fourth.

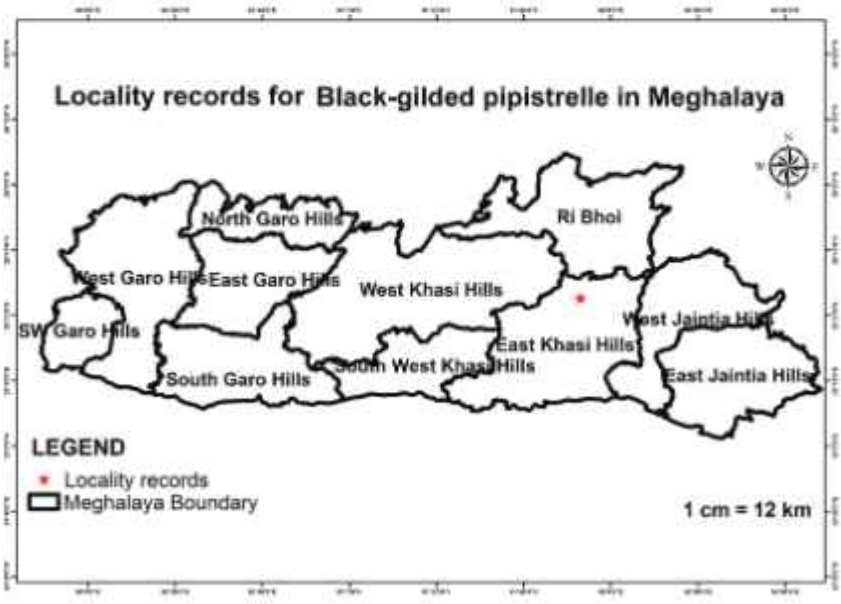
**Natural history note:** Very little information on its ecology is available. Apparently, restricted to higher elevation areas, all records from South and South East Asia are from above 1500 m. Its echolocation call has an FM-QCF structure which sweeps from roughly 60 kHz to 26 kHz. In Uttarakhand, its calls are similar to those of the syntopic *Eptesicus tatei* and *Nyctalus leisleri.*

**Distribution:** In India, it is distributed in Uttarakhand, Sikkim and Meghalaya. In Meghalaya, this bat was recorded from Shillong in East Khasi hills.

**Abundance status:** Rare. No recent records.

| Body measurements in mm. Numbers in bracket indicate mean values. Based on Bates and Harrison, 1997 | | | |
|---|---|---|---|
| Tail length | Ear length | Forearm length | Hind feet length with claw |
| 40.0 | 15.0 | 41.8-43.6 (42.4) | 10.0 |


Rohit Chakravarty


Locality records for Black-gilded pipistrelle in Meghalaya
N
W
E
S
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
West Jaintia Hills
SW Garo Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Barbastella darjelingensis* (Hodgson, 1855)

**English name:** Eastern Barbastelle

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A very distinctive bat with a short and wide muzzle and large ears joining over the forehead. The pelage on the dorsal side is long and soft, black frosted with paler tips. The ventral hairs are shorter, blackish in colour. The muzzle has prominent glandular swellings; the upper lip has a dense fringe of hairs. The ears are erect, broadly pointed with several horizontal ridges; the tragus is long with a straight anterior border and slightly concave posterior border. Feet are small and less than half the length of tibia. The wing membrane attaches to the base of the toes.

**Natural history note** This species is primarily restricted to the temperate or coniferous forest zone and always above elevations of 1000 m. In Meghalaya, it was reported between 1200-1500 m in the Khasi and Jaintia Hills. One individual was caught while entering a house in Shillong city adjacent to a Pine forest patch. In Uttarakhand and Himachal Pradesh, pregnant females were caught in May and lactating individuals were recorded inside a temperate coniferous forest in early June. In Uttarakhand, individuals were caught in oak forest and also near slow-flowing brook close to an open meadow. Its echolocation calls are distinctive on two accounts. They are narrowband (cover a narrow range of frequencies; typically 20-35 kHz) and of short duration (3-5 ms). Moreover, when flying in edge habitats, they often emit alternating calls of high and low frequency. The lower frequency calls are produced from the mouth while the higher ones are emitted through the nose.

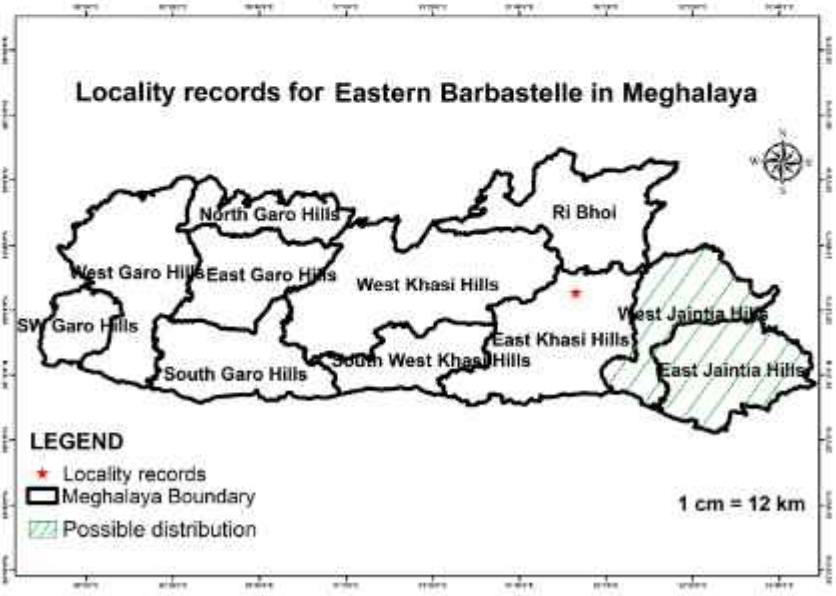
**Distribution:** In India, distributed in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Darjeeling in West Bengal and Meghalaya. In Meghalaya, this species has been reported from Shillong in East Khasi hills and "Jaintia Hills".

**Abundance status:** Uncommon.

| Body measurements in mm. Numbers in bracket indicate mean values. Based on Bates and Harrison, 1997 and specimen in ZSI | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet length with claw |
| 40.0-47.0 (43.7) | 15.0-17.0 (16.6) | 7.2 | 38.5-42.1 (40.5) | 17.9-20.1 (18.8) | 7.0-8.0 (7.6) |



Manuel Ruedi and Uttam Saikia



## *Eptesicus pachyotis* (Dobson, 1871)

**English name:** Thick eared bat

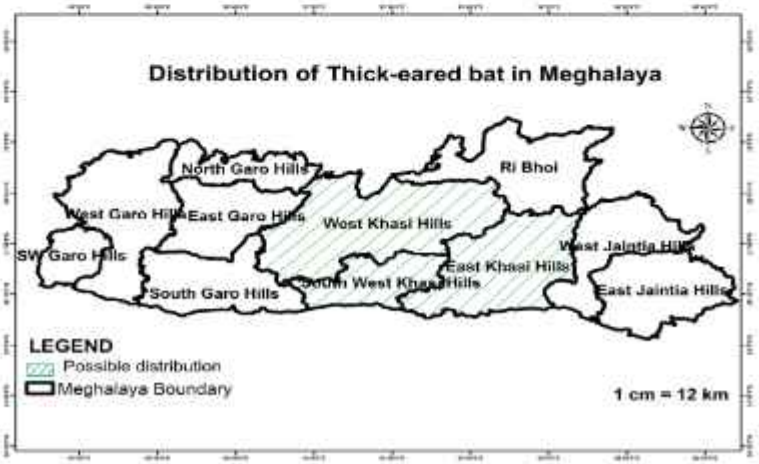
**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A rare and very little known bat in India. It is a medium sized bat with a forearm length of about 40.0 mm. According to the original descriptions of Dobson (1871), the pelage is dark brown above and paler below. The muzzles are very broad and short, glandular prominences of the upper lip largely developed. There is a furrow between the anterior ends of both eyes beyond which the fur on the head does not extend. The ears are triangular with rounded tips and the lower portion of the ears from below the level of the tip of the tragus to the termination of the outer margin near the angle of mouth is very thick, tragus short and inward curving. The wings are attached to the base of the toes.

**Natural history note:** Very little is known about this batexcept that it is a forest species . In Mizoram, a specimen was reportedly collected by placing mist nets near a water source inside the forest at Sairep (1500 m asl).
Distribution: In India, this bat was reported from Meghalaya and Mizoram. In Meghalaya, it was originally described from "Khasi Hills" although no exact locality is known.

**Abundance status:** Rare. No recent records.

| Body measurements in mm. After Dobson, 1871 and Mandal et al, 2000 | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 40, 40.2 | 13.7, 14.1 | 49 | 40 | 16, 16.5 | 6.9 |



## *Eudiscopus denticulus* (Osgood, 1932)

**English name:** Disk-footed bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A small species of bat with a forearm length of 33.5-33.9 mm. It has a bright reddish-brown pelage on the back while the belly fur is darker with paler tips. Juveniles individuals have wing membranes dark brown and devoid of hairs and joins at the base of the digits. The tail tip is completely enclosed within the interfemoral membrane which is little lighter in colour and slightly whitish on the underside. The muzzle is pinkish. The ears are long and erect with rounded tips; the tragus is straight with a concave outer border and blunt tip. The thumbs are short with three four dark pigmented callosities. Very prominent pinkish sub-rectangular adhesive discs are present on the feet.

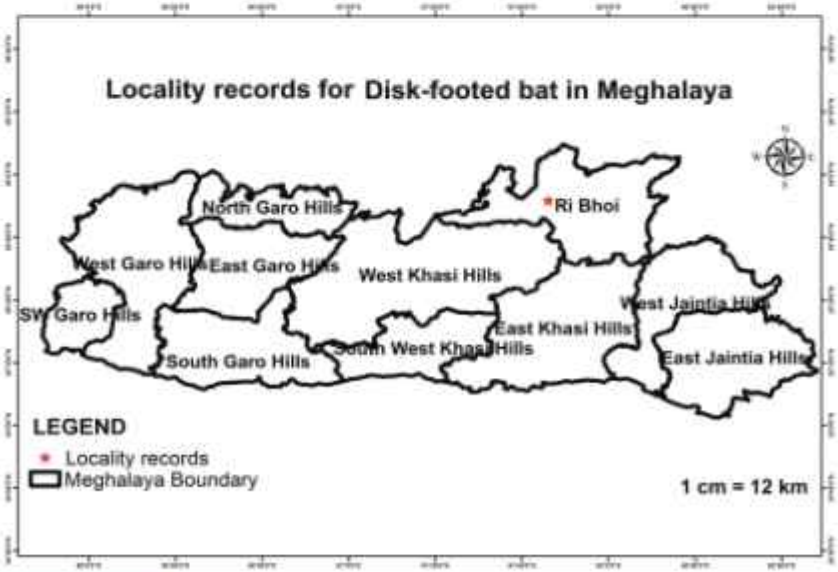
**Natural history note :** In Meghalaya this bat was caught in closed canopy bamboo forest while emerging out of the patch in Lailad (210 m asl) adjacent to Nongkhyllem WLS. Aided by remarkable morphological adaptations like flattened skull and adhesive pads, they can roost inside cramped space clinging to smooth surfaces like bamboo internodes. It flies in a slow fluttering manner similar to those of some Pipistrelles. The characteristic wing morphology and high frequency echolocation calls enable this bat to efficiently manoeuvre in cluttered space. Disk-footed bat is an edge space aerial forager meaning it can adapt to a fair degree of clutter, like bamboo forest, but perhaps cannot forage in complete open space. It produces steep FM calls of short duration (4-5 ms). The call starts at over 100 kHz and ends at about 50 kHz.

**Distribution :** In India, known to be distributed in Meghalaya. In Meghalaya, recently reported from Lailad area adjacent to Nongkhyllem WLS in Ri-Bhoi.

**Abundance status:** Rare.

| Body measurements in mm. Based on Saikia et al, 2021 | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 37.0, 38.0 | 11.5, 11.7 | 4.7, 5.2 | 33.5, 33.9 | 15.5 | 6.2, 6.8 |


Uttam Saikia


Locality records for Disk-footed bat in Meghalaya
N
Ri Bhoi
North Garo Hills
West Garo Hills
East Garo Hills
West Khasi Hills
West Jaintia Hills
SW Garo Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Harpiocephalus harpia* (Temminck, 1840)

**English name:** Lesser hairy-winged bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is a medium-sized bat with an average forearm length of 47.8 mm. Externally similar to tube nosed bats with tubular side facing nostrils. The pelage is long and soft, characteristically tricoloured on the back; bright orange on the tip, buffy brown in the mid-part and grey roots. The hairs on belly have a greyish tip and dark brown roots. The wing membrane is light brown covered with long orange coloured hairs. The ears are medium sized and roundish on both the ends, tragus convex on the anterior margin and slightly concave on the posterior border. The upper and lower lips bear whiskers. Like *Murina*, feet are small and hairy.

**Natural history note:** In Meghalaya, this species has been recorded between 1430 – 1825 m asl. Echolocation calls recorded in Kerala suggest that this bat has a very short duration, steep FM call structure which starts around 115 kHz and ends around 38 kHz. Such echolocation calls are common in species that are adapted to dense forests.

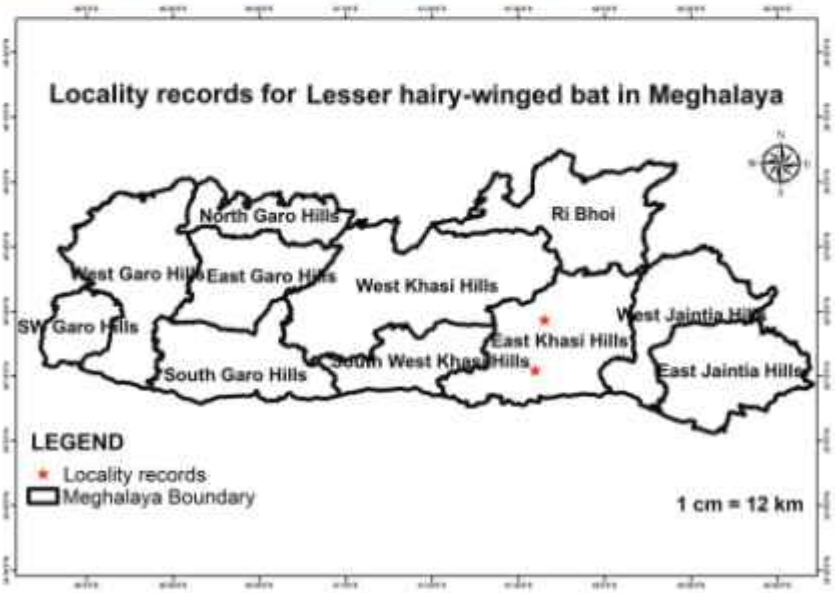
**Distribution:**In India, distributed in Kerala, Tamil-Nadu, Sikkim, the hilly region of West Bengal, Assam, Meghalaya and Mizoram.In Meghalaya, it was reported from Cherrapunji and Mawphlang in East Khasi Hills in Meghalaya.

**Abundance status:** Uncommon. No recent records.

Body measurements in mm. Numbers in bracket indicate mean values. After Bates & Harrison, 1997

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 40-0-50.0 (45.5) | 17.0-18.0 (17.8) | - | 44.1-50.1 (47.8 | - | 11.0-14.0 (12.3) |


Gabor Csorba


Locality records for Lesser hairy-winged bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Ia io* Thomas, 1902

**English name:** Great evening bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is the largest bat in the family Vespertilionidae with a forearm length of 76.7 mm. Dorsal pelage is dark brown with a glossy sheen, individual hairs have darker roots and slightly paler tips. Ventrally, the fur is grey brown. The ears are broad and short, tragus is short and curved forward. The muzzle is naked, dark brown in colour and nostrils pointed sideways. The wing and tail membranes are dark brown, slightly paler on the ventral side. The wings attaches to the outer metatarsal of each foot.

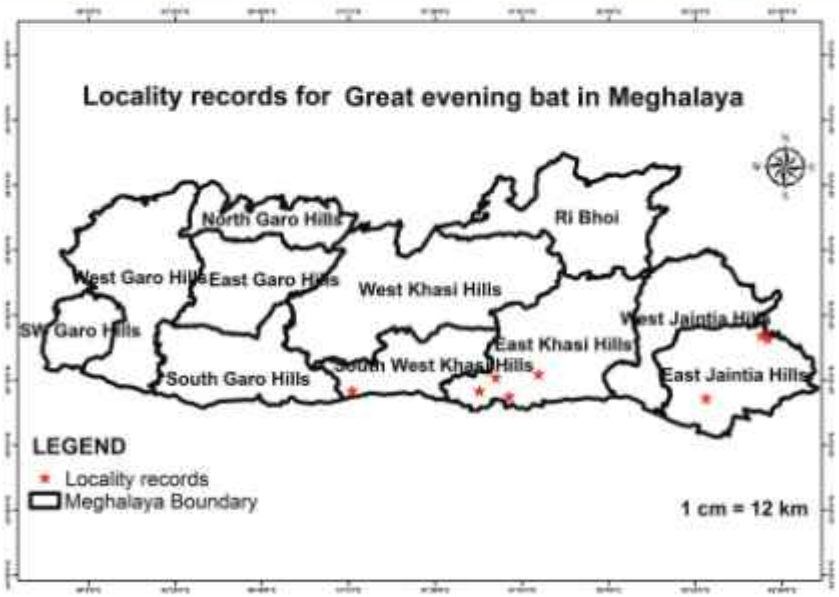
**Natural history note :** In Meghalaya, this species has been recorded within elevations of 97 -1430 m asl.A typical cave roosting bat and all the records of this bat from Meghalaya are from large cave systems. Torpid individuals were observed in mid-February in Meghalaya indicating that they undergo hibernation on the colder months. This species is known to hunt birds extensively. In Meghalaya, Thabah et al. 2007 reported that the diet comprises mainly Coleoptera and birds; bird feathers comprised 82% of its droppings by volume. They reported lower frequency calls in this species with minimum and maximum range between 18-40 kHz. As per current distribution records, these echolocation calls do not overlap with any other species found in Meghalaya.

**Distribution :** The Great evening bat is not known from other parts of the country except Meghalaya. However, in the state it is relatively commonly occurring, localities include Cherrrapunji, Phrang Karuh cave, Krem Ramong, Krem Mawphun in East Khasi Hills; Mondil Kol in South West Khasi Hills; Krem Labit Mynlin, Krem Shnong and Krem Shalong in East Jaintia Hills.

**Abundance status:** Common.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on released individuals from Meghalaya | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 72 | 21.2, 24.4 | 7.2, 7.7 | 76-77.4 (76.7) | 33.5-35.7 (34.3) | 12.2-15.7 (14.5) |


Manuel Ruedi


Locality records for Great evening bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Kerivoula hardwickii* (Horsfield, 1824)

**English name:** Common woolly bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is a small bat with an average forearm length of 33.7 mm. Pelage is dense and soft, clove brown on the back and greyish on the belly. The ears are relatively large, the tragus is straight and narrow with a pointed tip. The muzzle is densely covered with hairs except for the nostrils which slightly protrude out downward. Whiskers are present on both the lip fringes. The wings and interfemoral membranes are almost transparent, a fringe of hairs present on the interfemoral membrane along the body. The wings attaches to the base of the outer toes.

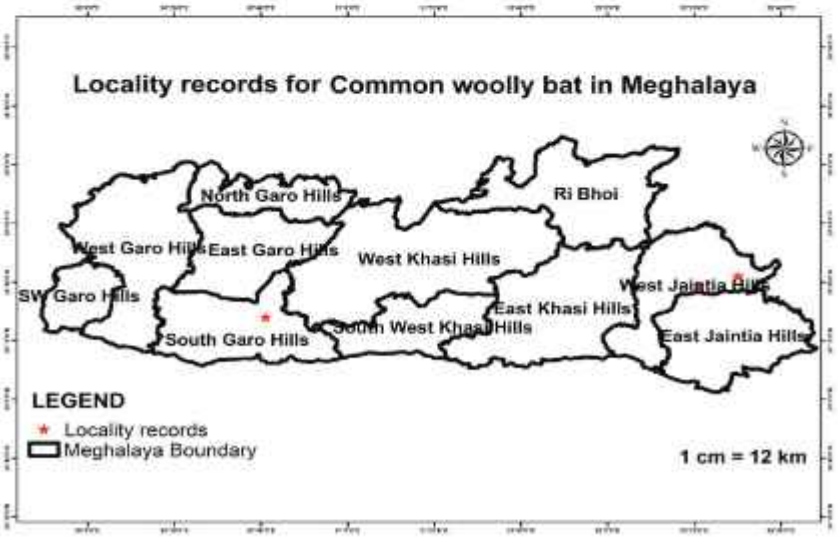
**Natural history note:** In Meghalaya, this species has been reported within elevations of c. 290 - 1231 m asl. Curiously, one specimen was reportedly collected from Siju cave although *Kerivoula* are forest dwelling bats. In Borneo, it commonly roosts inside the carnivorous pitcher plant, *Nepenthes hemesleyana*. This pitcher plant grows in nutrient poor peat swamp forests and depends on the nutrient-rich droppings of the bat. On the other hand, the bat benefits from having shelter during the day. It is also known to roost in hollow trees and inside curled leaves of monocots like wild turmeric. This bat produces very short duration, steep FM echolocation calls of very high frequency. The frequency descends steeply in 2-3 ms from about 180 kHz (or higher) to 90 kHz.

**Distribution :** In India, distributed in Jammu & Kashmir, West Bengal, Assam, Meghalaya and Nagaland.Recorded localities in Meghalaya include Siju cave in South Garo Hills; Khonshnong and Shangpung in West Jaintia Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. Numbers in bracket indicate mean values. After Bates and Harrison, 1997 | | | |
|---|---|---|---|
| Tail length | Ear length | Forearm length | Hind feet & claw length |
| 35.0-43.0 (39.7) | 11.0-15.0 (13.1) | 76-77.4 (76.7) | 5.0-8.0 (6.7) |


Manuel Ruedi


Locality records for Common woolly bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Kerivoula kachinensis* Bates et al., 2004

**English name:** Kachin woolly bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** It is a relatively large species of *Kerivoula* with an average forearm length of 40.8 mm in Meghalaya specimens. Pelage is overall dark and ochraceous brown without any contrast between the upper and under parts. Individual hairs have light brown tips and dark brown roots. Ears are broad and oval-shaped and have scattered hairs on the inner surface. The tragus is thin, long and pointed with a straight anterior margin and slightly concave posterior margin and reach almost two third of the ear length. Wings attach to the base of toes. An oval and whitish fleshy callosity is present on the joint of the first digit in each wing of our specimens.

**Natural history note:** At Laitkynsew (815 m asl), this bat was caught in a harp trap in a tropical evergreen forest patch near the village. Other bats recorded in this forest included *Rhinolophus pearsoni, Rh. macrotis, Hipposideros pomona, Murina pluvialis* and *Murina jaintiana.* In Sakwa, a single individual was caught just outside a cave, in a harp trap with very little bat activity at the time, in a mixed evergreen forest dominated by bamboo.

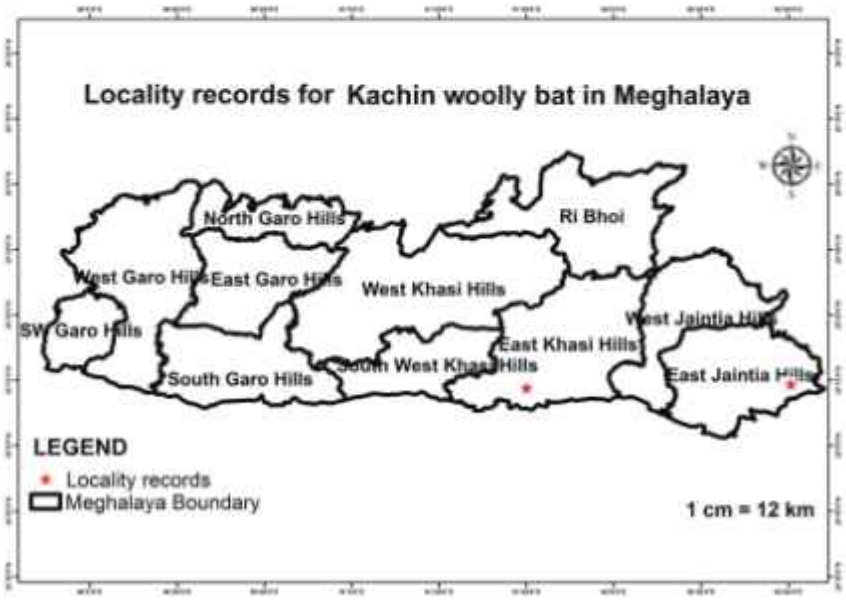
A recorded call of a hand released individual was extremely frequency modulated. The start frequency was at around 213 kHz and ended at around 30 kHz showing a remarkably broad band width. The frequency of maximum energy was not sharply defined, at around 110 kHz. Interpulse intervals were short (13.4 ± 2.0, range 10.4 – 16.1 ms). As the single bat recorded was hand-held, it is likely that these calls characteristics are not typical of free-flying animals, as they would generally emit longer, less frequency modulated calls and at longer intervals.

**Distribution:** In India, this species is known only from Meghalaya.The reported localities in Meghalaya are Sakwa in East Jaintia Hills and Laitkynsew in East Khasi Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. Based on Saikia et al, 2020 | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 48, 50 | 10.7, 14 | 6.9, 8.1 | 40.3, 41.4 | 20.9, 23.1 | 8.2, 8.5 |


Manuel Ruedi


Locality records for Kachin woolly bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Mirostrellus joffrei* (Thomas, 1915)

**English name:** Joffre's Pipistrelle

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:**This is a small bat with a forearm length of about 40 mm. It has a glossy, dark brown dorsal pelage with a slight reddish tinge and the ventral fur is light golden brown with a sharp demarcation between these two colours. Individual dorsal hairs have darker roots and lighter tips while the ventral hairs were uniformly coloured throughout their length. Wings and patagium are dark brown and naked, except for the region closer to the body. The sides of the muzzle between nostrils and eyes are characteristically swollen with a few long vibrissae. The ears are broad and short with rounded tip and roughly matching a right triangle in side profile. The tragus is short and rounded, with a basal lobe, inner margin concave and the outer margin convex. The tail membrane has a distinct unkeeled lobe and the tail tip projects out of the membrane.

**Natural history note:** This is a poorly known species globally and not much ecological information is available. In Shillong (1500 m asl), one individual was collected near a small stream along a pine forest. The male individual caught in October exhibited signs of breeding activities. In Uttarakhand, this species has been commonly caught in Kedarnath Wildlife Sanctuary along riverine habitats at the edge of oak forests. Pregnant females were netted from late March through April. It appears to prefer forest edge and open habitat, which is supported by its wing morphology and echolocation calls. Its echolocation calls have an FM-QCF structure with a sweep from roughly 50 kHz to 30 kHz.

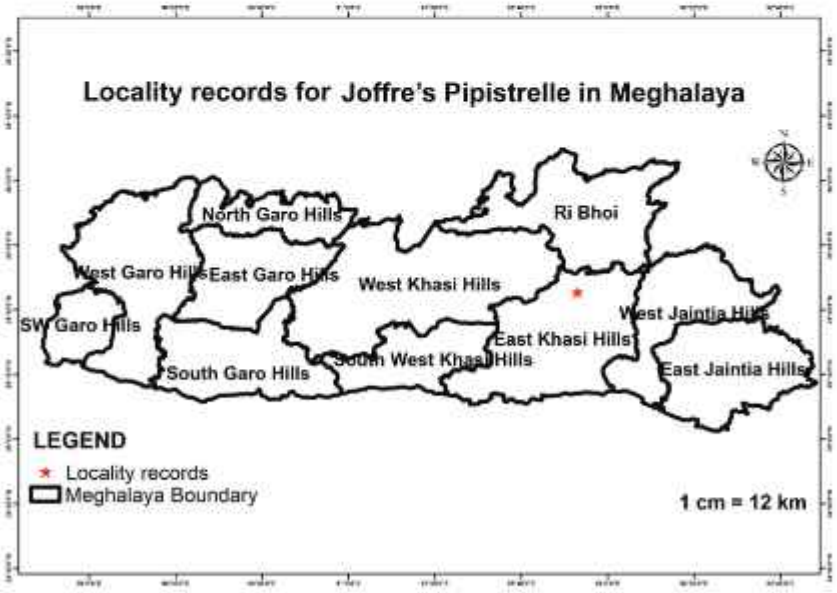
**Distribution:** In India, this species was reported from Meghalaya and recently in Uttarakhand. In Meghalaya, it was reported from Shillong.

**Abundance status:** Rare. Only a single individual is known from Meghalaya thus far.

| Body measurements in mm.Based on Saikia et al., 2017 | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 37.0 | 13.2 | 5.1 | 40.2 | 15.6 | 8.3 |



Uttam Saikia



## *Murina aurata* Milne-Edwards, 1872

**English name:** Littele tube-nosed bat

**Local names :** Do'bak Waget (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** A tiny bat with an average forearm length of 28.6 mm. The pelage on the back is rich golden interspersed with brownish hairs. The ventral hairs are greyish white with darker bases. The ears are broad and smoothly rounded, the tragus is thin, acutely pointed and slightly curved at tip, less than half the length of the ear. As typical for the genus, the nostril is very prominently projecting outward. Muzzle is densely hairyon the upper surface and whiskers are present on both the lip fringes.

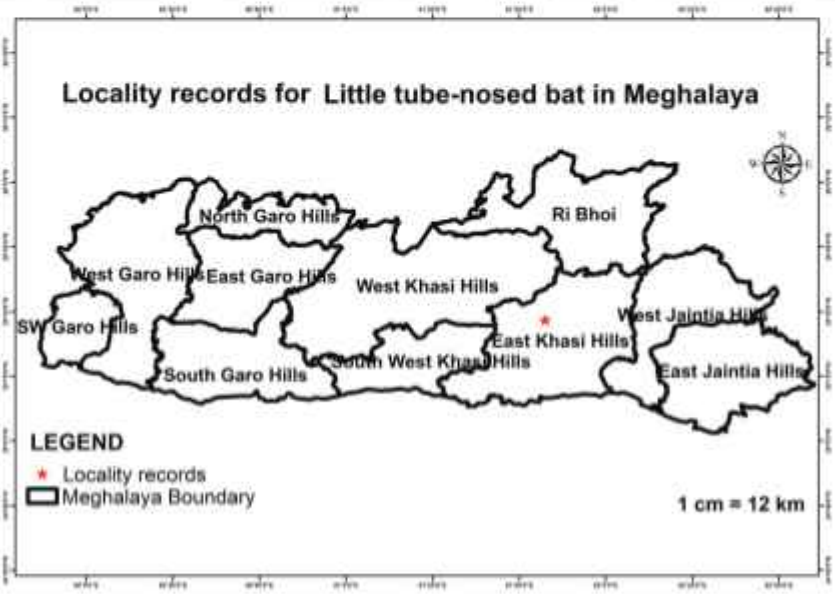
**Natural history note :** Ecological information on this species is very limited. In Meghalaya, the single record is from an elevation ofc.1800 m als. In Uttarakhand, this bat was recorded between 1600-2000 m asl although it was reportedly collected at a very high elevation of 4154 m asl in Nepal. In Uttarakhand, individuals were caught over a pool of water in dense primary oak forest or over a shallow, shaded stream at the edge of an oak forest in the same area during April. Apparently, it prefers to inhabit in forested mountainous country. Its echolocation calls are extremely broadband, ranging between ~190 kHz to ~50 kHz in clutter. The peak frequency is spread over a range of values from 70-100 kHz. Based on current data, no strong differentiating features are observed among the calls of *Murina* spp. in India.

**Distribution:** In India, known from Uttarakhand, Sikkim and Meghalaya. In Meghalaya, reported from Mawphlang in East Khasi Hills.

**Abundance status:** Rare. No recent record.

| Body measurement in mm. Numbers in bracket indicate mean values. After Bates and Harrison, 1997 | | | |
|---|---|---|---|
| Tail length | Ear length | Forearm length | Hind feet & claw length |
| 27.0 | 13.0 | 427.7-29.6 (28.6) | 4.5 |


Rohit Chakravarty


Locality records for Little tube-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Murina cyclotis* Dobson, 1872

**English name:** Round-eared tube-nosed bat

**Local names:** Do'bak Waget (Garo);Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A small bat with an average forearm length of 30.5 mm. The pelage on the back is bright orange with paler grey hair roots and the belly is beige. The ears are erect with a straight anterior border and slightly concave posterior border, broadly rounded off at both the ends. The tragus is tall with acutely pointed tip. The muzzle is hairy, light pinkish and the nostrils are protruding outward, a typical character of the genus *Murina*. Whiskers are present on both the lip fringes. The feet are densely covered with orange hairs.

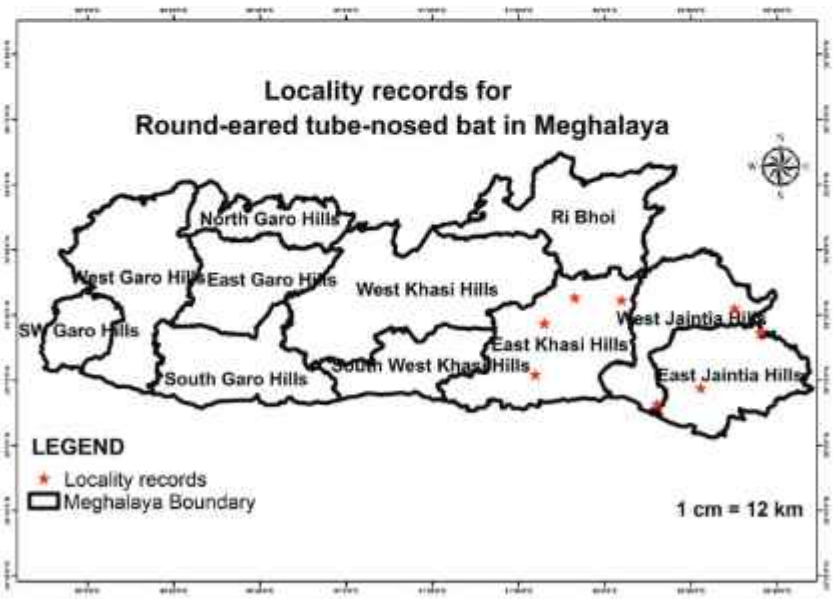
**Natural history note:** In Meghalaya, this species has been recorded within elevations of 63 -1500 m asl. In Uttarakhand an individual was caught over at the intersection of cedar forest and dry scrub. It produces steep FM calls ranging from 160 kHz to 65 kHz. In Shillong, an individual was caught while entering a house on the edge of a pine forest.

**Distribution :** In India, distributed in Tamil Nadu, Andhra Pradesh, Himachal Pradesh, Uttarakhand, Darjeeling in West Bengal, Sikkim, Meghalaya, Mizoram and Andaman and Nicobar Island. In Meghalaya, reported localities include Khonshnong in West Jaintia Hills; Forest near Krem Labit Kseh, Krem Hartali and Khahnar in East Jaintia Hills; Cherrapunji, Mawphlang, Mawrynkneng and Shillong in East Khasi Hills.

**Abundance status:** Common.

| Body measurements in mm. Numbers in bracket indicate mean values. Based on ZSI specimen from Himachal Pradesh and released individuals from Meghalaya | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 30-34 (31.3) | 12.8-15.4 (13.9) | 7-7.7 (7.5) | 29.4-31.7 (30.7) | 15.8-16.8 (16.3) | 6.9-7.2 (7.1) |


Manuel Ruedi


Locality records for
Round-eared tube-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Murina huttonii* (Peters, 1872)

**English name:** Hutton's tube-nosed bat

**Local names:** Do'bak Waget (Garo);Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** With an average forearm length of 35.5 mm, this bat exceeds Mu. cyclotis in size. Overall, it is light brown in colour, forehead and muzzle are distinctly covered by dark brown hairs. Individual dorsal hairs have greyish roots while hairs on the ventral surface have darker roots. The ear and tragus is very similar to *Mu. cyclotis*. The nostrils are protuberant, outward facing. The interfemoral membrane is covered lightly with long brown hairs on the upper surface, naked on the ventral surface. The feet are covered with long brown hairs.

**Natural history note:** In Meghalaya, this species has been recorded within elevations of 63 -1500 m asl. In Uttarakhand an individual was caught at the intersection of cedar forest and dry scrub. It produces steep FM calls ranging from 160 kHz to 65 kHz. In Shillong, an individual was caught while entering a house on the edge of a pine forest.

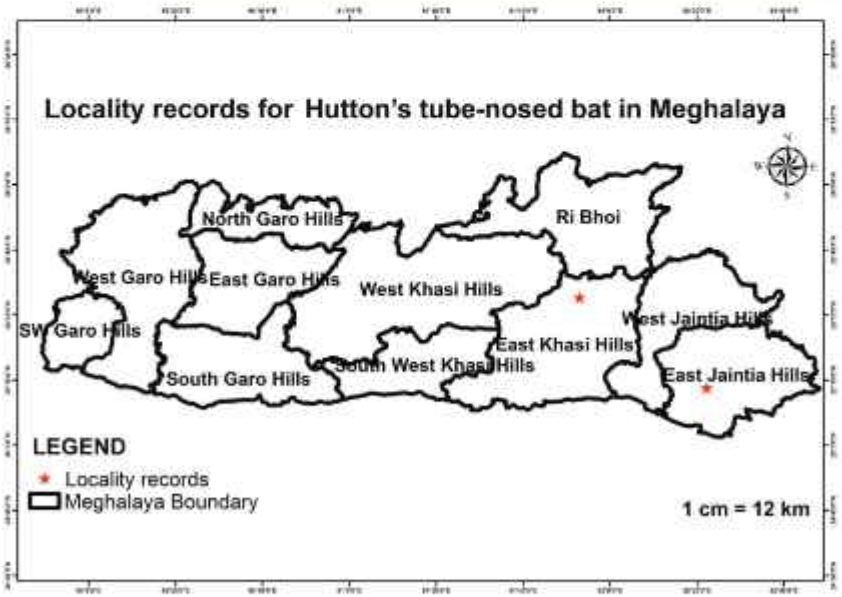
**Distribution :** In India, distributed in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, the hilly region of West Bengal and Meghalaya. An old record from western Assam is doubtful. In Meghalaya, it is known from Shillong in East Khasi Hills and Khahnar Village in East Jaintia Hills

**Abundance status :** Uncommon

Body measurements in mm. Numbers in bracket indicate mean values. Data from released specimens in Meghalaya and Himachal Pradesh.

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 30-42 (34.9) | 15.6-18.6 (17.2 | 7.4-8.2 (7.7) | 34.7-36.3 (35.5) | 15.7-17.8 (16.9) | 7.5-8.1 (7.8) |


Manuel Ruedi and Uttam Saikia


Locality records for Hutton's tube-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Murina jaintiana* Ruedi *et al.*, 2012

**English name:** Jaintia tube-nosed bat

**Local names:** Do'bak Waget (Garo);Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A diminutive bat with a forearm length of about 29.5 mm. The dorsal pelage is greyish and ventrally white with dark hairs roots. Ears are broad and rounded, the anterior border is convex and the posterior border is slightly concave. The tail membrane is densely hirsute especially on the dorsal surface. The wing membrane is attached near to the claw.

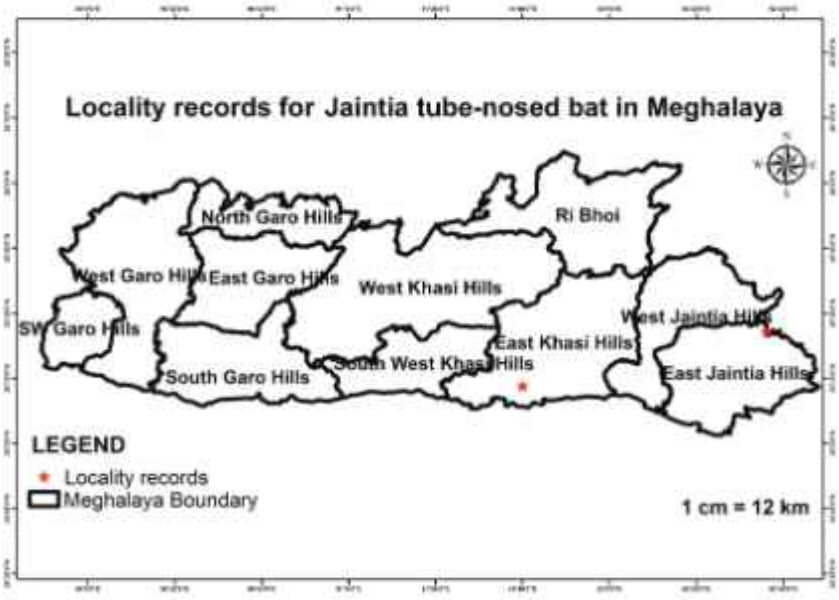
**Natural history note:** In Meghalaya, this species has been recorded between 730-870 m als.In Laitkynsew area, it was harp trapped inside a bamboo groove along a river tributary. The bamboo patch is surrounded by secondary semi-deciduous forests resulting from slash and burn cultivation practices. A male collected during February showed signs of sexual activities. In Chin hills of Myanmar, this species was recorded at an elevation of 1500 m and a specimen was collected from the hollow of a *Ficus* tree.

**Distribution :** A recently described species, it has thus far been reported only from Meghalaya and Myanmar. In Meghalaya, this bat is reported from a Forest near Krem Bylliat in East Jaintia Hils and Laitkynsew in East Khasi Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. After Ruedi *et al.*, 2012 | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 28, 33 | 12.8, 13.9 | 6.0, 6.3 | 29.1, 30.0 | 16.3, 17.1 | 6.2, 6.8 |


Manuel Ruedi


Locality records for Jaintia tube-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Murina pluvialis* Ruedi *et al.*, 2012

**English name:** Rainforest tube-nosed bat

**Local names:** Do'bak Waget (Garo);Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A medium sized bat with a forearm length of about 35 mm. Superficially similar to *Mu. cyclotis* but significantly larger in size. Dorsal colouration is bright orange and ventrally greyish. Individual dorsal hairs are tricoloured, the roots are dark brown, middle part is yellowish red and the tip is bright red. The tail membrane is densely covered by orange hairs on the dorsal side. The ears are roundish without any emargination and the tragus is straight and acutely pointed. Muzzle is pinkish, lip fringes dotted with long whiskers. The wing membrane attaches to the base of the claw of outer toe.

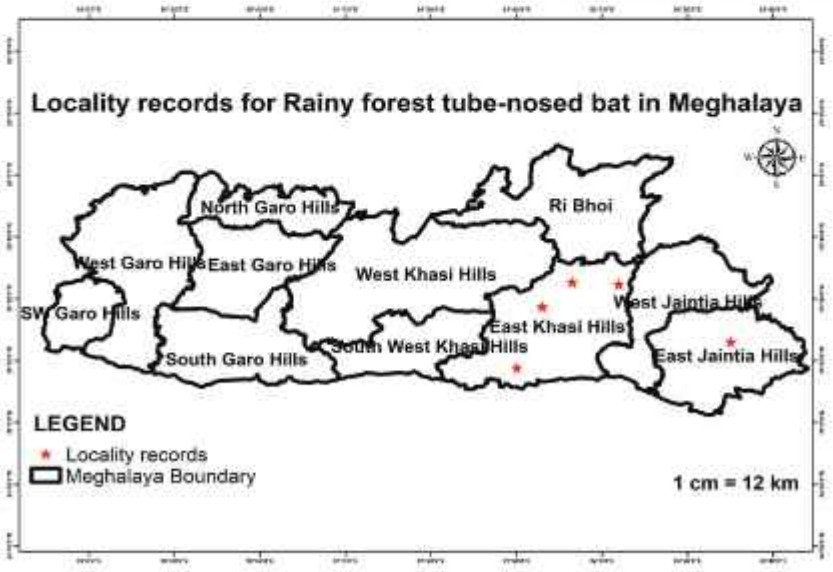
**Natural history note:** In Meghalaya, this bat has been recorded between 780 -1820 m asl. It was harp trapped close to a patch of dense evergreen forest in the high rainfall area of Laitkynsew.A female caught in February did not exhibit any signs of reproductive activities. This bat was also mist netted inside a pine forest in Shillong. Apparently a common species in Meghalaya with a large series of specimens caught from the Khasi Hills regions lodged in the Field Museum, Chicago.

**Distribution:**A recently described species, it has thus far been reported only from Meghalaya. In Meghalaya, it is known from several localities i.e. Laitkynsew, Mawphlang, Mawryngkneng and Shillong in East Khasi Hills and Tongseng near Krem Lanshat in East Jaintia Hills.

**Abundance status:** Uncommon

| Body measurements in mm.Numbers in bracket indicate mean values.Based on Ruedi *et al*, 2012, and two ZSI specimens | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 32.5-34.0 | 12.0-16.0 (13.8) | 5.1-7.5 (6.1) | 31.3-36.6 (33.3) | 15.3-17.6 (16.4) | 6.3-8.8 (7.4) |


Uttam Saikia


Locality records for Rainy forest tube-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Murina tubinaris* (Scully, 1881)

**English name:** Scully's tube-nosed bat

**Local names:** Do'bak Waget (Garo);Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:**A small bat with an average forearm length of 31.7 mm. The dorsal pelage is comparable to *Mu. jaintiana*, grey brown above and greyish white below. The hairs roots are dark brown on both sides. The ears are rounded with a concave anterior edge and slightly convex posterior border which possess a small emargination. The upper surface of the tail membrane are densely covered by grey or rufous hairs, ventral size is naked. This species can be separated from the similar looking *Mu. jaintiana* by the fact that the wing membrane is attached to the proximal phalanx of the outer toe (against base of the claw in the latter).

**Natural history note:** This species is thus far reported from relatively higher elevation areas of the Himalayan region. In Meghalaya, this species was recorded between c. 1280 -1820 m asl.

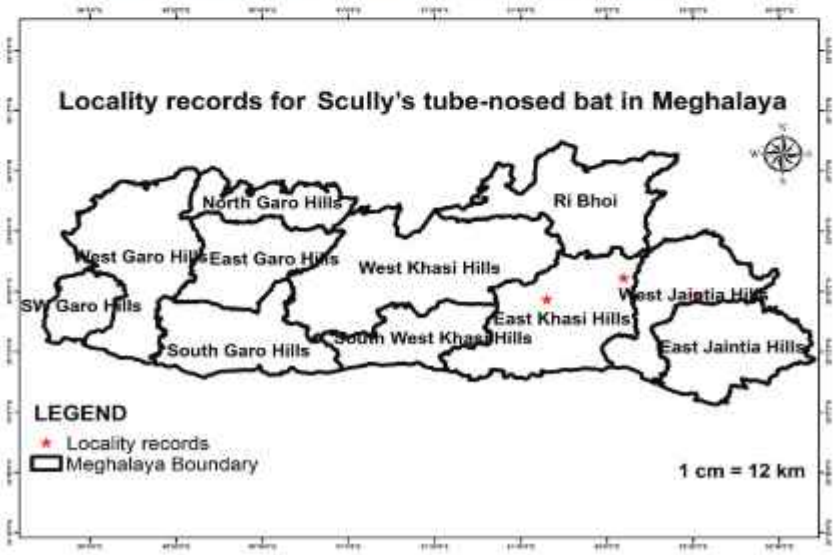
**Distribution :** In India, distributed in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Sikkim, Arunachal Pradesh, Meghalaya and Mizoram. In Meghalaya, it has been recorded from Mawphlang and Mawryngkneng in East Khasi Hills and Shangpung in West Jaintia Hills.

**Abundance status:** Uncommon

Body measurements in mm. The numbers within bracket indicate mean value. After Bates & Harrison, 1997. These values likely comprise a mix of *Mu. tubinaris* and *Mu. jaintinana*, as both were not differentiated.

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 22.0-35.0 (31.3) | 13.0-15.0 (14.3) | - | 31.3-36.6 (33.3) | - | 6.0-9.0 (6.7) |


Manuel Ruedi


Locality records for Scully's tube-nosed bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
West Jaintia Hills
SW Garo Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Myotis altarium* Thomas, 1911

**English name:** Szechwan Myotis

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is a medium sized bat with an average forearm length of 46.3 mm. dorsal fur is light brown while that on the belly is lighter. The wing and tail membrane are dark. The ears are very long with roundish tip which exceed the tip of the muzzle when laid forward. The tragus is half the length of pinna and blunted at the tip. The ear base possesses a small roundish antitragal lobe separated from the pinna by a notch. Wing membrane attaches to the base of the digit. The tail membrane is essentially naked dorsally and has scattered hairs on the ventral side with a small calcar lobe. The tail tip protrudes out of the interfemoral membrane.

**Natural history note:** In Meghalaya, this bat has been reported between 880-1490 m asl. Specimens were collected from inside caves roosting in small numbers. In other parts of the range, this species was recorded in small caves in karst areas. They are reported to share roosts with several species of horseshoe bats. In Krem Arwah, an individual of this species was observed in torpid state in February. It was also reported to undergo hibernation in Vietnam. Ground-dwelling beetles constitute the major portion of its food and similar feeding preference is indicated in Meghalaya also.

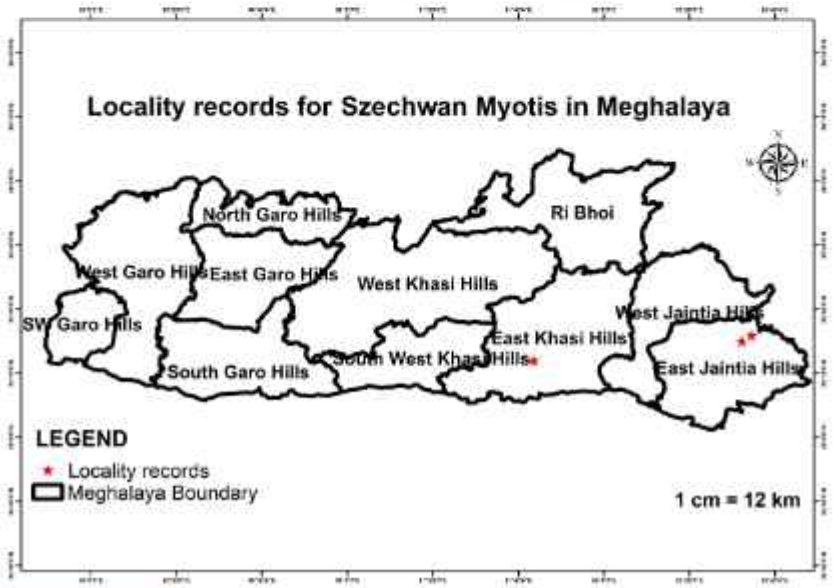
**Distribution:**In India, this species was thus far reported only from Meghalaya. In Meghalaya, it has been recorded from Krem Arwah in East Khasi Hills; Krem Khung and Krem Liat Prah East Jaintia Hills.

**Abundance status:** Uncommon.

Body measurements in mm. The numbers within bracket indicate mean value. After Bates & Harrison, 1997. These values likely comprise a mix of *Mu. tubinaris* and *Mu. jaintinana*, as both were not differentiated.

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 36-47 (43) | 20.9-23.1 (22.1) | 9.0-10.6 (9.7) | 45.4-47 (46.3) | 19.6-21 (20.5) | 10.3-11.5 (10.7) |


Vu Dinh Thong


Locality records for Szechwan Myotis in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Myotis formosus* (Hodgson, 1835)

**English name:** Hodgson's bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A medium-sized *Myotis* (mean forearm length 47.4 mm), with a bright rusty pelage. The belly is lighter than the dorsum. The ears are long and oval in shape, with a slight concavity on the posterior border. The ears and the muzzle are orange. The wings have a characteristic colour pattern, narrow orange strips run along the metacarpels and phalanges and triangular black patches in between. The interfemoral membrane is orange. The wings are attached to the base of the outer toe. Feet are small and covered by light coloured hairs.

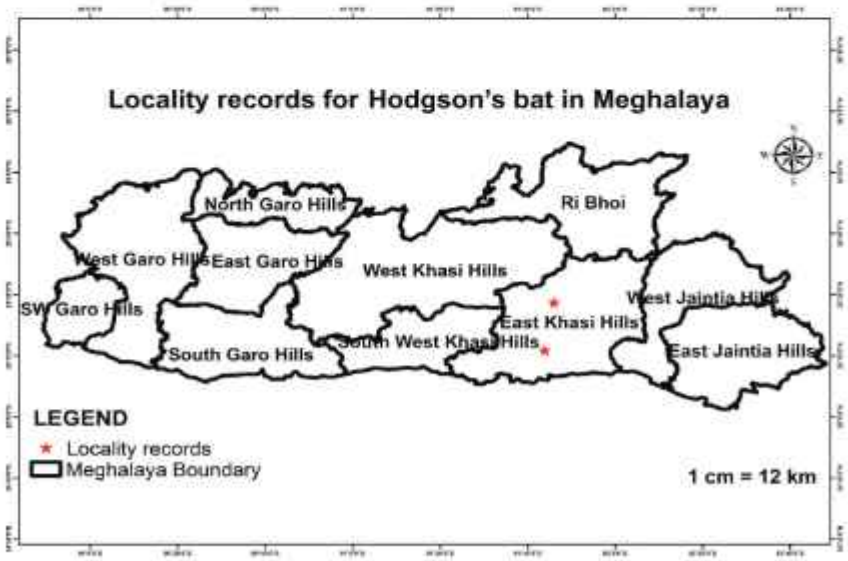
**Natural history note:** In Meghalaya, this bat has been reported between elevations of 1430-1820 m asl. This species is known to roost under foliages and also inside caves singly or in small numbers.In Manipur, one female individual was caught inside a cow shed at Thoubal (760m asl) during daytime indicating that they are also adapted to anthropogenic landscape. In Assam, a specimen was caught inside a tropical mixed deciduous forest patch of Lumding RF (c.300 m asl). In the Western Ghats of Karnataka, two individuals were observed in a torpid state inside a cave at 1900 m asl in January. In China its echolocation call was recorded with an FM structure with a start frequency of 95 kHz and end frequency of 44 kHz. This overlaps with the known frequencies of *Myotis muricola*.

**Distribution:** In India, distributed in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Maharashtra, Bihar, West Bengal, Sikkim, Assam, Manipur,Meghalaya and Mizoram. In Meghalaya, this bat has been reported fromMawphlang and Cherrapunji in East Khasi Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on Bates and Harrison, 1997 and ZSI specimen | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 36.0-48.0 (41.3 | 12.8-14.5 (13.6) | 7.1 | 44.5-49.1 (47.4) | 21.0-23.2 (22.5) | 10.2-11.6 (10.6) |


P. Elangbam
Rohit Chakravarty


Locality records for Hodgson's bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Myotis horsfieldii* (Temminck, 1840)

**English name:** Horsfield's Myotis

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A medium sized species with a forearm length of 38.5 mm in specimens from northeastern India. The pelage colour is dark brown dorsally while the ventral fur is greyish with darker hair roots. Ears are long with rounded tips, anterior border is convex, posterior border is concave above and convex below with a notch in the midpoint. Wing and tail membranes are dark and without hair on the dorsal surface, but scattered hairs are present on the ventral surface of the tail membrane especially along the tail. The attachment point of the wings is outer metatarsal of each foot. Feet are large exceeding the half the length of tibia and covered by scattered hairs.

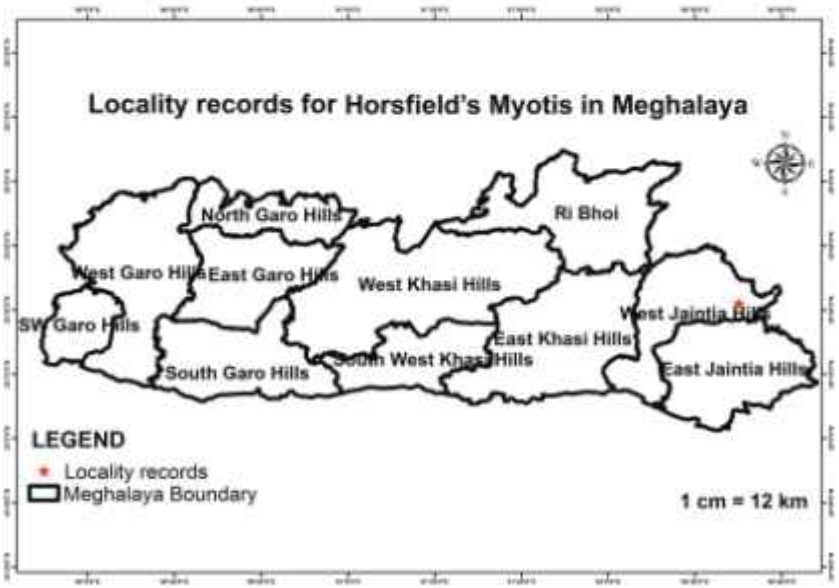
**Natural history note:** This species is known to roost in caves, abandoned tunnels, bridges and under palm leaves in small numbers although colony size may reach over hundred individuals sometimes. They are known to favour tunnels with water supplies. In Assam, specimens were caught inside crevices of a concrete culvert placed over a small watercourse and surrounded by dense deciduous vegetation. They were observed roosting in small packs of 4-5 individuals inside the crevices of culvert joints during August although the colony could not be located during the colder months. Its echolocation calls recorded in Tamil Nadu were steep FM with a drop of frequency from 91 kHz to 41 kHz in 2.5 ms.

**Distribution:** In India, distributed in Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Madhya Pradesh, Assam, Meghalaya and Andaman Islands.In Meghalaya, there is a very old record from Khonshong in West Jaintia Hills.

**Abundance status:** Rare. No recent record.

| Body measurements in mm. Based on ZSI specimens from NE India | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 31, 39 | 13.8 | 5.2, 5.7 | 34.7, 35.8 | 16.9, 17.1 | 8.0, 8.9 |


Manuel Ruedi


Locality records for Horsfield's Myotis in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
East Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Myotis laniger* (Peters, 1871)

**English name:** Chinese water Myotis

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A small bat with an average forearm length 35.9 mm. The dorsal pelage is grey brown and the ventral side is greyish white. The upper lip bears a fringe of short hairs along with scattered whiskers. The ears are thin and tall with convex anterior border and slightly roundish tip. The tragus is tall and narrow reaching about half the length of ear. Wings attach to the base of the outer metatarsal of foot, calcar lobe absent. The feet are enlarged with strong claws, toes sparsely covered with long hairs.

**Natural history note:** In Meghalaya, this species has been recorded between 290-1220 m asl.A cave dwelling and gregarious species, it was reported from a number of caves across the state. Sinha (1999) mentions that this species (as *My. longipes* with which it is often confused in northeastern India) roost in crevices and were caught at the entrance of Siju cave while entering from outside at around 6.00 hours. Since large feet and strong claws are typical of trawl hunters, it is likely that the bats entered the cave to hunt for aquatic organisms in the slow flowing stream inside.

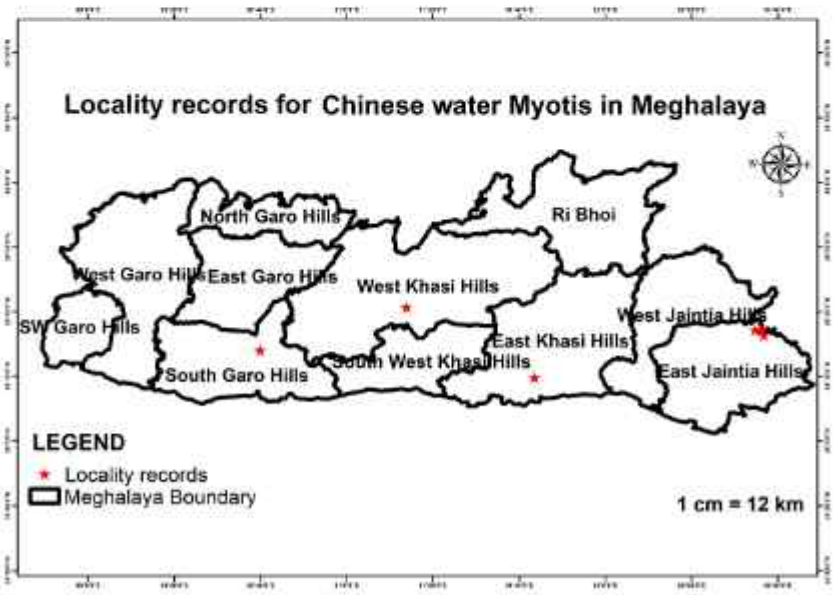
**Distribution:**In India, Chinese Water Myotis has so far been reported only from Meghalaya. In the state, this bat is recorded from Siju cave in South Garo Hills; Krem Shalong, Krem Labit Kseh, Krem Bylliat and Umkyrpong in East Jaintia Hills; Mawsmai cave in East Khasi Hills and Krem Pamskei in Lawbah in West Khasi Hills.

**Abundance status:** Common.

Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens and released animals.

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 26-41 (34.6) | 12.3-16.1 (14.6) | 5.5-8.1 (6.7 | 33.8-39.2 (35.9) | 14.5-17.5 (16.0) | 8.9-10.9 (9.7) |


Manuel Ruedi


Locality records for Chinese water Myotis in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Myotis montivagus* (Dobson, 1874)

**English name:** Burmese whiskered bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** The Burmese whiskered bat is a small sized bat with relatively small feet. Externally, similar to most of the small footed Myotis bats found in the region. The average forearm length is 42.6 mm. The dorsal pelage is grey brown with dark hair roots; fur on the belly is beige. Muzzle is flesh coloured and covered with hairs and whiskers except for the naked mid portion. Ears are thin and tall with a straight anterior border and rounded tip, covered lightly with hair on the inner side. The tragus is less than half the length of the ear, forward pointing and the posterior edge is mildly serrated. The wing membranes are dark brown and attached to the base of the toes.

**Natural history note:** One of the rarer bats in India, not much ecological information is available on this species. In Siju cave (290 m) in Garo Hills, an individual was caught while flying quite low near the cave entrance and over the stream surface. In Sairep in Mizoram, it was collected at an elevation of about 1500 m asl. This species reportedly roosts in small numbers in caves, rocky crevices and subterranean habitats in forested areas.

The echolocation call pulses recorded from an individual in Meghalaya have strongly frequency modulated sweeps with a very short quasi constant frequency tail. The average minimum frequency of the pulse is 48 kHz while the maximum frequency recorded is 76 KHz with an average mean frequency of 56 kHz. This animal, however, was recorded inside a small room, so free-flying *My.montivagus* may have distinct characteristics.

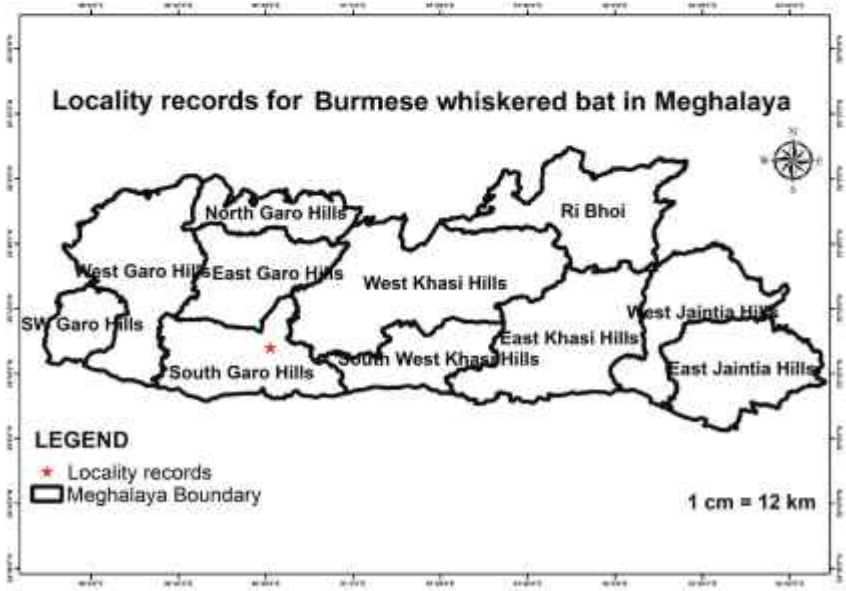
**Distribution:** In India, this bat is so far known from Sairep in Lunglei district in Mizoram and Siju cave in Meghalaya.

**Abundance status:** Rare. Only a single individual is known from Meghalaya.

Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens and Mandal et al. 2000

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 39.8-45 (42.6) | 13.2-13.6 (13.4) | 5.9-6.3 (6.1) | 40.6-42.9 (41.8) | 16.7-19 (17.9) | 9.2 |


Uttam Saikia


Locality records for Burmese whiskered bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Myotis pilosus* (Peters, 1869)

**English name:** Rickett's big footed Myotis

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is a large species of Myotis with average forearm length of 53 mm. Dorsally, the pelage is light brown while the ventral fur is greyish. Wing membranes are dark brown, however the tail membrane is lighter in shade. The wing and tail membranes are naked. The muzzle is dark brown and both lips have scattered whiskers on the sides. The ears are relatively long with concave anterior border and convex posterior margin. The margin of the tragus is almost straight; its tip is bluntly pointed. The feet are very large with strong sharp claws that help them to hold on to the prey while in flight. The wing membrane is inserted to the ankles slightly above the tibio-tarsal joint.

**Natural history note:** In Meghalaya, this bat has been recorded between elevations of 80 – 880 m asl. This is the only specialized piscivore (fish eating) bat in India. They roost in caves traversed by large river systems. Being a primarily fish eating species, they trawl over the calm waters flowing within the cave in search of fish. In Meghalaya, during the drier period of December to March, they primarily thrive on fish while in the rest of the year, beetles and moths constituted the bulk of their diet. In one of the large cave in Meghalaya, this species was observed cohabiting with other bats like *My. siligorensis, Ia io, Hi. armiger, Hi. lankadiva,* and *Rh. pearsonii.* Like other Myotis bats, this species also emit frequency modulated echolocation calls of short duration with start frequency around 61 kHz and ending at around 30 kHz.

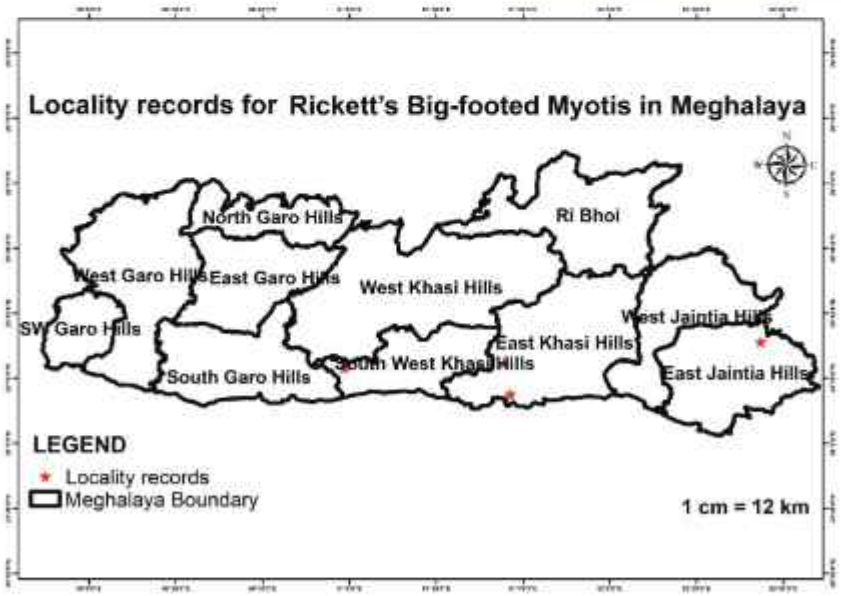
**Distribution:** In India, Rickett's Big-footed Myotis has so far been reported only from Meghalaya. In Meghalaya, it is known from Phlang Karuh Cave and Krem Dam East Khasi Hills; Amarsang in West Khasi Hills; Krem Khung in East Jaintia Hills.

**Abundance status:** Uncommon.

Body measurements in mm. The numbers within bracket indicate mean value (based on Saikia et al. 2020, and released individuals from Meghalaya)

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 42-48 (45.2) | 17.5-20.5(19.6) | 7.0-9.0(8.0) | 51.1-54.3 (53.0) | 20.8-21.3(20.9) | 17.2-19.6 (18.5) |


Manuel Ruedi


Locality records for Rickett's Big-footed Myotis in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Myotis muricola* (Gray, 1846)

**English name:** Nepalese whiskered bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A small bat with an average forearm length of 37.3 mm. The dorsal pelage is uniform dark brown, hairs on the ventral side have dark brown roots light brown tips. The wings and the interfemoral membranes are also dark brown. The ears are dark brown, narrow, anterior border is convex and the posterior border has a slight notch in the mid-point. Tragus is narrow and pointed. The upper lip fringe bears a few long whiskers. The third metacarpal is slightly longer than the fourth and the fifth. Feet are small and the wings were attached to the base of the toes.

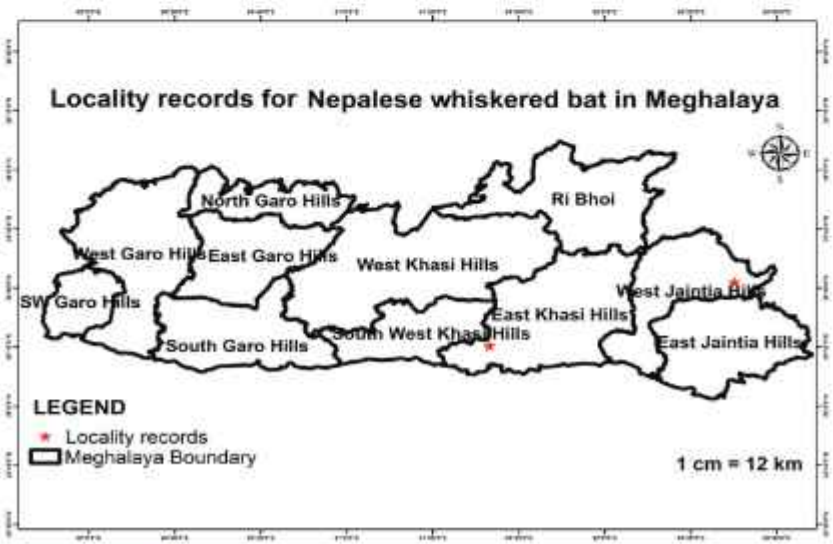
**Natural history note:** In Meghalaya, this species was recorded between elevations of 1020 -1250 m asl. In Manipur, specimens were harp trapped along a pine forest trail at an altitude of 1260 m asl; other species encountered in the area were *My. montivagus* and *Pi. coromandra*. In Uttarakhand, it has been caught between 1500 - 3000 m asl in primary oak forest, mixed oak-maple forest and rhododendron forest. Its echolocation calls have a FM structure which goes from about 100 kHz to 45 kHz. The calls produced in forest edges often have a short QCF tail which is unlike the European species of Myotis.

**Distribution :** In India, distributed in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Manipur, Meghalaya and Mizoram. Considering the complex taxonomy of this group and occurrence in relatively higher elevation areas, old records from the plains of Bihar, West Bengal and Assam are doubtful and need reassessment. In Meghalaya, this bat was reported from Khonshnong in West Jaintia Hills and; Krem Lum Shken in East Khasi Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens) | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 37.2-43.1 (40.2) | 9.6-12.0 (10.9) | 4.4-6.4 (5.1) | 36.8-37.8 (37.3) | 16.3-18.3 (17.3) | 6.4-8.6 (7.1) |


Uttam Saikia


Locality records for Nepalese whiskered bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Myotis siligorensis* (Horsfield, 1855)

**English name:** Himalayan whiskered bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A small bat with an average forearm length of 34.6 mm.The pelage is dark brown on the back, ventral pelage is ginger brown with dark hair roots. The muzzle has a dense fringe of hairs on the upper lips. The anterior border of ear is convex, tip slightly rounded and there is a pronounced notch on the posterior border around the midpoint; tragus is straight and pointed. The wings attach to the base of the phalanx of outer metatarsal of feet. Calcar lobe is absent.

**Natural history note:** In Meghalaya, this species was reported between an elevation of 63 m-1500 m asl. Specimens were harp trapped near a perennial stream in a pine forest late in the evening. In Uttarakhand, it was caught in alpine meadows at an elevation of 3240 m indicating broad ecological tolerances. Known to roost inside caves in small numbers.

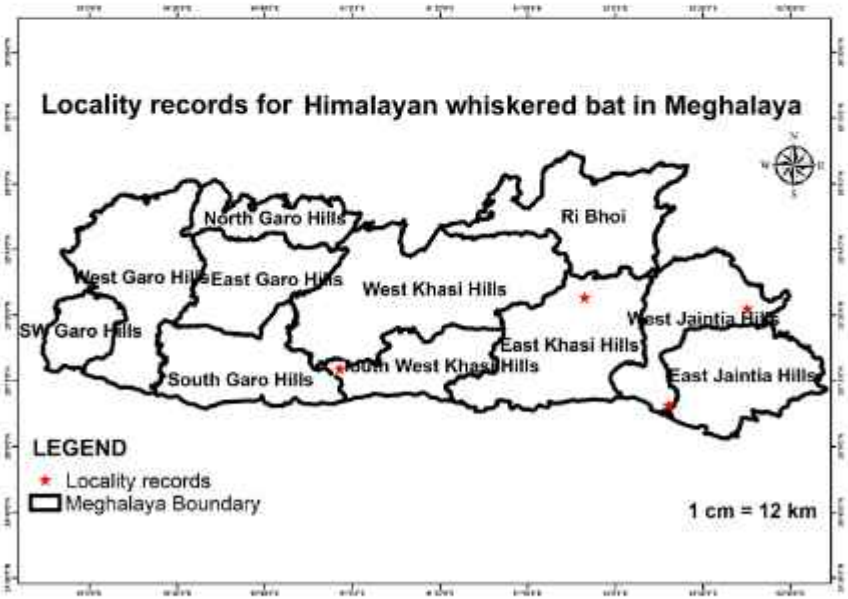
**Distribution :** In India, reported from Uttarakhand, West Bengal, Sikkim and Meghalaya. In Meghalaya, this bat has been reported from Krem Hartali in East Jaintia Hills; Amarsang in West Khasi Hills, Khonshnong in West Jaintia Hills; Shillong in East Khasi Hills.

**Abundance status:** Uncommon

| Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 31.7-39.1 (35.4 | 10.9-14.9 (12.8) | 5.2-5.9 (5.5) | 33.0-35.4 (34.6) | 14.4-16.2 (15.2) | 8.8-9.0 (8.9) |



Manuel Ruedi



## *Pipistrellus ceylonicus* (Kelaart, 1852)

**English name:** Kelaart's Pipistrelle

**Local names:** Do'bak Wacheksi (Garo);Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:**A relatively large-sized Pipistrelle with an average forearm length of 33.4- 35.0 mm in specimens from NE India. Pelage colour is variable from chestnut brown to reddish brown or golden brown. In older individuals, the colouration tends to become bright golden yellow. Individual hairs have lighter tips and darker roots. Muzzle, ears and interfemoral membranes are dark brown. The ears are triangular in profile with roundish tips, tragus is curved and blunt. The wing joins to the base of the phalanx of the outer toe.

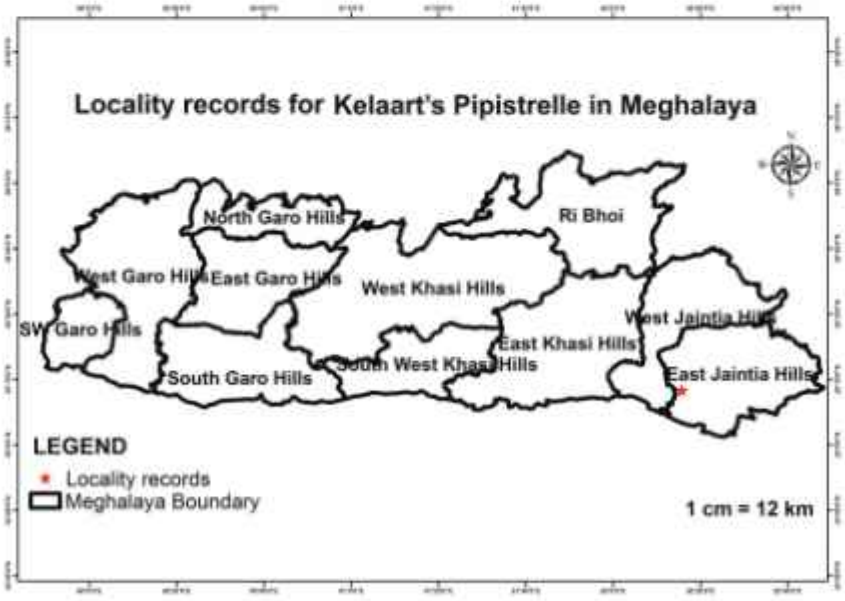
**Natural history note :** Like most other Pipistrelles, this bat is anthropophilic and routinely roosts in cracks and crevices in human dwellings. These bats emerge from their roost a little before dusk. In Assam, a specimen was opportunistically collected inside a house in a settlement on the bank of river Brahmaputra. Although the roosting location was not ascertained, villagers informed that a colony of these bats roosted on the ceiling of an occasionally used community health centre building nearby. The echolocation calls are FM-QCF with an end frequency between 35-40 kHz and show strong overlap with *Scotophilus heathii*.

**Distribution :** In India, reported from Himachal Pradesh, Rajasthan, Gujarat, Maharashtra, Goa, Karnataka, Andhra Pradesh, Kerela, Tamil Nadu, Madhya Pradesh, Bihar, West Bengal, Assam and Meghalaya. In Meghalaya, reported from a single locality in Umlyngsha (675 m asl) in East Jaintia Hills.

**Abundance status:** Rare.

| Body measurements in mm. Based on ZSI specimens | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 32.3, 35.1 | 10.4, 12.0 | 3.4, 4.1 | 33.4, 35.0 | 11.6, 13.4 | 7.3, 8.6 |


Uttam Saikia


Locality records for Kelaart's Pipistrelle in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Pipistrellus coromandra* (Gray, 1838)

**English name:** Coromandel Pipistrelle

**Local names:** Do'bak Wacheksi (Garo);Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A small bat with an average forearm length of 32.2 mm. The pelage colour varies from clove brown to dark brown on the back and cinnamon brown on the belly. The ears are broad, straight sided anteriorly and slightly concave posteriorly with rounded tip. The feet are very small and less than half the length of tibia. A prominent calcar lobe is present. Wings attach to the base of the metatarsus.

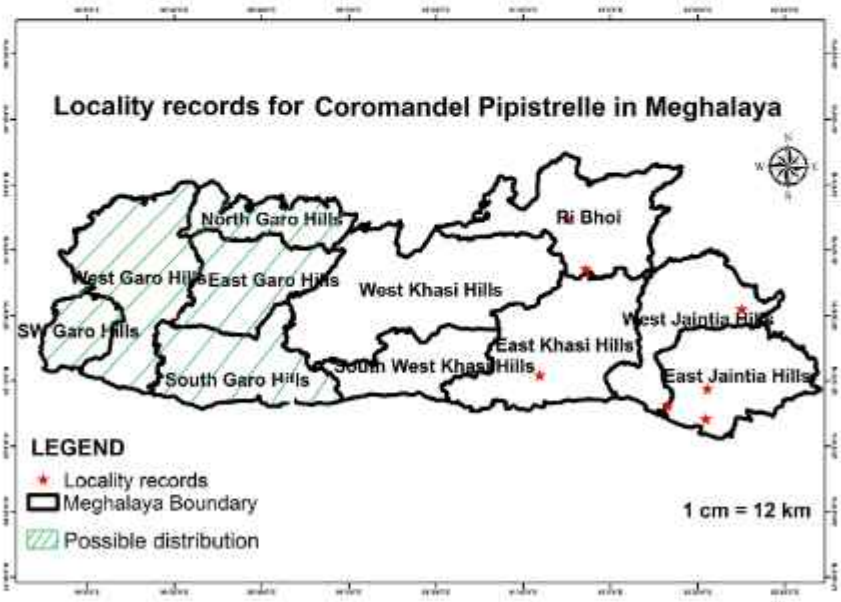
**Natural history note:** In Meghalaya, this bat was recorded between elevations of 480 -1500 m asl. Specimens were caught inside pine forests and around human habitations. Known to roost inside human dwellings, tree holes, bamboo holes, under tree barks and foliage. One of the earliest bat to emerge in the evening, individuals were observed hunting over water bodies for a short period before disappearing. Its echolocation calls recorded in the Andaman Islands, indicate an FM-QCF structure (typical of *Pipistrellus* spp.). The calls start at 80-90 kHz and end at 40-45 kHz.

**Distribution :** In India, widely distributed throughout the country. In Meghalaya it is reported from Sonapur, Kharkhana, Khahnar village, Laitiam Vilage in East Jaintia Hills; Khonshnong in West Jaintia Hills; Shillong and Cherrapunji in East Khasi Hills; Umiam and Nongpoh in Ri-Bhoi and "Garo Hills"

**Abundance status:** Common

| Body measurements in mm. The numbers within bracket indicate mean value. Based on specimens in ZSI | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 20-37 (32.2) | 8.5-12.8 (10.8) | 3.8-5.8 (4.8) | 30.2-33.9 (32.2) | 11.8-13.8 (12.7) | 4.1-7.2 (5.8) |


Uttam Saikia


Locality records for Coromandel Pipistrelle in Meghalaya
N
W
E
S
Ri Bhoi
North Garo Hills
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
Possible distribution
1 cm = 12 km

## *Pipistrellus javanicus* (Gray, 1838)

**English name:** Javan Pipistrelle

**Local names:** Do'bak Wacheksi (Garo);Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** A relatively medium-sized Pipistrelle, the average forearm length is 33 mm in specimens from northeastern India. The pelage is ginger brown overall with darker hair roots. The ears, wing and tail membrane are dark brown and hairless. Ears are short and rounded with a distinct fold at the posterior margin; tragus curved forward very much like other Pipistrelles. The wings attach to the midpoint of metatarsus, a small but prominent calcar lobe is present.

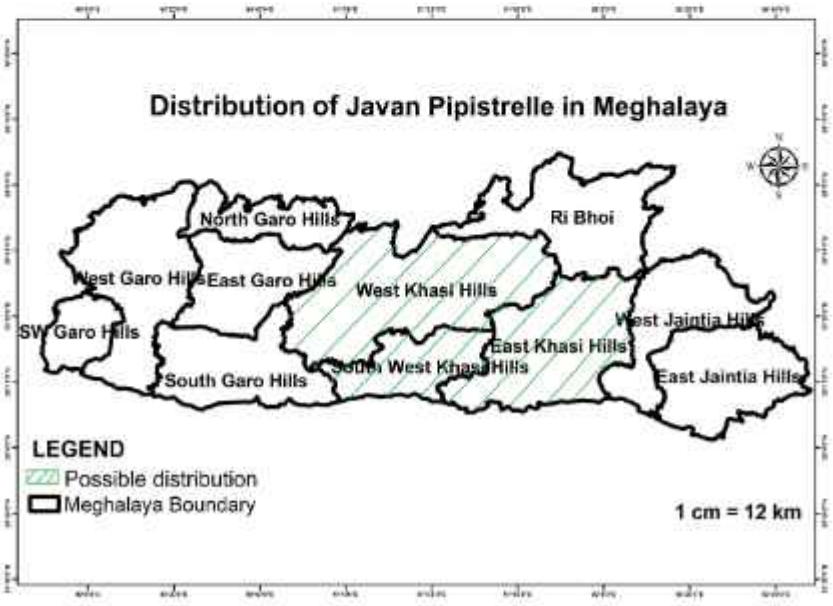
**Natural history note :** Very little ecological information about this species exists from Meghalaya. In Manipur, this species was harp trapped along a pine forest trail at an altitude of 1260 m. In Andaman Islands, it was netted over nullahs near habitation and was observed roosting inside a tree hole on a *Rhizophora* mangrove tree. In South-East Asia, this bat has been recorded in a wide range of habitats, from lowland and mangrove forests to primary hill forest up to 2,000 m elevation. It is known to roost in tree-ferns, fallen logs, caves, and human dwellings in urban areas. Based on calls recorded in the Andaman Islands, there appears to be significant overlap of frequencies between this species and *Pi. coromandra*.

**Distribution:** The exact distribution range in India is indeterminate, possibly restricted to Northeastern India and Andaman and Nicobar Islands. Records from Northern India are referable to *Pi. babu*. In Meghalaya, reported from "Khasi Hills" without any exact locality.

**Abundance status:** Rare.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens from NE India | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 32.0-34.3 (32.9) | 9.3-11.2 (10.2) | 4.4-4.8 (4.5) | 32-34.6 (33.0) | 13.0-14.3 (13.5) | 6.5-7.6 (7.2) |


Manuel Ruedi


Distribution of Javan Pipistrelle in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Possible distribution
Meghalaya Boundary
1 cm = 12 km

### *Pipistrellus paterculus* Thomas, 1915

**English name :** Mount Popa Pipistrelle

**Local names:** Do'bak Wacheksi (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** The forearm length in this bat averages 30.9 mm. Dorsal side is uniformly coloured with chocolate brown, ventrally ginger brown with darker hair roots. The ears, muzzle, wing and tail membrane are all dark brown. The muzzle is naked except for a few whiskers and glandular swellings are prominent. The anterior border of the ear is straight with a roundish tip, the posterior border bears a deep notch on the middle. The tragus is similar to other Pipistrelles, short and forward curving.

**Natural history note:** Very little ecological information is available on this species. Reportedly distributed up to an altitude of 2400 m asl in China. It is known to roost inside tree holes, banana leaves and thatch roof of huts and collected from clearings in forested regions.

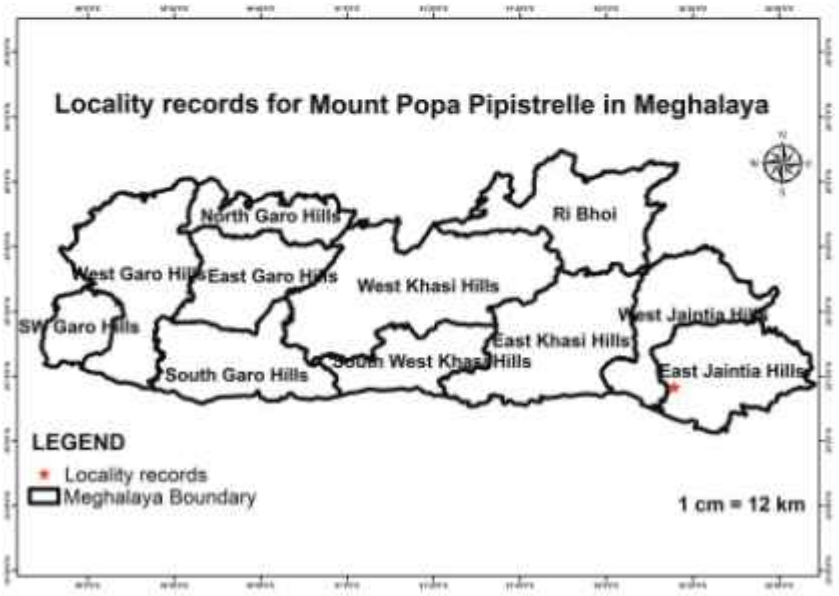
**Distribution :** In India, reported from Jammu and Kashmir, Uttarakhand, Bihar, Assam, Manipur, Meghalaya, Nagaland. In Meghalaya, this bat is reported from a single locality in Umlyngsha in East Jaintia Hills.

**Abundance status :** Rare.

Body measurements in mm. The numbers within bracket indicate mean value (Bates & Harrison, 1997)

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 31.0-38.0(33.7) | 10.0-13.0 (10.9) | - | 30.0-31.6 (31.0) | - | 6.0-7.0 (6.1) |


Manuel Ruedi


Locality records for Mount Popa Pipistrelle in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Pipistrellus tenuis* (Temminck, 1840)

**English name:** Least Pipistrelle

**Local names:** Do'bak Wacheksi (Garo); Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is the smallest Pipistrelle in India with an average forearm length of 27.7 mm. Very similar to *Pi. coromandra* except for slightly smaller average body measurements (although hardly useful in distinguishing these two species in the field). The dorsal pelage is deep clove brown and the ventral hairs are lighter ginger brown. The ears, muzzle, wing membranes are dark brown and almost naked. The ears are small, straight on the anterior border and rounded tip while the posterior border bears a deep concavity in the middle.

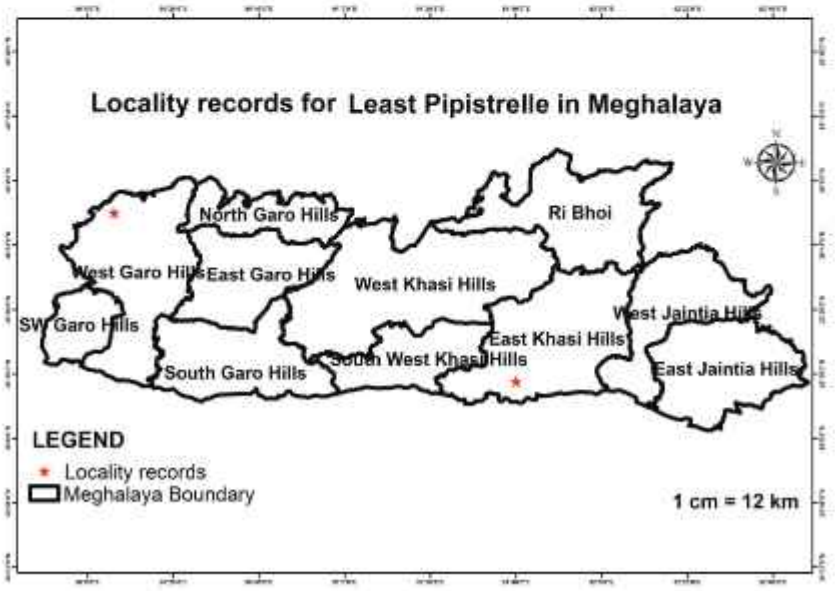
**Natural history note:** One of the commonest bat species in India, it can be found both inside forest and around human environment. Usually confined to lower elevation areas and in Meghalaya, reported between altitudes of 74-815 m asl. Known to roost in human dwellings especially in the wall crevices and roofs, bamboo internodes, in tree holes and foliage. It produces broadband echolocation calls with an FM-QCF structure. The calls may start above 100 kHz and end above 45 kHz, which separates it from other *Pipistrellus* spp.

**Distribution :** In India, widely distributed throughout the country. In Meghalaya, this bat has been reported from Laitkynsew in East Khasi Hills and Phulbari in West Garo Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens from NE India | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 23.0-31.0 (28.3) | 6.8-9.6 (8.5) | 3.7-4.7 (4.2) | 26.7-30.8 (28.5) | 11.0-12.2 (11.5) | 5.8-6.8 (6.3) |


Uttam Saikia


Locality records for Least Pipistrelle in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Plecotus homochrous* Hodgson, 1847

**English name:** Hodgson's long-eared bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** This is a relatively small batwith forearm length of 36.2-39.4 mm. Instantly recognizable from its very distinctive long ears. The fur is long, buffy brown on the back and shorter ginger brown on the belly. The oval shaped ears joins over the forehead through a thin membrane. The ears are semi translucent and have many prominent vertical ridges and a semi-circular lobe projects from the base of the anterior border. The wings and tail membrane are light brown, hairless and the long tail is fully enclosed within the membrane. The wing attaches to the mid metatarsus and calcar lobe absent.

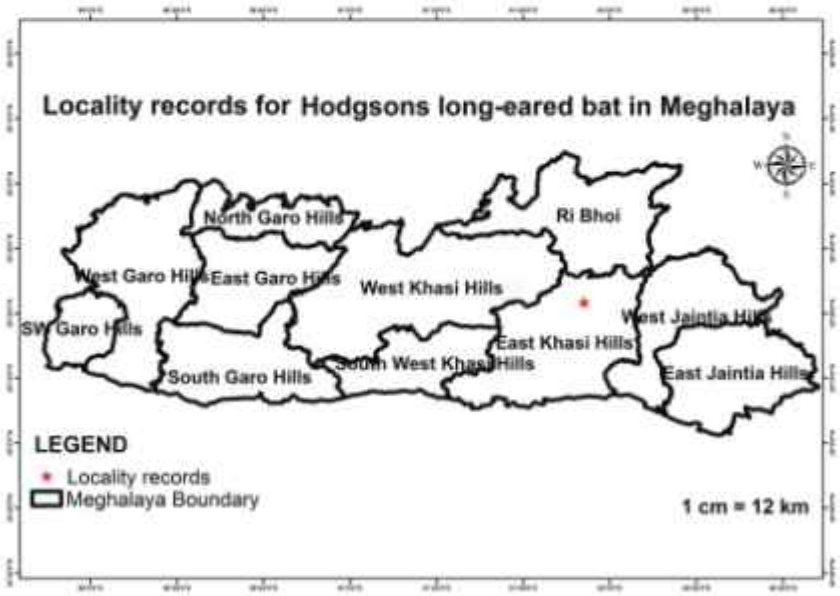
**Natural history notes :** Nothing is known about this species in Meghalaya. In Uttarakhand, this species occurs in primary oak, cedar and rhododendron forest from 1600-3000 m asl. It has also been recorded around forest edges in alpine meadows. Pregnant females were caught in late April and May. This species produces faint narrowband calls of short duration, and have a prominent second harmonic. The first harmonic (dominant) begins at about 45-50 kHz and ends around 24 kHz.

**Distribution :** In India, distributed in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Darjeeling region of West Bengal and Meghalaya. In Meghalaya, reported from "Khasi Hills" without any exact locality (possibly around Shillong).

**Abundance status:** Rare. No recent record.

| Body measurements in mm. Based on ZSI specimens from Uttarakhand | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 42, 43 | 34.9, 37.8 | 13.1, 13.7 | 36.2, 39.4 | 17.6, 18.9 | 7.3, 8.1 |


Rohit Chakravarty


Locality records for Hodgsons long-eared bat in Meghalaya
N
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Scotophilus heathii* (Horsfield, 1831)

**English name :** Asiatic greater yellow house bat

**Local names :** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** This is a medium-sized bat with an average forearm length of 59.2 mm. The pelage is short and silky, the back is olive brown while the throat and belly are sulphur yellow. The muzzle is thick, blunt and swollen on the sides and without any hairs. Nostrils are directed sideways. Ears are small, hairless and glossy black, the tragus is crescent shaped and there is a prominent antitragus. The tail is long and enclosed within the interfemoral membrane except for the tip.

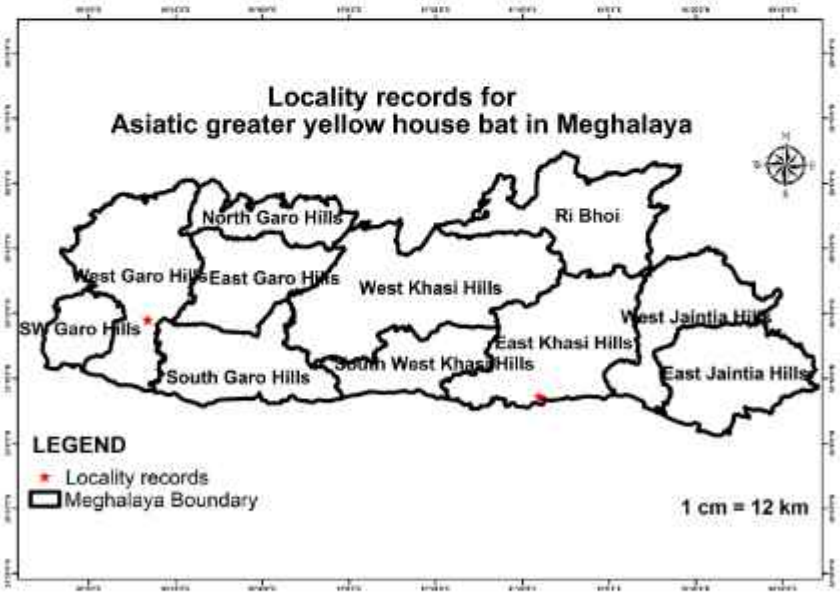
**Natural history note:**In Meghalaya, this species has been reported between c.300-590 m asl.This species is well-adapted to urban areas and human habitation. It typically roosts in small colonies of up to 20 individuals both in crevices on buildings, and under the foliage of palm trees. Tree holes especially in coconut or areca palm are its favourite roosting places. A very large colony of this bat numbering several hundreds of individuals was located on the ceiling of a school building in Haipi village of Manipur dominated by pineforest and agricultural fields. This colony was reportedly roosting in that location for many years and stubbornly resists any attempt to evict. Interestingly, its echolocation call is similar to that of *Pipistrellus ceylonicus,* a species about half its size.

**Distribution :** In India, this species is widely distributed throughout the country. In Meghalaya, it is reported from Tura in West Garo Hills and Sohbar in East Khasi Hills.

**Abundance status:** Uncommon.

| Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens from NE India | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 57.0-60.0 (58.6) | 14.2-14.9 (14.6) | 7.9-8.0 (7.9) | 58.3-60.2 (59.2) | 23.9-24.9 (24.5) | 12.6-14.2 (13.4) |


Uttam Saikia


Locality records for
Asiatic greater yellow house bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Scotophilus kuhlii* (Leach, 1821)

**English name :** Lesser Asiatic yellow house bat

**Local names :** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** This species is essentially a smaller version of *Sc. heathii* with forearm length of 50-52 mm. However, there is some difference in pelage colour, the head, back and neck is chestnut brown and the belly is beige, characteristically lacks the yellowish hue of the larger cousin. There is a sharp demarcation of colour between the throat and the belly.

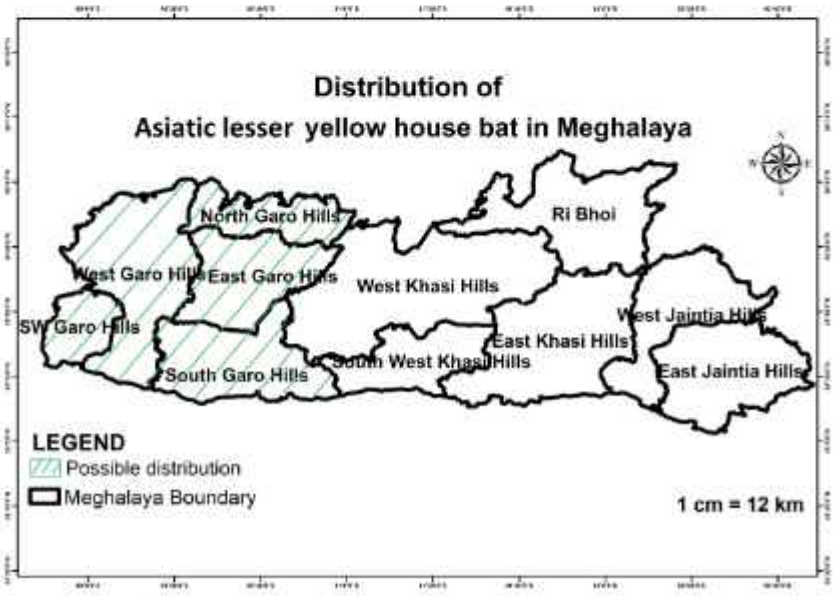
**Natural history note :** A common species with peri-human occurrence. In Assam, it was frequently observed roosting singly or in small groups inside crevices of mud walls, spaces between bamboo poles in human dwellings and inside hollows of areca palm trees. Recent studies in Uttar Pradesh have revealed that *Sc. kuhlii* consumes a variety of insects like Coleoptera, Lepidoptera, Orthoptera, Diptera, Hemiptera, and Hymenoptera across all seasons and potentially an effective biological pest control agent. In parts of its range, parturition occurs in June and females reportedly give birth to two pups.

**Distribution:** InIndia, widely distributed throughout the country. In Meghalaya, reported from "Garo Hills"although likely to be present in other parts of the state as well.

**Abundance status :** Uncommon.

| Body measurements in mm. Based on ZSI specimens from NE India | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 50, 52 | 11.3, 12.7 | 6.1, 6.3 | 49.5, 50.5 | 20.6, 24.3 | 9.3, 9.7 |


Uttam Saikia


Distribution of
Asiatic lesser yellow house bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
South Garo Hills
East Jaintia Hills
LEGEND
Possible distribution
Meghalaya Boundary
1 cm = 12 km

## *Scotomanes ornatus* (Blyth, 1851)

**English name:** Harlequin bat

**Local names:** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions:** An unmistakable bat with an orange or chestnut brown back and tufts of white hairs around the flanks and also forming a white line around the mid back. The belly is frosty white mixed with chestnut brown hairs. The wing and tail membranes are dark brown. The muzzle is naked except for scattered long whiskers. Ears are large and oval in shape, essentially naked and the tragus is crescent shaped.

**Natural history note:** In Meghalaya, this bat was reported between c.400-1300 m asl. In Other parts of India, it was collected from warm valleys in low to medium elevations. It is known to roost under tree leaves and banana leaves. In Meghalaya, this bat reportedly hibernates and emerges from hibernation by June.

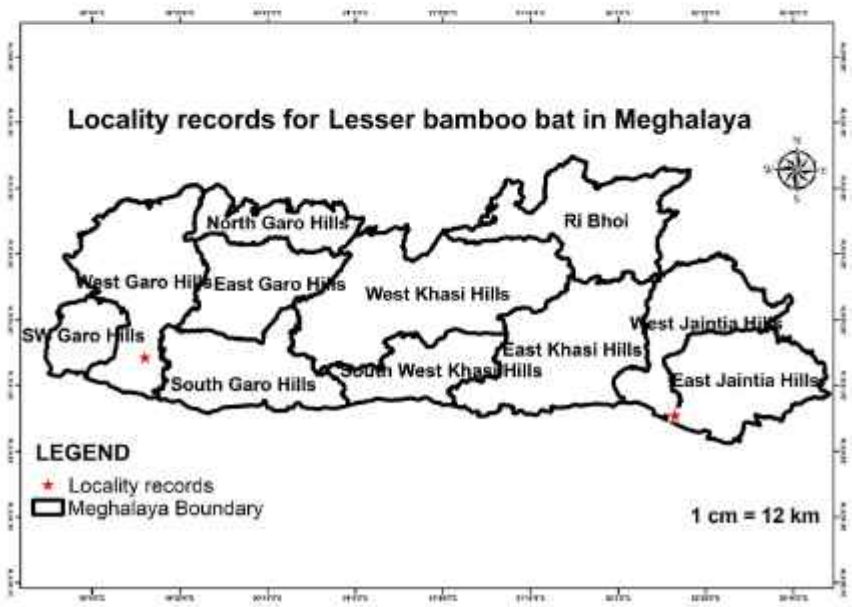
**Distribution:** In India, distributed in West Bengal, Sikkim, Arunachal Pradesh, Nagaland, Manipur and Meghalaya. This species was originally described from Cherrapunji in East Khasi Hills. Other reported localities in the state include Jowai and Khonshnong in West Jaintia Hills; Darugre in East Garo Hills.

**Abundance status:** Uncommon. No recent records.

Body measurements in mm. The numbers within bracket indicate mean value. After Bates & Harrison, 1997

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 52.0-62.0 (57.6) | 19.0-23.0 (21.1) | - | 56.1-61.2 (58.8) | - | 12.0-15.0 (12.9) |


Manoel Ruedi


Locality records for Lesser bamboo bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Tylonycteris fulvida* (Blyth, 1859)

**English name:** Lesser bamboo bat

**Local names :** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** Another miniature bat with an average forearm length of 25.2 mm in Indian specimens. It is slightly smaller than *Ty. malayana*. The dorsal fur is light golden brown in some individuals and reddish brown in others. Belly is golden brown with chocolate brown hairs on the flanks. As in the larger cousin, the head is broad and flattened. The muzzle is flesh coloured, almost naked with a few whiskers, nostrils projecting forward sideways. The wings attaches to the base of the metatarsus. The soles of feet and base of the thumb bear roundish fleshy callosities.

**Natural history note :** A relatively commonly occurring species where bamboo grooves are widespread and specimens were collected either from inside bamboo internodes or netted near bamboo grooves. The body is typically adapted to live inside bamboo internodes. The highly flattened skull allows them to gain entrances to bamboo internodes through slits made by Cerambycid beetles. The thumb and sole pads are possibly used for adhesion during roosting inside smooth surface. It produces high frequency FM calls with a short QCF tail. The calls start above 100 kHz and end around 60 kHz.

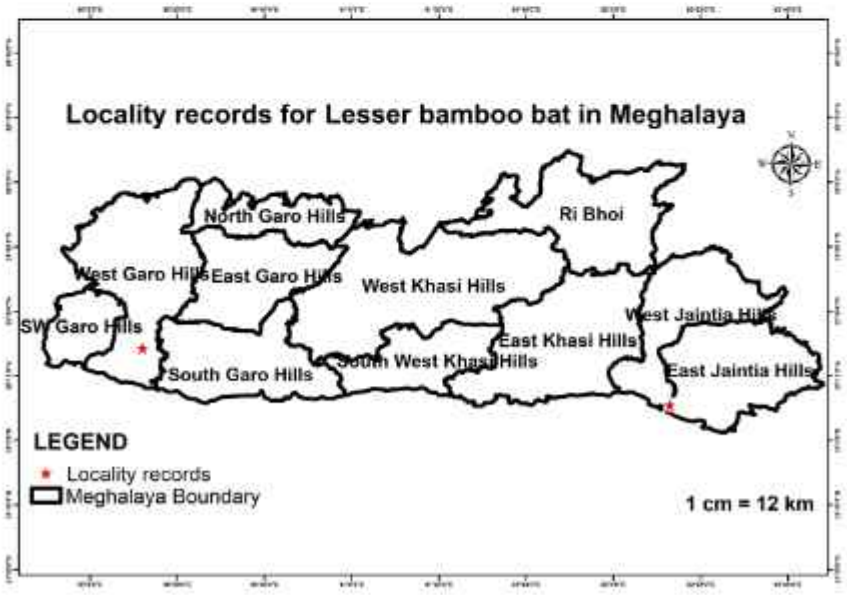
**Distribution :** In India, distributed in Karnataka, Kerela, West Bengal, Sikkim, Manipur, Meghalaya and Mizoram.InMeghalaya, this bat was reported from a forest near Kharkhana in East Jaintia Hills and Selbalgre in West Garo Hills.

**Abundance status :** Uncommon.

Body measurements in mm. The numbers within bracket indicate mean value. Based on specimens from Indochina.

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 25-29.4 (26.4) | 8.8-12 (10.2) | 31.-3.5 (3.4) | 24.7-25.9 (25.2) | 11.2-12.2 (11.7) | 4.7-5.8 (5.3) |


Manuel Ruedi


Locality records for Lesser bamboo bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South West Khasi Hills
East Jaintia Hills
South Garo Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Tylonycteris malayana* Chasen, 1940

**English name :** Malayan bamboo bat

**Local names :** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** This is a very small bat with an average forearm length of 27.6 mm in specimens from NE India. Pelage is short and silky, golden brown on the upperparts and light brown on the underparts. Individual hairs are uniformly coloured throughout the length. The muzzle and ears are dark brown. The wing membranes are dark brown and hairless. The head is typically very broad and flattened which is also discernible in live specimens. The feet are small and the wing membrane attaches to the base of the metatarsus and around the middle of the roundish thumb pad.

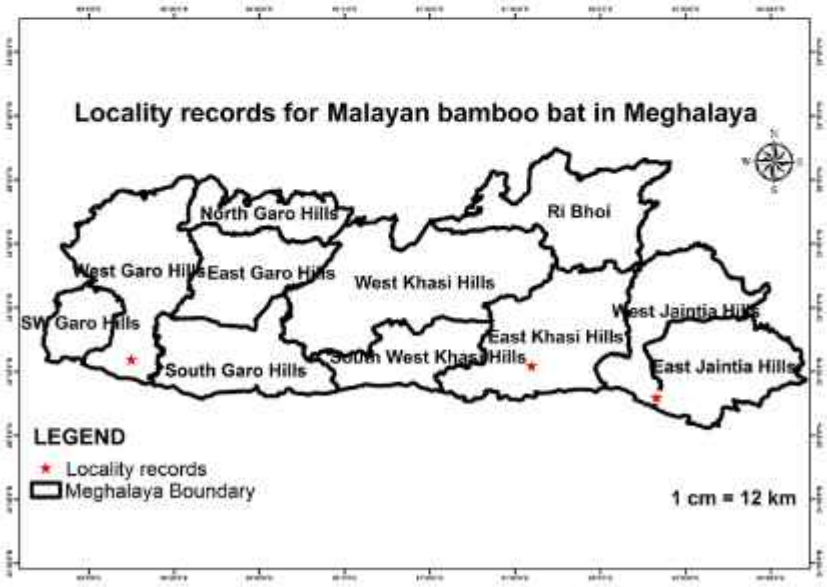
**Natural history note :** In Meghalaya, this species has been reported between c.60 – 1430 m asl.In Assam, several pups were observed roosting with a single female inside the intermodal space of a bamboo during July month.

**Distribution :** In India, distributed in Assam, Mizoram and Meghalaya. In Meghalaya, it is known from Kharkhana in East Jaintia Hills; Kherapara in West Garo Hills and Cherrapunji in East Khasi Hills.

**Abundance status:** Uncommon.

| Body measurements in mm.The numbers within bracket indicate mean value. Based on ZSI specimens and released animals | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 29-31 (30.2) | 8.6-11.5 (10.1) | 2.0-4.2 (2.9) | 26.8-27.9 (27.6) | 11.2-12.7 (12.2) | 5.2-6.1 (5.6) |


Manuel Ruedi


Locality records for Malayan bamboo bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## Family: Miniopteridae

### Bent-winged bats

This family of Bent-winged bats includes about 40 extant species and are geographically widespread over southern Europe, Africa, Asia, Australia and oceanic islands like Madagascar, New Caledonia and the Vanuatu. These bats are characterized by small size and very long wings and tail membranes. The ears are small with a short tragus that is curved forward. The braincase is large and abruptly elevated above the rostrum.



## *Miniopterus magnater* Sanborn, 1931

**English name :** Large bent-winged bat

**Local names :** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** This is the larger between the two *Miniopterus* species found in Meghalaya with an average forearm length of 50.6 mm. The dorsal pelage is russet brown to dark brown, ventral pelage is slightly paler with greyish hairs tips. Ears, wings and interfemoral membranes are dark brown. The second phalanx of the third metacarpal is characteristically very long with an average length of 39.3 mm which is roughly three times the length of the first phalanx.

**Natural history note :** A typical cave dweller and mostly a gregarious species roosting in colonies sometimes numbering thousands of individuals. Commonly occur in many of the caves across the state which they share with several species of horseshoe and leaf-nosed bats. A strong odour is associated with this bat and they are almost always found to be infested with large numbers of ectoparasites. The structure of the echolocation calls of free flying *Mi. magnater* has a brief and strongly frequency-modulated sweep terminated by a narrow band tail. The starting frequency was recorded at about 118 kHz and terminating at 39 kHz. The frequency of maximum energy was marked at 47 kHz.

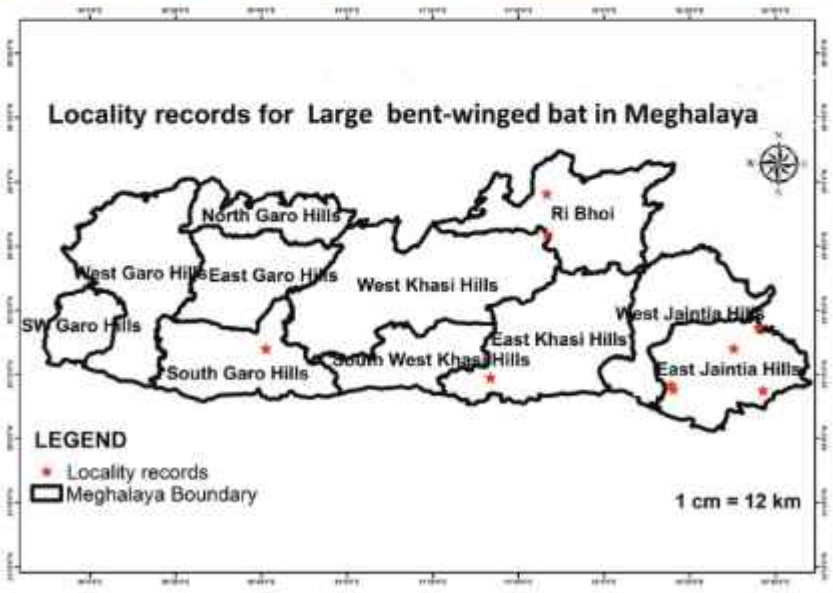
**Distribution :** In India, distributed inMeghalaya and Manipur. In Meghalaya, it is widely distributed throughout the state, recorded localities include Siju cave South Garo Hills; Krem Labit - Lum Dait Khung; Krem Labit Kseh, Krem Lymbiat Lakadong, Syndai and Umlyngsha in East Jaintia Hills; Phrang karuh cave in Shella in East Khasi Hills; Krem Pamskei in Lawbah in West Khasi Hills; Umiam Umtrew Stage IV dam site in Ri Bhoi.

**Abundance status:** Common.

Body measurements in mm. The numbers within bracket indicate mean value. Based on ZSI specimens and released animals from Meghalaya.

| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
|---|---|---|---|---|---|
| 44.8-59.6 (55.8) | 10.5-14.2 (12.9) | 4.1-6.8 (5.7) | 48.8-52.4 (50.6) | 20.4-22.5 (21.6) | 9.2-11.3 (9.6) |


Uttam Saikia


Locality records for Large bent-winged bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## *Miniopterus pusillus* Dobson, 1876

**English name :** Small bent-winged bat

**Local names :** Lymbit (Khasi); Labit Tadong (Jaintia)

**Descriptions :** Externally, this species is very similar to *Mi. magnater* except for the considerably smaller size with an average forearm length of 43.0 mm. Fur colour varies from dark brown to blackish on the back and paler below. Compared to darker muzzle and lips in *Mi. magnater,* the face is lighter flesh-coloured; the ears more delicate and without any obvious folds.

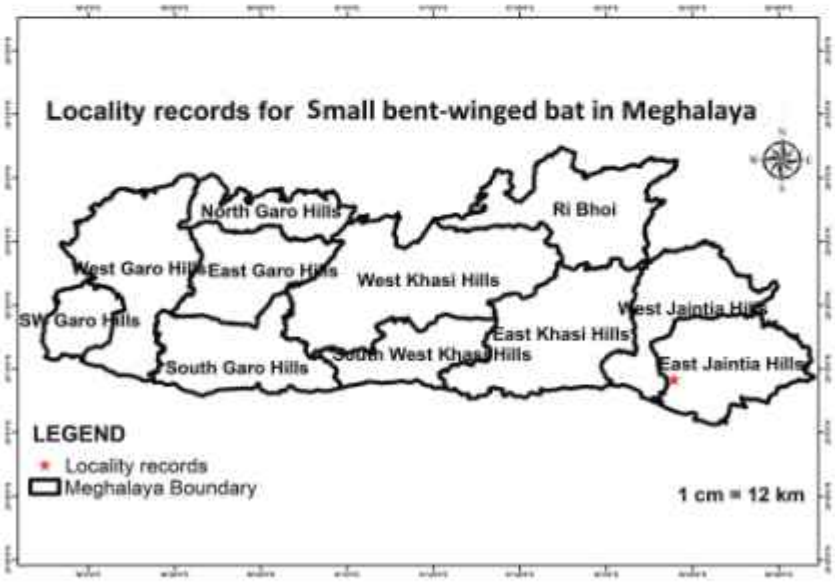
**Natural history note :** An adult female was caught in a mist net placed across a river near the village of Umlyngsha, East Jaintia Hills District. In a heterogenous agro-forestry landscape in Tamil Nadu, this species has been reported from all kinds of habitats, ranging from pristine forests to tea plantations. Echolocation calls recorded in Kerala and Tamil Nadu indicate an FM structure with a short QCF tail. The start frequency can be higher than 120 kHz and the call ends around 58 kHz.

**Distribution :** In India, distributed in Karnataka, Tamil Nadu, Meghalaya and Nicobar Islands.Apparently an uncommon bat in Meghalaya,this species is thus farreported from Umlyngsha in East Jaintia Hills.

**Abundance status :** Rare.

| Body measurements in mm. Based on a single specimen from Meghalaya in ZSI | | | | | |
|---|---|---|---|---|---|
| Tail length | Ear length | Tragus length | Forearm length | Tibia length | Hind feet & claw length |
| 51.0 | 11.0 | 4.8 | 43.0 | 17.6 | 7.6 |


Manuel Ruedi


Locality records for Small bent-winged bat in Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
SW Garo Hills
West Jaintia Hills
East Khasi Hills
South Garo Hills
South West Khasi Hills
East Jaintia Hills
LEGEND
Locality records
Meghalaya Boundary
1 cm = 12 km

## Glossary of terms used

Antitragus: A lobe developed from the basal part of the outer margin of ears insome bats.

Archonta: A superorder (a taxonomic hierarchy above order) that included Primate, Scandentia and Dermoptera.

Bioacoustics: The study of sound in animals. It involves investigation of sound production, dispersion and reception in animals.

Calcar: A cartilaginous projection arising out of the ankle that helps to support the free end of the tail membrane.

Carnivora: A mammalian order that are primarily flesh eaters. A wide range of animals like dogs, bears, cats, hyenas, mongooses, pandas, seals, walrus etc. are included in this group.

Cetartiodactyla: A superorder that includes whales and dolphins together with even-toed ungulates.

Dermoptera: A mammalian order consisting of two species of flying lemurs living in Southeast Asia and the Philippines.

Eulipotyphla: An order of mammals that includes hedgehogs, moles, solenodonsand shrews

Foraging: Searching for food and feeding.

Forearm: The part of the arm between the wrist and the elbow consisting of two bones, the radius and the ulna.

Gular sac: A glandular skin pouch present in the chin region of some species of bats.

Guano: Faeces of bats or the accumulated excreta of seabirds.

Harem: An animal group consisting of one or two males, a number of females and their offspring.

Hematophagous: Animals that feed on blood.

Insectivorous: An animal feeding on insects or other invertebrates

Karstic: Dominated by Karst. Karst is a landscape formed due to dissolution of soft rock like limestone due to action of water. It is characterized by extensive network of underground drainage with sinkhole and caves.

Lancet: A structure in the terminal end of noseleaf in horseshoe bats which is normally erect and sub triangular in shape.

Metacarpal: One of any tubular bones between the wrist (carpal bones) and phalanges of fingers.

Metatarsus: The bones in the middle of feet between the ankle and phalanx.

Monogamous: Having only one mate at a time.

Monophyletic: Refers to a group of organisms which are descended from a single ancestor. A monophyletic group includes the most recent common ancestor and all its descendants.

Nectarivorous: An animal feeding on nectar.

Noseleaf: Complex facial structures developed around the nostrils in bat families Phyllostomidae, Megadermatidae, Hipposideridae and Rhinolophidae.

Old world: Collectively refers to the continents of Africa, Europe and Asia which were in cultural contacts from Bronze age (3300-1300 BC) onwards.

Paraphyletic: A situation in which one or several monophyletic subgroups of organisms (e.g., genera, species) are left apart from all other descendants of a unique common ancestor. A paraphyletic taxon includes the most recent common ancestor, but not all of its descendants.

Passive flight: Flight where no expenditure of body energy is involved, rather relying on external sources like wind.

Patagium: A thin fold of skin developed between the limbs in certain animals which acts as aerofoil to generate thrust.

Perissodactyla: A mammalian order commonly called odd toed ungulates that include asses, horses, zebras, rhinoceroses and tapirs.

Phalanx: A bone of the toe or finger (plural phalanges)

Pholidota: A mammalian order that includes the pangolins or scaly ant eaters.

Phylogenetic: Relating to the relationships of an organism to other organisms according to evolutionary similarities and differences

Powered flight: Flight performed using internal body energy of organism.

Polyphyletic: Group of unrelated organisms descended from different ancestors. A polyphyletic group does not include the common ancestor of all members of the group

Pteropodid: Bats belonging to the family Pteropodidae*i.e.* fruit bats

Primate: A mammalian order that includes over 300 species of lemurs, lorises, tarsiers, monkeys, apes, and humans.

Radio-metacarpal pouch: A skin pocket developed on the underside of wings of certain bats.

Roosting: Taking rest or sleeping .

Rostrum: The anterior part of the skull in front of the orbits.

Scandentia: A mammalian order that includes about 20 species of tree shrews and pen-tailed tree shrews.

Species complex: Group of two or more similar looking species which are difficult to distinguish morphologically.

Speciose: Containing many species; species rich.

Tibia: The larger of the two bones between knee and ankle in vertebrates.

Tragus: A cartilaginous projection in front of ear cannel found in some bats.

Uropatagium: The posterior portion of the wing membrane developed between the hind limbs, commonly called tail membrane.

Ultrasonic: Sound frequencies greater than the upper audible range of humanears, generally considered above 20 kHz.

Zoonotic: Deriving form animals.

Zoonosis: A disease that has jumped to human from non-human animals.

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