Zootaxa 5644 (1): 001–078
https://www.mapress.com/zt/

Monograph

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5644.1.1
http://zoobank.org/urn:lsid:zoobank.org:pub:98354CF6-78A5-4CCD-84FE-1E220B722DE9

ZOOTAXA

5644

Taxonomic reassessment of bats from the Western Himalayas, India and description of a new species of the *Myotis frater* complex (Mammalia, Chiroptera, Vespertilionidae)

UTTAM SAIKIA[1], ROHIT CHAKRAVARTY[2,3,4], GABOR CSORBA[5], MOSTAQUE AHMED LASKAR[6] & MANUEL RUEDI[7*]

[1]*Zoological Survey of India, North Eastern Regional Centre, Risa Colony, Shillong, Meghalaya–793003, India.*
uttamzsi@gmail.com; https://orcid.org/0000-0001-9184-8071
[2]*Leibniz Institute for Zoo and Wildlife Research, Alfred-Kowalke-Str. 17, 10315, Berlin, Germany.*
rohitchakravarty@ncf-india.org; https://orcid.org/0000-0001-7432-6917
[3] *Nature Conservation Foundation, 1311, "Amritha". 12th Main. Vijayanagar 1st Stage, Mysore–570017, India.*
[4]*Bat Conservation International, 500 N Capital of TX Hwy, Bldg. 1, Suite 175, Austin, Texas 78746, USA.*
[5] *Department of Zoology, Hungarian Natural History Museum, Baross 13., Budapest, H–1088, Hungary.*
csorba.gabor.hnhm@gmail.com; https://orcid.org/0000-0001-5720-4600
[6]*Department of Biotechnology, St. Anthonys College, Bomfyle Road, East Khasi Hills, Shillong, Meghalaya–793001, India.*
laskar41@gmail.com; https://orcid.org/0000-0001-6294-0450
[7]*Department of Mammalogy and Ornithology, Natural History Museum of Geneva, BP 6434, 1211 Geneva 6, Switzerland.*
**Corresponding author, Manuel.Ruedi@geneve.ch; https://orcid.org/0000-0003-3283-7764*

Magnolia Press
Auckland, New Zealand

Accepted by P. Velazco: 8 May 2025; published: 5 Jun. 2025

UTTAM SAIKIA, ROHIT CHAKRAVARTY, GABOR CSORBA, MOSTAQUE AHMED LASKAR & MANUEL RUEDI

Taxonomic reassessment of bats from the Western Himalayas, India and description of a new species of the *Myotis frater* complex (Mammalia, Chiroptera, Vespertilionidae)

(*Zootaxa* 5644)

78 pp.; 30 cm.

5 Jun. 2025

ISBN 978-1-77973-387-0 (paperback)

ISBN 978-1-77973-388-7 (Online edition)

FIRST PUBLISHED IN 2025 BY

Magnolia Press

P.O. Box 41-383

Auckland 1041

New Zealand

e-mail: magnolia@mapress.com

https://www.mapress.com/zt

ISSN 1175-5326 (Print edition)

ISSN 1175-5334 (Online edition)

Table of Contents

Abstract

Based on specimens collected during recent field surveys and re–examination of museum specimens, we critically reviewed the taxonomic status of several bat species occurring in the Western Himalayan states of Himachal Pradesh and Uttarakhand in India. The present review incorporates both morphological and molecular data and additionally illustrates new echolocation call characters of some little–known species from the region. A new species, *Myotis himalaicus* **sp. nov.**, belonging to the *My. frater* complex is described based on multiple evidence of unique characters. We revised putative records of *Tadarida teniotis* as *Ta. insignis* and report this species for the first time from India. We also detail the first occurrence of *Rhinolophus nippon*, *Hypsugo savii* and *My. sicarius* from the Western Himalayas. We conclusively delineate *Pipistrellus babu* occurring in the Western Himalayas as a species distinct from *Pi. javanicus* in Southeast Asia and draw attention to several species–complexes (*i.e*. *Rhinolophus macrotis*, *Eptesicus pachyomus*, *Murina cyclotis* or *Mu. huttonii*) where further material and analyses are needed to clarify the species boundaries.

Key words: Himalayas, Chiroptera, systematics, DNA barcode, echolocation

Introduction

Mountains are cradles and globally important centres of biological diversity (Perrigo *et al.* 2019; Sharma *et al.* 2009). The Himalayan mountain range constitutes one of the richest and most diverse ecosystems on Earth and is recognized as one of the 36 global biodiversity hotspots, which supports a large number of mammalian taxa (Olson *et al.* 2001; Mittermeier *et al.* 2004; Salick *et al.* 2009; CEPF 2024). By virtue of its location in the transition zone of Oriental and Palearctic zoogeographic realms, the Himalayan hotspot shares faunal elements of both. Huge elevational range of the Himalayas resulted in topographic and microclimatic variations and ecological gradients. This diverse biophysical habitat sets the stage for rich biodiversity and species evolution (Miehe *et al.* 2009; Xu *et al*. 2019). The Indian Himalayas straddles across a length of over 2500 km from Jammu and Kashmir to northeastern India and is divided into Eastern and Western Himalayas, the latter encompassing the administrative units of Jammu and Kashmir, Ladakh, Himachal Pradesh, and Uttarakhand (Bhatt *et al.* 2016). The Western Himalayas apparently harbours a rich assemblage of bat fauna but is insufficiently elucidated. The earliest chiropterological documentation from the region dates back to the last decades of 19th century when *Murina huttonii* and *Mu. grisea* (= *Harpiola grisea*) were described from Kumaon area (Peters 1872) and *Vespertilio macropus* (=*Myotis longipes*) from Bhima Devi in Jammu and Kashmir (Dobson 1872). In the subsequent period, several new species were documented from the area *e.g*. *Vespertilio murinoides* (=*Myotis blythii*) from Chamba area of Himachal Pradesh (Dobson 1873); *Pterygistes* (=*Nyctalus*) *montanus* from Mussoorie in Uttarakhand (Barrett–Hamilton 1906) and *Plecotus wardi* from Leh in Jammu and Kashmir (Thomas 1911) etc. Some of the other early reports on the bat fauna of the Western Himalayas pertain to Allen (1908) and Dodsworth (1913) who reported a few species like *Rhinolophus ferrumequinum*, *Scotophilus kuhlii* and *Scotoecus pallidus* from Kullu valley and *Pteropus leucocephalus* (=*medius*), *Rhinolophus tragatus* (=*nippon*), *Ny. montanus*, *Ny. labiata* (=*plancyi*), *My. blythii*, *My. muricola* and *Pipistrellus coromandra* from Shimla district of Himachal Pradesh, respectively. The Mammal Survey conducted by the Bombay Natural History Society (1911–1923) brought new momentum to the collection and study of mammalian specimens throughout the Indian subcontinent. The surveys' result from Kumaon region was reported by Wroughton (1914) and recorded *Pt. giganteus* (=*Pt. medius*)*, Rh. rouxii, Rh. lepidus, Rh. pearsonii, Hipposideros armiger, Lyroderma lyra, Pl. homochrous, Mu. huttonii, Pi. mimus* (=*Pi. tenuis*)*, Sc. wroughtoni* (=*Sc. kuhlii*)*, My. darjelingensis* (=*My. siligorensis*)*,* and *Miniopterus fuliginosus* from the area. Thomas (1915a) reviewed the *Myotis* bats collected during mammal surveys and reported *My. blythii* from Shimla and *My. formosus* from Dharamshala. In the meantime, Captain H. W. Wells made extensive mammalian collections from various parts of Himachal Pradesh and based on these collections, H. M. Lindsay (1927) reported the occurrence of seven species of bats from that region namely *Pt. giganteus* (=*Pt. medius*), *Rh. ferrumequinum*, *Pi. babu*, *Ny. noctula*, *Ny. leisleri*, *My. muricola* and *My.* (=*Submyotodon*) *caliginosus*. In connection with an extensive bat ectoparasite survey in Uttarakhand, Bhat (1974) recorded 19 species of bats in 13 genera including the extralimital species *My. myotis* (likely representing *My. blythii*). Besides, as a byproduct of a series of haematophagus arthropods survey in Western Himalaya, Bhat *et al.* (1983) reported 13 bat species, including five new for Uttarakhand and/or Himachal Pradesh (*Cynopterus sphinx, Rousettus leschenaulti, Eonycteris spelaea, Sphaerias blanfordi,* and *Sc. heathii*). In the classic compilation of the bats of the Indian Subcontinent, 19 and 33 species were included from Himachal

Pradesh and Uttarakhand respectively (Bates & Harrison 1997). A further mammalian account of Uttarakhand state reported the occurrence of 28 species of bats from six families (Sati & Tak 2010). More recent documentations of the bat fauna of the Western Himalayas include Saikia *et al.* (2011) and Chakravarty *et al.* (2020) wherein 28 and 49 species of bats were reported from the states of Himachal Pradesh and Uttarakhand, respectively. However, the first study was constrained by the lack of complementary sampling techniques (harp trap, acoustic survey tools etc) and limited coverage of forest habitats and therefore, the reported diversity was underestimated. The second study was primarily focused on descriptions of echolocation calls, and mostly lacked vouchered specimens thus precluding taxonomic scrutiny. More recently, there have been significant revisions in chiropteran systematics with consequences to Indian fauna including nomenclatural changes, genus–level revisions, and better delineation of geographic distribution (Appleton *et al.* 2004; Benda & Gaisler 2015; Juste *et al.* 2013; Ruedi *et al.* 2015). However, the lack of comparative museum specimens and fresh collections from the Himalayas has greatly hampered our understanding of the true chiropteran diversity in the region. Taxonomy of several species–groups occurring in the Himalayas e.g., *Rh. ferrumequinum/nippon, Ep. serotinus*/*pachyomus, Pi. javanicus*/*babu*, *Murina* spp., *Myotis* spp. etc. remained unsettled. In fact, a recent integrative revision of the small Myotinae from the Himalayan region demonstrated fairly common occurrence of the poorly known genus *Submyotodon* in the area and evidenced species–level divergences within that genus (Ruedi *et al.* 2021). As a region of high bat diversity, the Western Himalayas remains underexplored, and it is imperative to carry out a thorough revision of the bat fauna of the region based on recent material and utilizing multiple taxonomic tools. We had the opportunity to conduct rapid bat surveys (yielding vouchered specimens) in selected areas of Himachal Pradesh during the summer of 2017 and more extensively in Uttarakhand during spring of 2018, 2019 and 2021. We also re–examined the chiropteran collection in the Zoological Survey of India, Solan, most of which formed the basis for the report of Saikia *et al.* (2011). Based on critical examination of the new material from the Western Himalayas and comparative material from elsewhere in the Himalayan region, aided by molecular data, we revisit the taxonomic status of several species occurring in the region. We also provide distribution and ecological data and present an up–to–date inventory of the bat fauna of the Western Himalayan states of Himachal Pradesh and Uttarakhand.

Materials and methods

Study area

Our study area comprises the states of Himachal Pradesh and Uttarakhand in the Western Himalayas of India. The region extends within 30°22’ and 28°51’N and 75°47’ to 80°01’E and covers an area of 109,156 km^2 which is about 3.3% of the total geographic area of India.

The state of Uttarakhand lies on the southern slopes of the Himalayan range and is physiographically divided into six distinct zones, *i.e.,* Greater Himalaya, Lesser Himalaya, Siwalik Himalaya, Haldwani Bhabar, Western Terai, and Upper Ganga Doab. The elevation gradient is very steep from 250–7817 m with increasing elevation from Siwalik region northwards to Greater Himalaya region (Singh & Mal 2014). Vegetation structure varies with elevation and rainfall; Himalayan Subtropical Pine Forests dominate areas with elevation below 1500 m, Temperate Western Himalayan Broadleaf Forest grows between 1500–2600 m and the Western Himalayan alpine shrubs and meadows occupy areas with elevations between 3000 m and 4800 m (Mishra & Chaudhury 2014). The state has a forest cover of 45.4% of the total geographic area of which 33.3% consists of very dense to moderately dense forests (Forest Survey of India 2017). The climate ranges from warm tropical in Siwalik via the warm temperate, to the extremely cold in glacial regions in the Greater Himalaya (Singh & Mal 2012). In Uttarakhand, our sampling was restricted to several elevational sites in Chamoli and Rudraprayag districts in the Greater Himalaya zone.

The state of Himachal Pradesh has been divided into four distinct physiographic zones, namely Siwalik Himalaya, Lesser Himalaya, Greater Himalaya, and Trans–Himalaya, running parallel to each other and covering around 10.5% of the total Himalayan land mass (Nandy *et al.* 2006). The Siwalik Himalaya (up to an elevation of 1500 m) represents the southernmost zone, extending from northwest to south, 40–60 km wide and covering the districts of Sirmour, Solan, Bilaspur, Hamirpur, Una and parts of Chamba and Kangra. The Lesser Himalaya (about 80 km wide) runs from north of the Shiwalik and parallel to the Greater Himalaya range. This zone encompasses the districts of Shimla, Mandi, and parts of the districts of Chamba, Kullu, Kangra and Sirmour. The Greater Himalaya

range lies just north of the Chandrabhaga River in Lahaul–Spiti and contain peaks with an elevation over 6000 m. This zone covers the Pangi region of Chamba District and certain portions of Kullu and Kinnaur districts. The Trans–Himalaya region, comprising Lahaul and Spiti valleys and parts of the district of Kinnaur, is characterised by extreme cold, low precipitation and lack of vegetation and is referred to as cold desert. The state has a forest cover of 27.1 % of the geographic area of which 17.6% consists of very dense and moderately dense forests (FSI 2017). In Himachal Pradesh, sampling was conducted in Solan and surrounding areas (Siwalik Himalaya); Narkanda (Lesser Himalaya) and Sangla valley (Trans–Himalaya).

Field sampling

Sampling was conducted between May and June 2017 in fourteen localities of Solan, Shimla and Kinnaur district of Himachal Pradesh and between March and May in 2018, 2019 and 2021 in Chamoli and Rudraprayag districts in Uttarakhand (Table 1; Figs 1 and 2). The survey localities included some areas covered by the earlier studies of Saikia *et al.* (2011) and Chakravarty *et al.* (2020). Mist nets of various sizes (Ecotone, Poland), a two–bank harp trap (Austbat, Australia) and occasionally, a flap net (Borisenko 1999) was employed to sample bats in the surveyed localities. Opportunistic collections were also made inside confined spaces like tunnels and caves by using a butterfly net. 77 individuals of 29 species were captured in the field of which 58 specimens of 24 species were retained as vouchers whereas the others were released in the capture sites immediately after taking measurements. Animals were handled according to the protocols recommended by the American Society of Mammalogists (Sikes *et al.* 2016). The voucher animals were photographed and humanely euthanized by exposure to chloroform vapour. Body weight and standard sets of morphological measurements accurate to 0.1mm were obtained immediately after sacrificing the animals and then preserved in 70% ethanol. The preserved specimens were deposited into the National Zoological Collection of Zoological Survey of India, Shillong and registered under the series V/M/ERS/.

TABLE 1. Details of localities sampled during the present study.

No	Survey localities	Coordinates and altitude	Locality descriptions
1.	Derghat, Solan district, Himachal Pradesh	30°57’07.3” N, 77°06’35.7 E, 1560 m	A railway tunnel of about 20 m length surrounded by *Quercus* forest and cropland.
2.	Mount Karol, Solan district, Himachal Pradesh	30°56’11.2” N, 77°06’15.9” E, 1850–1980 m	Two sites were sampled. First site is a forest area covered by dense *Quercus* trees. Harp trap was set across a gully inside the forest. Mist net was also employed near the forest edge. A small limestone cave adjacent to a temple was also surveyed.
3.	Salogra cave and adjacent areas, Solan district, Himachal Pradesh	30°55’39.8” N, 77°07’32.2” E, 1440 m	A small cave adjacent to a temple surrounded by human habitation and *Pinus rouxburghii* strands. Sampling was conducted from both inside the cave and nearby area with an artificial pond.
4.	Saproon cave, Solan district, Himachal Pradesh	30°54’28.1” N, 77°04’42.2” E, 1500 m	A shallow two–chambered cave of about 30 feet length surrounded by mixed pine forest and human habitations.
5.	Barog tunnel, Solan district, Himachal Pradesh	30°53’25” N, 77°04’56” E, 1560 m	Barog tunnel is 1150 m long railway tunnel along historic Kalka–Shimla track. The crevices on the wall and ceilings and joints provide roosting sites for a large number of bats. The tunnel is surrounded by *Pinus rouxburghii* forest.

.....continued on the next page

TABLE 1. (Continued)

No	Survey localities	Coordinates and altitude	Locality descriptions
6.	Devthal, Solan district, Himachal Pradesh	30°50’36.6” N, 77°10’06.4” E, 963 m	Two localities were surveyed. One is a shallow ancient gold mine situated on riverbank. The tunnel entrance is 4 feet in diameter with slushy floor. Mist netting was also conducted across the river Narag and a flap trap was used. The area was covered with mixed *Pinus rouxburghii* forest
7.	Tungnath, Rudraprayag district, Uttarakhand	30°29’19” N, 79°13’4.7” E, 3500 m	The site is an open alpine meadow with bushes of *Rhododendron campanulatum*.
8.	Ansuya, Chamoli district, Uttarakhand	30°29’15.5” N, 79°17’29” E, 2000 m	Mist nets were set across a forest trail in a temperate forest.
9.	Chopta, Chamoli district, Uttarakhand	30°28’21” N, 79°13’0.74” E, 2800 m	Mist netting was conducted over a slow–flowing brook close to an open sub–alpine meadow.
10.	Kanchula, Chamoli district, Uttarakhand	30°27’31.1” N, 79°14’3.9” E, 2511 m	This site is a clearing in the middle of a secondary oak–maple forest. Mist netting was conducted across a pool of water.
11.	Mandal village, Chamoli district, Uttarakhand	30°27’30.6” N, 79°16’20.7” E, 1500–1800 m	Mist netting was conducted primarily across hill streams and other water bodies. Primary vegetation includes Pine and Oak forest.
12.	Khalla village, Chamoli district, Uttarakhand	30°26’39.9” N, 79°16’10.6” E, 1630 m	Secondary oak forest near human settlement. Mist net was set across a pool of water in an undulating stream.
13.	Forest near Narkanda, Shimla district, Himachal Pradesh	31°15’45.1” N, 77°27’05.2” E, 2700 m	The area represents a temperate coniferous forest of *Abies pindrow, Cedrus deodara* and *Pinus wallichiana.* Mist netting and harp trapping was done near to an artificial pond meant to provide water for wildlife.
14.	Sangla, Kinnaur district, Himachal Pradesh	31°25’38.9” N, 78°16’17.2” E, 2700 m	Sangla valley is surrounded by temperate forest dominated by *Abies pindrow* and *Quercus semecarpifolia*. Harp trapping and mist netting was conducted inside forest and near a pond in apple orchard

Morphological studies

The collected vouchers were studied in the laboratory of Zoological Survey of India, Shillong. Besides, comparative material from the study area and from Meghalaya, as well as from South and Southeast Asia housed in other Asian and European collections were also examined (see comparative material). Cranio–dental measurements of the vouchers were obtained with digital callipers accurate to the nearest 0.01mm following standard methods. Baculum was prepared by macerating the dissected penis in 6% KOH solution and stained with Alizarin Red S (Topál 1958). Prepared bacula were measured and photographed under a Leica stereo zoom microscope with 40–120x magnification using the software Leica Application Suite V. 3.

The acronyms for measurements are: Tail length (TL); Ear length (E); Tragus length (TR); Hindfoot length including claw (HFCL), excluding claw (HF); Forearm length (FA); Tibia length (TB); 3rd Metacarpal length (3MT); 4thMetacarpal length (4MT); 5thMetacarpal length (5MT); Length of the 1st phananx of the 3rd metacarpal (1PH3MT), Length of 2nd phalanx of the 3rd metacarpal (2PH3MT), Length of 1st phalanx of the 4th metacarpal (1PH4MT), Length of 2nd phalanx of the 4rd metacarpal (2PH4MT), Thumb length without claw (THL), Greatest length of skull including incisors (GTLi), and excluding incisors (GTL); Condylobasal length (CBL); Condylocanine length (CCL); Maxillary toothrow length (CM^3); Width across third molars (M^3M^3); Length of upper molars (M^1M^3); Width across canines (C^1C^1); Zygomatic breadth (ZW); Postorbital constriction (PoC); Breadth of braincase (BW);

Mastoid breadth (MAB), Skull height (SKH), Width of the lachrymal bridge (AOB), Length of mandible including incisors (MLi), and excluding incisors (ML); Mandibular toothrow length (CM_3); Length of lower molars (M_1M_3); Height of coronoid process (COH).

Besides our recently captured specimens from the western Himalayas, we also examined specimens from the study area and several extra–limital specimens held in various museum collections, the acronyms of which are AMNH: American Museum of Natural History, New York, USA; NHMUK: Natural History Museum, London, UK; HNHM: Hungarian Natural History Museum, Budapest, Hungary; IEBR: Institute of Ecology and Biological Resources, Hanoi, Vietnam; KKC: Kuniko Kawai Collection, Sapporo, Japan; KMC: Kishio Maeda Collection, Nara, Japan; MHC: Masashi Harada Collection, Osaka, Japan; MHNG: Muséum d'histoire naturelle de Genève, Geneva, Switzerland; MNHN: Muséum national d'histoire naturelle, Paris, France; NSMT: National Museum of Nature and Science, Tokyo, Japan; NTU: National Taiwan University, Taipei, Taiwan; THUMB: Department of Biology, Tunghai University, Taiwan; ZSI–NERC: North Eastern Regional Centre, Zoological Survey of India, Shillong, India; ZSI–HARC: High Altitude Regional Centre, Zoological Survey of India, Solan, India and ZMB: Zoological Museum, Berlin, Germany. The details of the comparative material are listed as Appendix A.

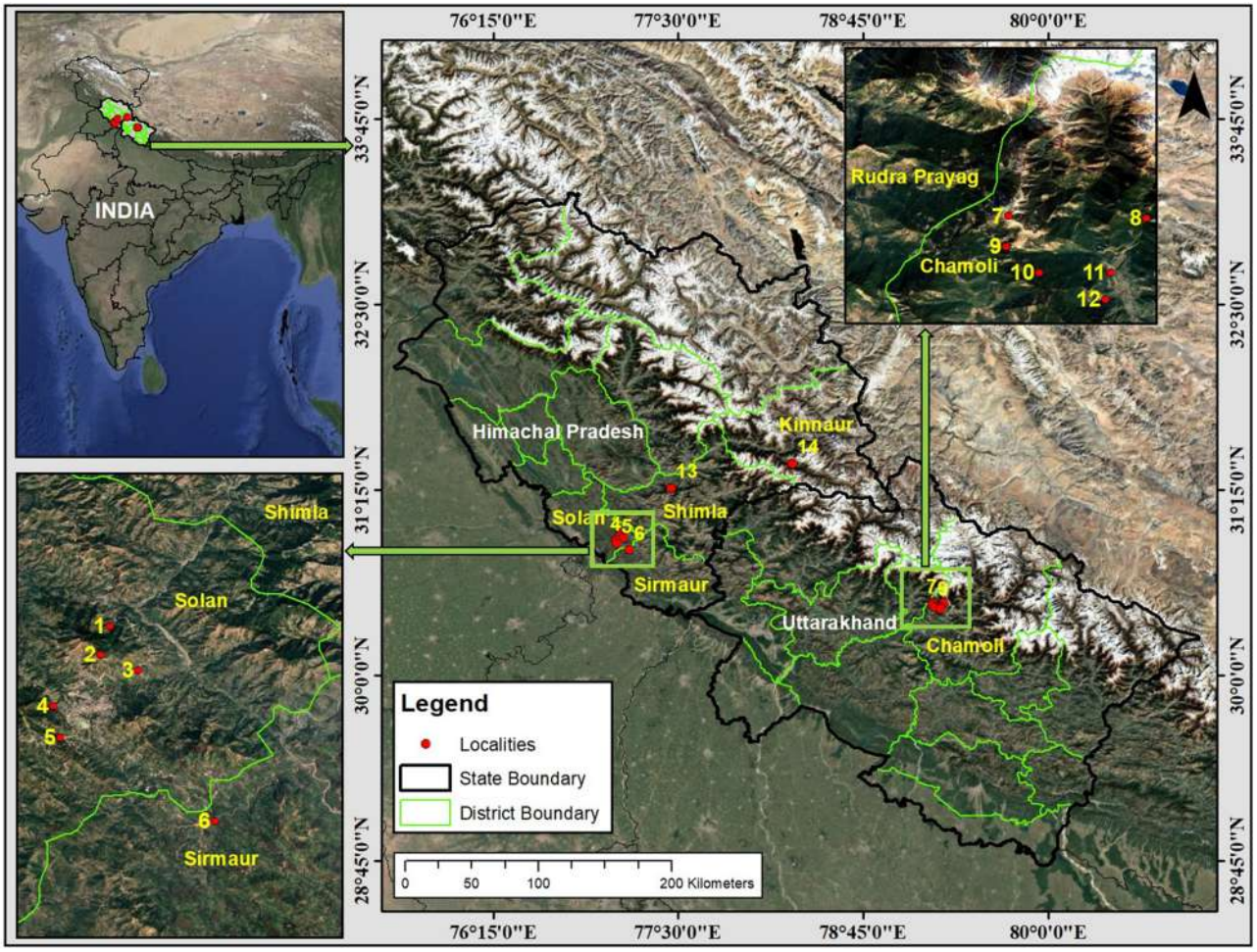

FIGURE 1. Map of the study area showing surveyed localities (red dots). 1. Derghat; 2. Mount Karol; 3. Salogra; 4. Saproon; 5. Barog; 6. Devthal; 7. Tugnath; 8. Ansuya; 9. Chopta; 10. Kanchula; 11. Mandal Village; 12. Khalla village; 13. Narkanda; 14. Sangla.

DNA sequencing and phylogenetic reconstructions

For a small subsample of specimens, DNA was extracted from blood or tissue samples preserved in alcohol using the Qiagen DNeasy blood and a tissue kit (Hilden, Germany) and eluted in a final volume of 200 µl TE buffer. Depending on which comparative genes were available, fragments of the cytochrome b (abbreviated hereafter CYTB) or the cytochrome C oxidase subunit 1 (COI) were amplified, using the primer pairs Molcit–F/Cytb–H

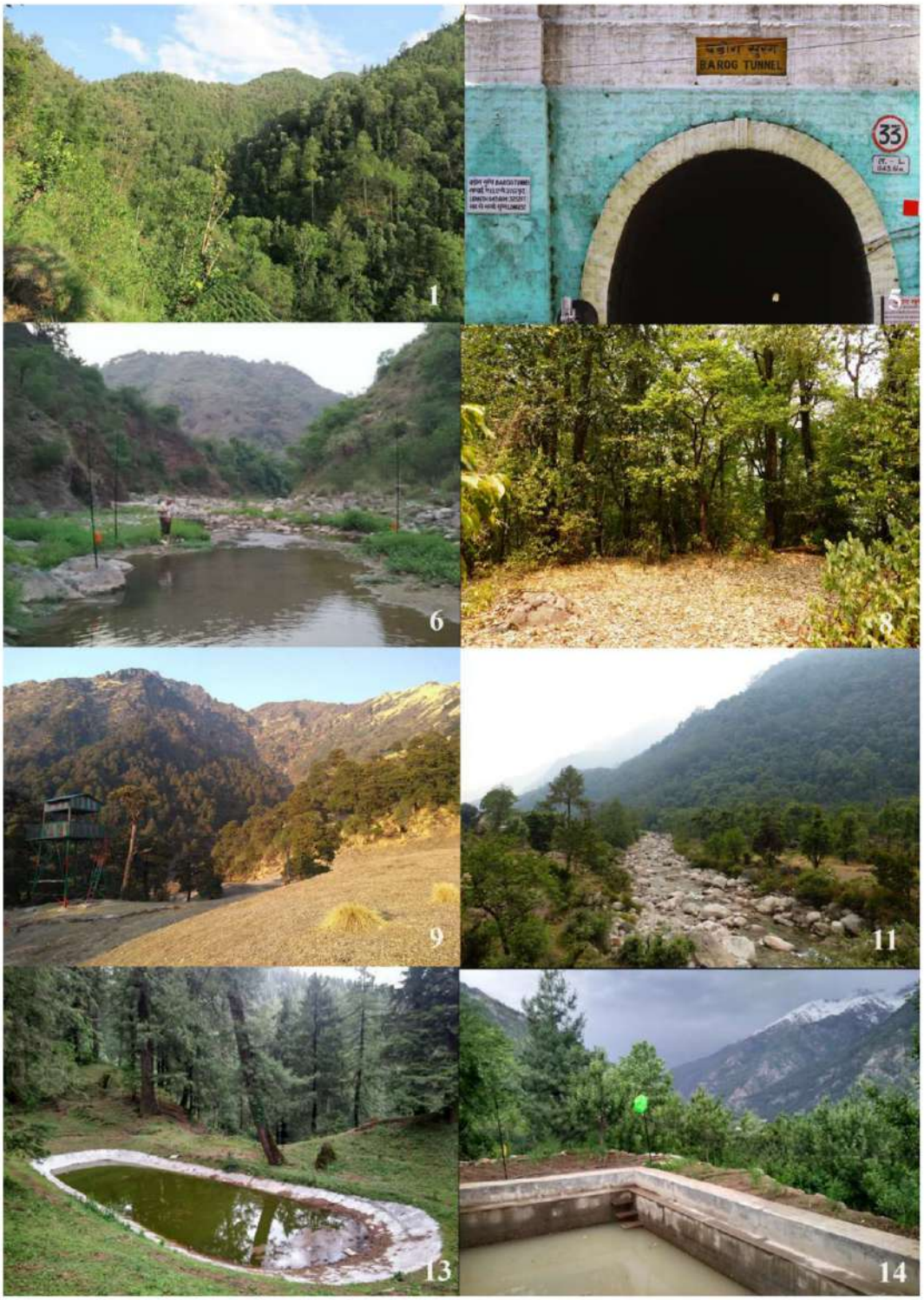

Figure 2

FIGURE 2. Some of the representative sampling localities in the present study. Numbers represent corresponding localities: 1. Derghat; 5. Barog; 6. Devthal; 8. Ansuya; 9. Chopta; 11. Mandal Village; 13. Narkanda; 14. Sangla.

(Ibáñez *et al.* 2006; Weyeneth *et al.* 2008) and UTyr/C1L705 (Hassanin *et al.* 2012), respectively. For *Rhinolophus* species, the COI was amplified with the primer pair VF1d/VR1d (Ivanova *et al.* 2007) instead. PCRs conditions and sequencing of amplicons follow methods described in Ruedi e*t al.* (2018). The obtained chromatographs were checked, assembled, and edited using Sequencher 4.1 (Gene Codes Corp., USA).

Sequences were aligned and analysed separately for the COI and CYTB genes, and levels of genetic divergence evaluated with the Kimura two parameter model (K2P) implemented in MEGA X (Kumar *et al.* 2018). We also visualised haplotype relationships using the Neighbour–joining method (NJ; Saitou & Nei 1987) based on a matrix of K2P distances with the same programme. We did not seek to reconstruct proper phylogenetic relationships with these partial genes, as our purpose was simply to have a phenetic representeation of newly produced sequences to interprete them in a taxonomic context. We also compared individual COI sequences to those present in the BOLD repository (Ratnasingham & Hebert 2007) through its built–in Identification Engine (Ratnasingham & Hebert 2013), or queried COI and CYTB sequences with a BLAST search in GenBank (Boratyn *et al.* 2013).

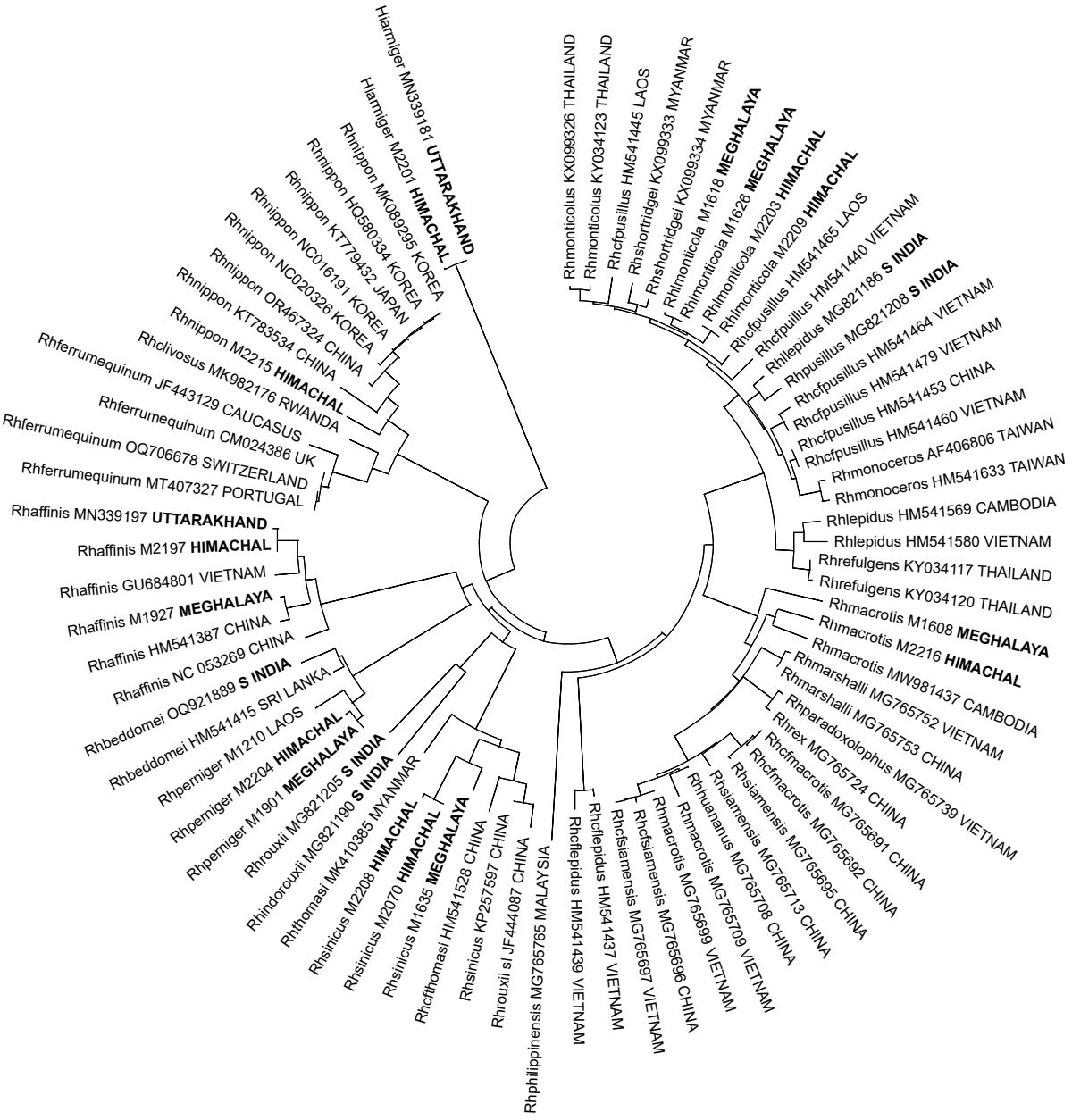

FIGURE 3: Neighbor-joining tree reconstruction of examined rhinolophids and hipposiderids COI sequences and based on the K2P matrix in Table S2. Branches are proportional to the number of mutational steps. Sequence names are composed of the first two letters of the genus, followed by the species name, the GenBank number (or field number for newly sequenced samples), and the region of origin. Samples from India are highlighted in bold face.

Echolocation call analysis

Echolocation calls were recorded using an Anabat Walkabout detector (Titley Scientific, Australia) with a sampling rate of 500 kHz. The echolocation calls of rhinolophid and hipposiderid bats were recorded indoors with the bats constrained inside a cloth bag or held by hand. All other species' calls were recorded during release. For two species, *Hy. affinis* and *Hy. savii*, calls were recorded inside a cemented room of roughly 3x3 m. The calls were analysed using BatSound software v4.x (Pettersson Elektronik, Sweden) and Raven Pro v1.6.1 (The Cornell Lab of Ornithology, Ithaca, NY). Up to 10 clear pulses with the highest signal–to–noise ratio were selected from each recording and then averaged for each individual. The analaysis was performed on a spectrogram with Hanning window of FFT size 1024 and 95% overlap.

FIGURE 4: Neighbor-joining tree reconstruction of examined vespertilionids, miniopterids and molossids COI sequences and based on the K2P matrix in Table S2. Branches are proportional to the number of mutational steps. Sequence names are composed of the first two letters of the genus, followed by the species name, the GenBank number (or field number for newly sequenced samples), and the region of origin. Samples from India are highlighted in bold face.

Locality records and ecological notes

Locality records and ecological notes for individual species are based on present field data and published records. Relevant publications from the study area were comprehensively reviewed and all reliable species records are included. The approximate geocoordinates of past localities were obtained from Google Earth.

Results

We successfully generated 26 new sequences of CYTB and 43 of COI from a total of 45 specimens examined genetically (see Table S1). These sequences were up to 1140 bp and 703 bp long for the CYTB and COI, respectively. All new sequences were deposited in the GenBank (GB) under numbers GB PQ778181–PQ778206 (for CYTB) and PQ776273–PQ776315 (for COI). Closest matches available in public repositories are reported for each sequenced species and incorporated into the respective species account. A global reconstruction based on the K2P distance matrix and neighbour–joining algorithm for all those sequences and selected reference sequences can be found in figures 3 and 4 for the COI maker, and figures 5 and 6 for the CYTB marker**.** The corresponding matrices of all K2P pairewise genetic distances can also be found as Excel files in the supplementary information (Tables S2 and S3).

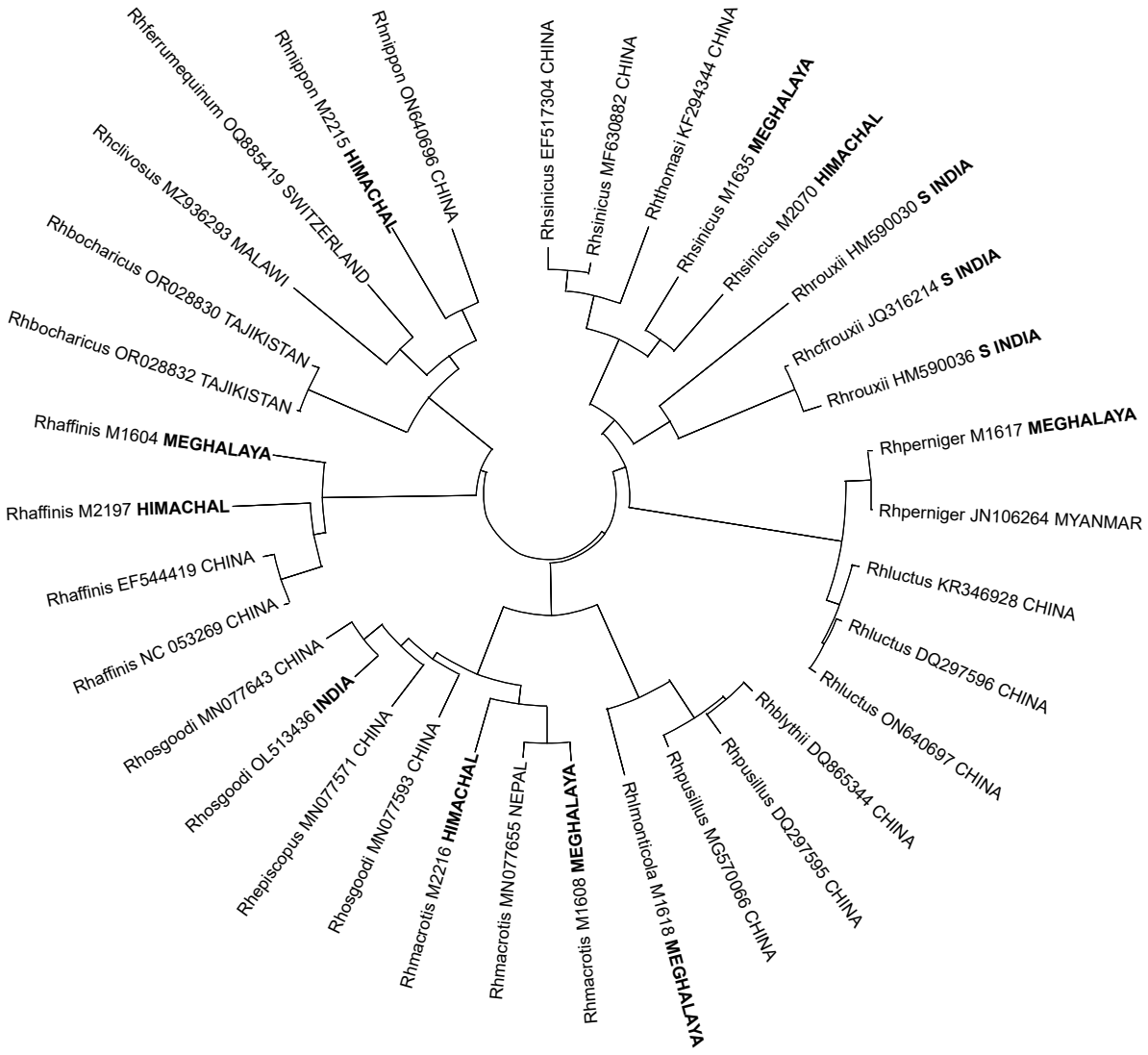

FIGURE 5: Neighbor-joining tree reconstruction of examined rhinolophids and hipposiderids CYTB sequences and based on the K2P matrix in Table S3. Branches are proportional to the number of mutational steps. Sequence names are composed of the first two letters of the genus, followed by the species name, the GenBank number (or field number for newly sequenced samples), and the region of origin. Samples from India are highlighted in bold face.

We present an up–to–date inventory of 53 species representing seven families of Chiroptera from the Western Himalayan region of India as Appendix B. The morphometric measurements of some of the examined specimens from the study area are provided as supplementary information (Table S4)**.** Taxonomic accounts of the 29 species recorded during the present surveys are detailed below.

FIGURE 6: Neighbor-joining tree reconstruction of examined vespertilionids, miniopterids and molossids CYTB sequences and based on the K2P matrix in Table S3. Branches are proportional to the number of mutational steps. Sequence names are composed of the first two letters of the genus, followed by the species name, the GenBank number (or field number for newly sequenced samples), and the region of origin. Samples from India are highlighted in bold face.

Species accounts

Family: Pteropodidae

1. *Sphaerias blanfordi* (Thomas, 1891)
(Blanford's Fruit Bat)

New material: 1 F, 14.05.2019, Kanchula, Kedarnath WLS, Uttarakhand (released).

Morphological description of specimen: An adult female was caught in a clearing at a mixed oak–maple forest. It had a forearm length of 52.8 mm. The muzzle was short, and the ears had a thin white anterior margin. Tail was absent and the interfemoral membrane and hindfeet were densely covered with hairs. Two pairs of lower incisors were visible. It also had two tufts of yellowish hairs on either side of the neck.

DNA: no biological material was obtained from this species.

Locality records and ecological notes: Himachal Pradesh: Not recorded. Uttarakhand: Dogalbita (2370 m), Kanchula (2600 m), Chamoli district; Sukhidhang (1380 m), Almora district; Dharchula (920 m), Dummer (1540 m), Khela (1540 m) and Tawaghat (1140 m), Pithoragarh district (Bhat 1974; present study).

Family: Molossidae

2. *Tadarida insignis* (Blyth, 1862)
(East Asian free–tailed bat)

New material: 1 M, 07.04.2021, Mandal village, Chamoli District, Uttarakhand, V/M/ERS/651.

Morphological description of specimen: The adult male specimen had brown dorsal pelage and lighter brown ventral fur. Individual hairs were short, tips brownish and the bases were creamy white. It had a forearm length of 62.2 mm. The feet were covered with long grey hairs, and small fleshy callosities were present on the sole. The thumb bore a small claw and a prominent thumb pad (2.5 mm in diameter) was present. The tail membrane was essentially naked except for the dorsal region closer to rump and fringes which were covered with short grey hair. The ventral side of the tail membrane was perceptibly lighter coloured than the dorsal side. About one third of the tail protruded out of the membrane and this protruding portion was brownish in colour. Ears were large and broad and closely positioned over the forehead with 8–9 vertical ridges. Ear fringes were covered with short grey hairs on the ventral side. Tragus was shorter, with a slightly constricted basal portion. The plagiopatagium was inserted just above the tibio–metatarsal joint. The penis was pendulous and without any special modifications, the scrotal area was distinctively white coloured.

The skull was robustly built and elongated. The anterior part of the braincase was slightly raised ending in a concavity posteriorly. The lamboid region was also slightly raised. The sagittal crest was absent but lateral lamboid crests were present. The coronoid process in mandible was high and reaching almost to the level of lower canines (Fig. 7).

DNA: We obtained a fragment of 651 bp of the COI gene from this male individual. Compared to homologous sequences from genuine European *Ta. teniotis* (e.g., Portuguese GB KY581661 or Swiss GB OQ706681) or from *Ta. aegyptiaca* from India (GB MG821187), this Uttarakhand specimen was clearly very divergent (11–15% K2P distance) and thus did not belong to either of these two species. It was, however, minimally divergent (0.7–0.8% K2P distance) from Asian sequences labelled as *Ta. insignis* (e.g., from Japan GB MK410371) or as *Ta. latouchei* (e.g., from South Korea GB MK177282).

Locality records and ecological notes: Uttarakhand: Dehradun City (670 m), Dehradun District; Taapu Sera (1007 m), Tehri Garhwal district; Mandal village (2000 m), Chamoli district (Chakravarty *et al*. 2020; present study). This is the first mention of *Ta. insignis* from India, but at the same time implies that previous mentions of *Ta. teniotis* from India represent this species. The Uttarakhand records also extend the westward range of this species by a considerable c.2500 km. It may be mentioned that based on acoustic call signatures, *Ta. teniotis* was recently reported from Kali Gandaki canyon of Central Nepal (Sharma *et al.* 2021) which might also represent *Ta. insignis* indicating widespread occurrence across the Himalayan range. The present specimen was attracted to the trapping site by playing social calls of *Ta. teniotis* recorded in Portugal and was caught in a mist net. A strong and high–flier

and preferring to roost in hilly inaccessible areas (Chakravarty 2017), this species is always difficult to catch and possibly is one of the reasons for its scant records from the country. The echolocation calls from individuals in Uttarakhand had a max–min frequency range of 31.6–9.9 kHz and was described in Chakravarty *et al.* (2020) as *Ta. teniotis*.

Taxonomic note: The taxonomic status of *Ta. teniotis* in India must be reconsidered. There are indeed close similarities in external and craniodental measurements between *Ta. teniotis* and its Oriental congener *Ta. insignis*, but according to Benda *et al*. (2015) the former is a Western Palaearctic species which reaches its eastern limit in Afghanistan, and thus should not be distributed in India. This view is clearly corroborated by our molecular comparisons with up to 15% sequence divergence between European *Ta. teniotis* and Oriental *Ta. insignis* (Table S3). Previous mentions of *Ta*. "*teniotis*" from India (e.g., Hill 1963, Deshpande & Kelkar 2015, Chakravarty 2017) and elsewhere in the Oriental Region (e.g., Sharma *et al.* 2020, Taylor 2019, Francis *et al.* 2010) therefore most likely represent *Ta. insignis*.

Regarding the two *Tadarida* species endemic to the Oriental Region (*Ta. insignis* and *Ta. latouchei*), external and craniodental measurements of the specimen from Uttarakhand (e.g., FA 62.2 mm) is more akin to the larger *Ta. insignis* (FA >60 mm), whereas *Ta. latouchei* is considerably smaller (FA< 57 mm; Funakoshi & Kunisaki 2000). However, we found minimal genetic distances (<1%) among all Asian *Tadarida* variously labelled as *"teniotis"*, *insignis* or *latouchei,* and sampled over considerable geographic distances (*i.e*., from India to Japan). Some of these sequences are based on vouchered specimens with verifiable morphological identification, which suggest that typical (large) *Ta. insignis* (e.g., HNHM–MAM 25862 and 25864, both from Yunnan, China) may share virtually identical mitochondrial sequences with typical (small) *Ta. latouchei* (ROM MAM 118321 from Laos). Thus, based on mitochondrial markers these two Asian molossids cannot be discriminated and nuclear markers should be investigated before further taxonomic decisions can be taken.

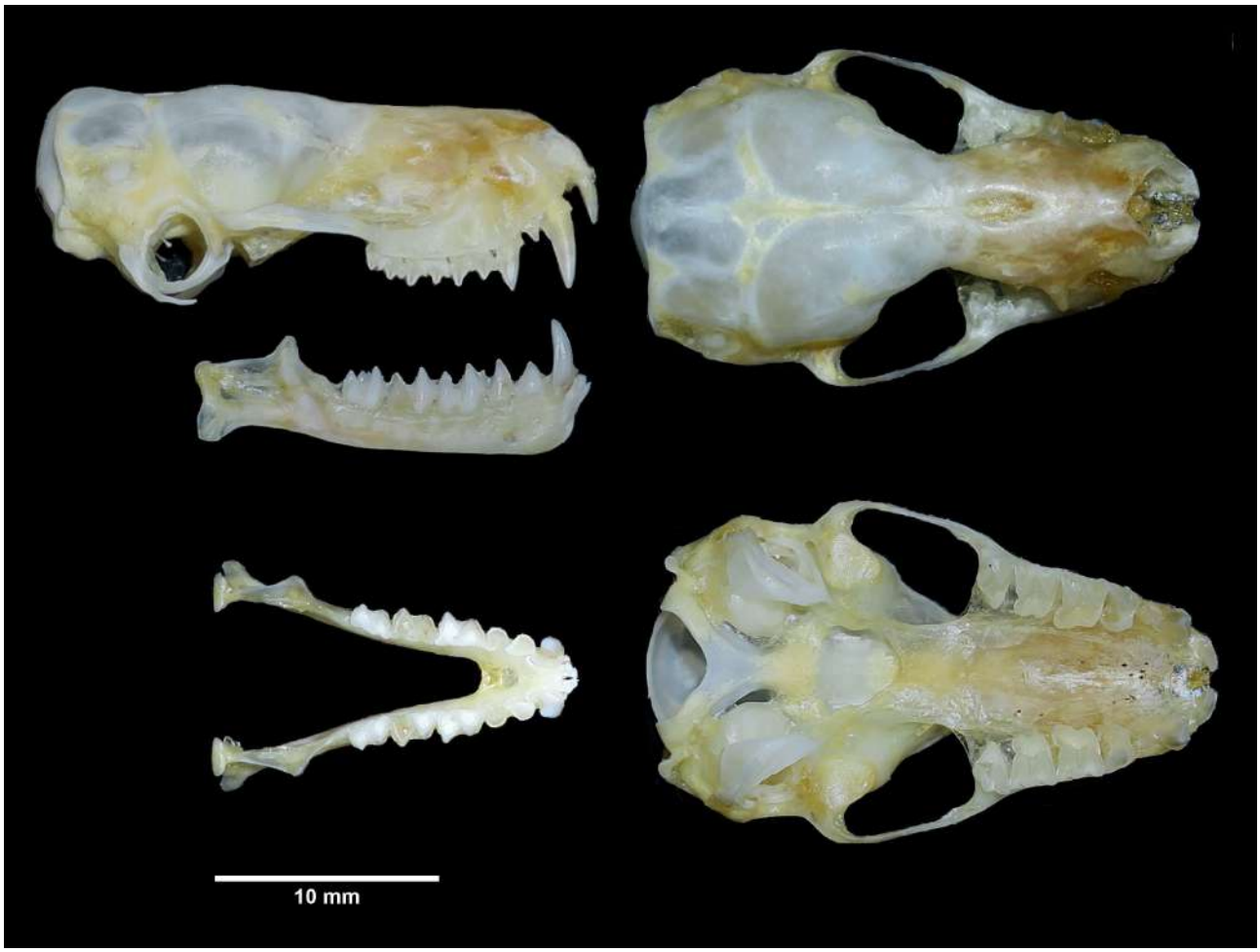

FIGURE 7. Dorsal, ventral, and lateral view of cranium and lateral and ventral view of mandible of *Ta. insignis* from Uttarakhand (ZSI–NERC V/M/ERS/651).

Family: Rhinolophidae

3. *Rhinolophus affinis* Horsfield, 1823
(Intermediate horseshoe bat)

New material: 1 M, 30.05.2017, Bank of river Narag, Devthal, Solan District, Himachal Pradesh, V/M/ERS/416.
Morphological description of specimen: The average forearm length was 53.3 mm in three measured males. The specimens were rusty brown dorsally and buffy brown ventrally. Dorsal hairs were grayish white with brownish tips and ventral hairs were also whitish except for the light brown tips. The ear of specimen 416 was smaller at 19.6 mm. The superior connecting process of the sella was broadly rounded off when viewed laterally. The lancet was straight sided and pointed. The lower lips had three mental grooves. The 3rd metacarpal (39.5 mm) was slightly shorter than 4th (41.3 mm). The first phalanx of the 3rd metacarpal (15.9 mm) was characteristically short, much less than half the length of the metacarpal. The 2nd phalanx (30 mm) is 75% of the length of the metacarpal.

The baculum of the collected male was 2.16 mm in length and 0.77 mm in width at the base. The tip was pointed, and the basal cone was deeply emarginated on the ventral side and the emargination was little shallow on the dorsal side. In lateral profile, it was bent forward forming an elongated C–like structure.

DNA: We obtained 684 bp of the COI gene from the individual from Solan (M2197/V/M/ERS/ 416), which was identical to that of *Rh. affinis* from Uttarakhand (GB MN339197) or very close to one individual from Meghalaya (M1927, released). Its CYTB (1140 bp) sequence was similar to various individuals from Meghalaya (e.g., M1604) or China (e.g., GB EF544419) at about 3.5% divergence. In NJ reconstructions, *Rh. affinis* from throughout continental Asia always formed a strongly supported, monophyletic clade distinct from other species of rhinolophids (Figs 3 and 5).

Locality records and ecological notes: Himachal Pradesh: Barog tunnel (1560 m), Happy valley near Solan town (1550 m), Kot Beja (1100 m) and Devthal (963 m) in Solan district (Saikia *et al.* 2011; present study). Uttarakhand: Kaladhungi (400 m) and Bilaspur (1380 m) near Bhim Tal in Naini Tal district; Maldevta (850 m), Landour (2000 m), and Benog WLS (1755 m) in Dehradun district, Devalsari (1700 m) and Dhanaulti (2100 m) in Tehri–Garhwal district, (Bhat 1974; Bates & Harriosn 1997; Chakravarty *et al*. 2020).

Three males were caught (two were released upon measuring) from inside an ancient gold mine of about 13 m length and about 1 m in diameter on the bank of a river. They were roosting in three groups of 3–20 individuals sharing space with some *Hi. armiger*. They had FM–CF–FM structure, and the peak frequency (FmaxE) recorded from our Himachal individuals ranged between 79 and 81 kHz. This was lower than those previously recorded in Uttarakhand i.e., 88 kHz (Chakravarty *et al.* 2020) suggesting geographical variations which is common in rhinolophid bats (Sun *et al.* 2013).

4. *Rhinolophus nippon* Temminck, 1835
(Japanese greater horseshoe bat)

New material: 1 F, 31.05.2017, Barog Tunnel, Solan District, Himachal Pradesh, V/M/ERS/ 403; 1 M, 02.06.2017, Mount Karol, Solan District, Himachal Pradesh, V/M/ERS/402.

Morphological description of specimens: Four individuals from Himachal Pradesh were examined of which two were old museum specimens. They had an average forearm length of 60.5 mm. One of the females had the largest forearm length of 62.5 mm and longest ear at 27 mm. Dorsally, the pelage was light golden brown while the belly was slightly lighter in colour. The dorsal hairs had light brown tips and dark brown roots. Ears were pointed at the tip with 8–9 ridges on the inner side. The horseshoe width was 7.2–7.3 mm, the median emargination of the horseshoe was broad. The superior connecting process of sella was rounded off when viewed laterally (Fig. 8A). The lancet was pointed at the tip and sides are concave. The lower lip had three mental grooves, the middle one extended forward. On average, the 3rd metacarpal was 9.2% shorter than the 4th. The length of first phalanges of the 3rd metacarpal was 52.8 % of the length of the metacarpal.

The skull was robust (zygomatic width considerably exceeding mastoid width) with an average greatest length of 24.77 mm. A well–developed sagittal crest was present which bifurcated anteriorly forming a shallow nasal pit and extended posteriorly till the lambda, albeit weakly. Prominent lamboid crests were present laterally. The palate

was highly emarginated, its anterior margin extending till the middle of the first molar and the posterior border resting approximately at the level of the line drawn between M^2 and M^3 (Fig. 9B).

DNA: We obtained 651 bp of the COI gene and 1140 bp of the CYTB from one individual captured in Mt Karol (M2215/V/M/ERS/402), which represents the first DNA evidence from northern Indian specimens of the *Rh. ferrumequinum* species complex. None of the CYTB sequences available in the GeneBank matched the Himachal Pradesh sample, the most similar sequence (at 5% K2P distance) being that of a sample from Yunnan (GB ON640696) and labelled as "*Rh. ferrumequinum*" (Table S2). The COI gene also gave similar results, the closest match (at 3.4% K2P distance) being Asian samples from southern China (e.g., from Zhejiang, GB OR467324), or a sample of *Rh. nippon* from Japan (GB KT779432) at 3.5% divergence. Western Palaearctic and some Central Asian sequences of genuine *Rh. ferrumequinum s.s*. were all more divergent, >5% for the COI (e.g., GB OQ706678), or >6.5% for the CYTB (e.g., GB OQ885419) (see Tables S2 and S3). Thus, both molecular markers suggest that the Himachal Pradesh sample is a unique and rather distinctive lineage. However, its phylogenetic position with respect to the two major mitochondrial clades assigned respectively to *ferrumequinum* and *nippon* by Koh *et al.* (2014) places it as sister to the latter with strong bootstrap support (Figs 3 and 5). Consistent with our results, Uvizl *et al*. (2024) also pointed that the smaller Central Asian *Rh. bocharicus* was also part of this species complex but distinct from other species.

FIGURE 8. Portrait showing frontal and side views of the noseleaf structure of A) *Rh. nippon* (ZSI–NERC V/M/ERS/403) and B) *Rh. sinicus* (ZSI–NERC V/M/ERS/404) from the Western Himalayas.

Locality records and ecological notes: Himachal Pradesh: Barog Tunnel (1560 m), Lutru Cave near Arki (1550 m), Mount Karol (1890 m), Solan Town (1500 m) in Solan District (Saikia *et al.* 2011; present study); Chakmoh (c.760 m), Hamirpur District (Ghosh 2008); Chamba (c.1000 m), Chamba District (Chakraborty 1977); Kullu Valley, Manali (1950 m) Kullu District (Allen 1908; Lindsay 1927); Mandi (c.1050 m), Mandi District (Ghosh 2008); Ghannati (c.1640m), Shimla (2100 m), Tottu (c.1900 m) in Shimla District (Dodsworth 1913; Bates & Harrison 1997; Ghosh 2008). Uttarakhand: Katarmal (1380 m) and Almora (c. 1600 m) in Almora district and Mussorie (2000 m) in Dehradun district (Bhat 1974; Bates & Harrison 1997). A female specimen was caught at about 300 m inside Barog tunnel (1530 m asl). They were seen roosting in two small groups with females carrying babies. We could record two other rhinolophids namely *Rh. lepidus* and *Rh. perniger* inside the tunnel although in lesser numbers. Another specimen was caught in a mist net at Mount Karol (1850 m) inside oak forest. A cave located nearby this forest patch held a breeding population of *Rh. sinicus* although no *Rh. nippon* could be observed there.

Taxonomic note: Traditionnally, *Rh. ferrumequinum* was considered as a single, polytypic species spanning the entire Palearctic region, from Europe to Japan, and parts of northern Oriental Region (e.g. Bates & Harrison 1997; Csorba *et al.* 2003). Bates & Harrison (1997) showed that northern India was inhabited by two distinct forms, a smaller one found in Kashmir (*proximus* Andersen, 1905), and a larger one (*tragatus* Hodgson, 1835) found in Himachal Pradesh to Nepal, Arunachal Pradesh and southern China (Csorba *et al.* 2003). Recent revisions based on molecular and morphological characters (Koh *et al.* 2014; Uvizl *et al.* 2024) showed that *Rh ferrumequinum* is a species complex, represented in Asia by the nominal species in the western half of the continent, by the smaller *Rh. bocharicus* in Central Asia and by *Rh. nippon* further east to the Japanese Archipelago. The exact geographic extent of each species though was unclear owing to inadequate sampling from the Himalayan region. We show here that the taxon *tragatus* from Himachal Pradesh is genetically closely related, but morphologically slightly distinct from *Rh. nippon*, and thus should be considered as a distinctive subspecies of the latter (i.e., *Rh. nippon tragatus*). Under this concept, Himachal Pradesh would represent the westernmost limit of distribution of *Rh. nippon*, while further west *Rh. ferrumequinum s.s.* occur. According to this suggested taxonomic arrangement, the smaller form from Kashmir (*proximus*) might represent the easternmost representative of *Rh. ferrumequinum* s.s., pending new genetic analyses to address its extact phylogenetic relationships. However, as some species of *Rhinolophus* may show instances of mitonchdrial introgression, blurring phylogenetic relationships (Dool *et al*. 2016; Uvizl *et al.* 2024), taxonomic conclusions should ideally be based on several independent DNA markers, which is currently lacking for Himalayan specimens.

5. *Rhinolophus lepidus* Blyth, 1844

(Blyth's horseshoe bat)

New material: 1 M, 31.05.2017, Barog Tunnel, Solan District, Himachal Pradesh, V/M/ERS/491; 1 M, 01.06.2017, Saproon cave, Solan District, Himachal Pradesh, V/M/ERS/492; 1 F, 15.04.21, Ansuya, Chamoli District, Uttarakhand, V/M/ERS/656.

Morphological description of specimens: The examined specimens had average forearm length of 38.8 mm. The dorsal pelage was cinnamon brown, individual hairs were buff with cinnamon brown tips. Ventrum was lighter brown with bicoloured hairs. In lateral view, the tip of the triangular connecting process was broadly rounded off compared to more acute shape in *R. pusillus* (Bates & Harrison 1997). The tip of the lancet in our specimens had straight sides for about 1.7 mm and then rounded off broadly. There were three mental grooves in the lower lips. The 3rd metacarpal was shorter, and 4th and 5th were subequal.

The skull had a mean GTLi value of 16.38 mm and almost all cranial measurements overlaped with values for *R. pusillus* with which this Himalayan form was mostly confused (Bates & Harrison 1997; Csorba *et al.* 2003). The sagittal crest, although weak, extended to the anterior portion of the lamboid region; this was unlike *R. pusillus* from northeastern India (e.g., V/M/ERS/ 722) wherein the weak sagittal crest flattened off in the posterior sagittal region. The upper canine was well developed exceeding the length of the second premolar. The first upper premolar was minute and situated on the toothrow; the canine and the second premolar were not in contact. The small lower third premolar was aligned with the toothrow and second and fourth premolars were not in contact.

The bacular shape was characteristic, elongated and S–shaped. The dorsal edge of the basal cone was shorter than the ventral one. The shaft gradually tapered towards the tip which was wide and roundish. The baculum of specimen V/M/ERS/491 was 3.52 mm in length and 0.95 mm wide at the base.

DNA: We obtained up to 702 bp of the COI from two individuals sampled in Himachal Pradesh (M2203/V/M/ERS/491, M2209/V/M/ERS/492) representing the smaller, northwestern subspecies *Rh. lepidus monticola*. Sequences were most closely related to *Rh. shortridgei* from northern Myanmar or to *Rh. monticolus* from Thailand (within 1.2% sequence divergence). One COI sequence from South India (GB MG821186, Srinivasulu *et al*. unpublished) refereable to the larger, nominal subspecies *Rh. l. lepidus* differed slightly more (up to 3%). All these sequences formed a poorly resolved clade within the *pusillus* species complex (Fig. 3), as already evidenced by Soisook *et al*. (2016).

Locality records and ecological notes: Himachal Pradesh: Drang (c.780 m), Mandi District (Ghosh 2008); Kullu (c.1200 m), Kullu District (Ghosh 2008); Barog Tunnel (1560 m), Saproon cave (1500 m) and Salogra cave (1440 m) (present study). Uttarakhand: Ansuya Devi (2000–2582 m), Benog WLS (1755 m), Mandal (1530 m) Chamoli district, Khati (2300 m), Almora (1600 m), Almora District (Wroughton 1914 as *R. monticola*; Chakravarty *et al.* 2020; present study); Ranibag (757 m), Nainital District (Wroughton 1914).

This species was roosting inside the Barog tunnel, Salogra temple cave and a cave in Saproon although earlier surveys in some of these sites failed to find the species (Saikia *et al.* 2011). In Barog tunnel, a few non–breeding individuals were found along with a few *Rh. affinis*. In Salogra and Saproon caves, they were observed in higher numbers (c.100 individuals) sharing roosting space with *Rh. sinicus* and *My. longipes*. The peak call frequency of Himachal specimens was recorded at 98–100 kHz, which is slightly less than those recorded in Uttarakhand 101–109 kHz (Chakravarty *et al.* 2020). This frequency does not overlap with any other species in the study area and thus provides a reliable identification clue in the field.

Taxonomic note: The small rhinolophids of the Oriental Region are members of the *Rh. pusillus* species complex (Csorba *et al.* 2003) and represent another group in a stage of taxonomic uncertainty (Hutson *et al.* 2019). Recenty, Soisook *et al.* (2016) revised Indochinese taxa and concluded that several morphologically distinct taxa should warrant species rank although all were genetically poorly differentiated (mostly within 4% sequence divergence). As detailed by Bates & Harrison (1997) this uncertainty in species discrimination is a long–standing problem in the Himalayan foothills as well. Indeed, the distinctly smaller subspecies *Rh. lepidus monticola* living in this region overlaps in size and craniodental characteristics with the larger specimens of *Rh. pusillus* (Bates & Harrison 1997; Csorba *et al.* 2003). Our samples from Himachal Pradesh and Uttarakhand were sampled closer to the type locality of *Rh.* [*l.*] *monticola* (Mussorie; Andersen 1905) and all keyed out morphologically as typical *Rh. l. monticola*. These samples, however, were also genetically very similar (within 1.7% divergence) to other specimens sampled elsewhere in the Oriental Region, casting doubts about their specific distinctness. Clearly, nuclear markers are needed to solve this taxonomic conundrum within the *pusillus* species complex.

6. *Rhinolophus pearsonii* Horsfield, 1851

(Pearson's horseshoe bat)

New material: 1 M, 03.05.21, Ansuya, Chamoli District, Uttarakhand, V/M/ERS/657.

Morphological description of specimens: A medium sized horseshoe bat with forearm length of 53.9 mm in the Uttarakhand specimen. The pelage was long and woolly, dorsally chestnut brown, slightly paler on the belly. Ears were very long compared to the body size. The noseleaf was similar to the Northern woolly horseshoe bat but without the circular basal lappets in the former. The horseshoe was broad covering the entire muzzle and had a wide and deep emargination. When viewed laterally, the superior connecting process of the sella was rounded, deflected downward but the inferior surface was almost straight. The lancet was triangular with a relatively pointed tip. The lower lip had a single mental groove. The tail membrane was characteristically covered with hairs on the upper surface.

DNA: No biological sample from the Western Himalayas could be obtained for DNA analyses.

Locality records and ecological notes: Uttarakhand: Ansuya (2580 m), Mandal (1530 m), Chamoli district; Mussoorie (2000 m), Dehradun district; Narkota (1350 m), Rudraprayag district; Loharkhet (1800 m) Bageshwar district (Bates & Harrison, 1997; Chakravarty *et al.* 2020; present study).

The individual from Uttarakhand was caught in a mistnet covering a narrow trail in primary oak forest. *Su. caliginosus*, *My. muricola*, and *Murina* sp. were also caught in the same net. The echolocation call peak frequency was recorded at ~60 kHz and overlaps with the smaller *Rh. macrotis*.

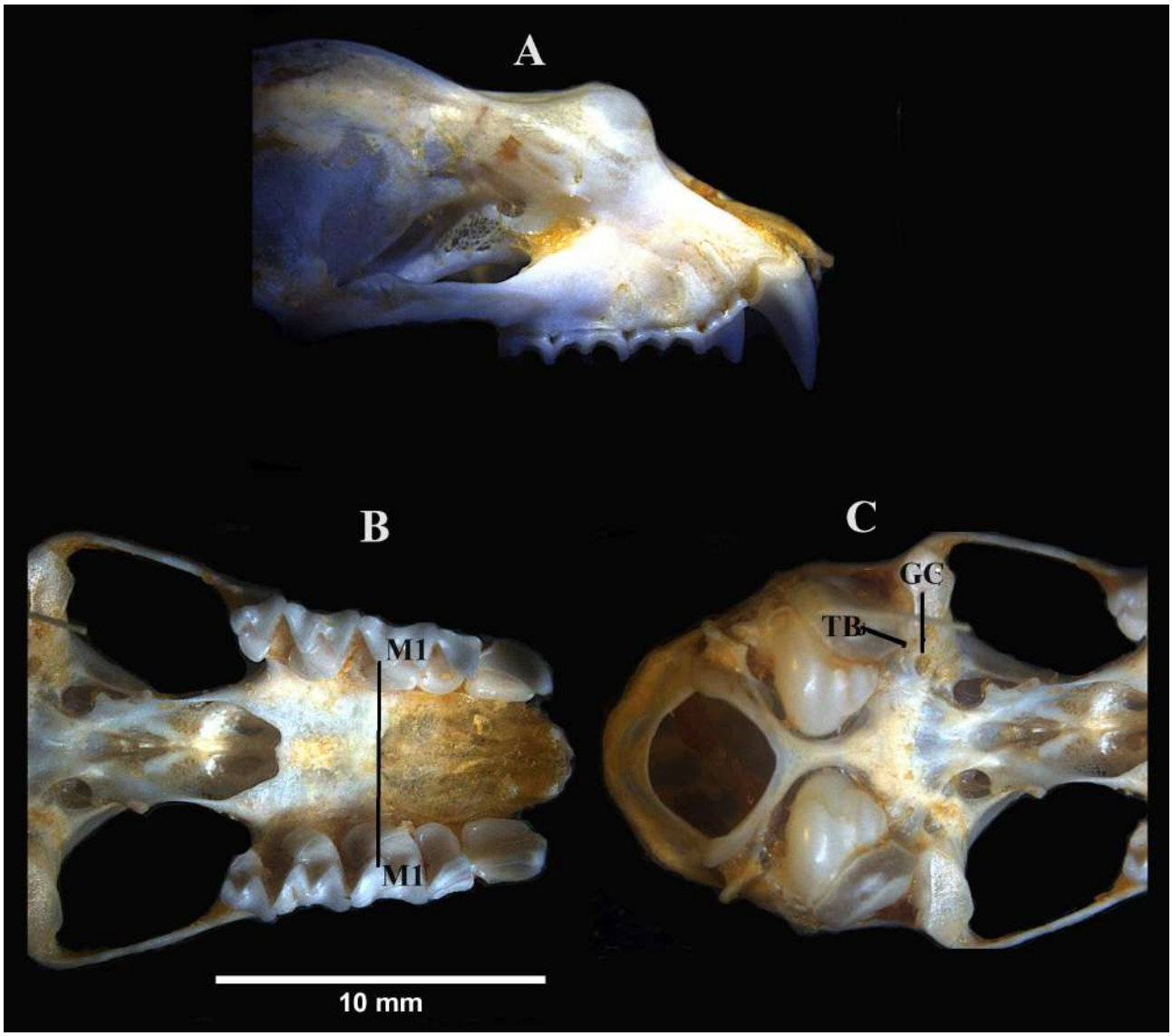

FIGURE 9. Skull features of a *Rh. nippon* from Himachal Pradesh (ZSI–NERC V/M/ERS/402). A) Lateral view of the rostrum, B) occlusal view of palate and dentition, and C) occlusal view of the posterior portion of skull showing relative position of the glenoid cavity and tympanic bullae.

7. *Rhinolophus perniger* Hodgson, 1843

(Northern Woolly horseshoe bat)

New material: 1 M, 31.05.2017, Barog Tunnel, Solan District, Himachal Pradesh, V/M/ERS/ 400 and three relased individuals at Mandal, Uttarakhand.

Morphological description of specimens: The largest rhinolophid in the Indian subcontinent with average forearm length of 71.7 mm in the Western Himalayan specimens. The forearm of the released individuals averaged 71.59 mm. A distinctive bat with long woolly fur, dorsally dark brown to black with lighter tips in some hairs giving a frosted appearance. Ventral fur was little lighter, but in some individuals, this was not noticeable. Horseshoe was broad, extending beyond the margins of upper lip. There was a deep median emargination on the horseshoe dividing it into two halves. The sella base had pronounced circular basal lappets on either side. The connecting process of the sella was rounded off downward and forward. The lancet was broadly rounded off. The lower lip had only one mental groove.

DNA: We obtained 713 bp of the COI gene from a single individual captured in the Barog tunnel (M2204/V/M/ERS/400), which is the first DNA evidence from a Himalayan specimen and representing topotypical material of *Rh. perniger*. This north Indian sample was very similar (within 2% sequence divergence) to other samples from China or the Indochinese Peninsula (e.g., northern Laos, M1210), but were more distinct (≥ 3% sequence divergence) from individuals representing the Lesser Woolly horseshoebat *Rh. beddomei* sampled in Sri Lanka (GB HM541415) or southern India (GB OQ921889) (Fig. 3).

Locality records and ecological notes: Himachal Pradesh: Arki (900 m), Shalaghat (1200 m) and Barog tunnel (1560 m) in Solan district (Saikia *et al.* 2011; present study). Uttarakhand: Jharipani (1410 m) in Dehradun district; Maldevta (846 m) in Tehri–Garhwal district; Pangot (1976 m) in Nainital district; Mussoorie (2000 m) in Dehradun district (Chakravarty *et al.* 2020; Dobson 1878).

A lone roosting male individual was caught inside Barog tunnel. Previous observations from Himachal Pradesh and Uttarakhand also indicate its solitary roosting habit in caves and abandoned man–made structures (Saikia *et al.* 2011; Chakravarty *et al.* 2020). The peak call frequency of the Himachal individual was 31–32 kHz which is similar to that reported from Uttarakhand (Chakravarty *et al.* 2020). This frequency is the lowest amongst the rhinolophid bats in the study area, thereby aiding unambiguous acoustic identification in the field.

Taxonomic note: *Rh. luctus*, a member of the *trifoliatus* group (Csorba *et al.* 2003), was long considered as a polytypic and widespread species found across most of the Oriental Region. However, based on a combination of chromosomal, acoustic, bacular and morphological characters several subspecies were recently elevated to species rank and few new taxa were recognized (e.g., Volleth *et al*. 2015, 2017), including the Indomalayan *Rh. perniger*. Our new, topotypical genetic data support that Himalayan *Rh. perniger* and most Chinese specimens are indeed highly similar and should be conspecific (Fig. 3) as they are phylogenetically distinct from the smaller, South Indian and Sri Lankan *Rh. beddomei* (Srinivasulu *et al.* 2023). However, more extensive comparative studies, notably from the Sundaland (terra typica of *Rh. luctus* is Java), are still needed to firmly establish relationships within the whole *Rh. luctus* species complex (Volleth *et al.* 2017).

8. *Rhinolophus macrotis* Blyth, 1844

(Big–eared horseshoe Bat)

New material: 1 M, 04.06.2017, Mount Karol, Solan District, Himachal Pradesh, V/M/ERS/ 564.

Morphological description of specimens: The adult male was caught in a harp trap set in an oak forest atop Mount Karol in Solan district. The dorsal fur of the specimen was buff brown with whitish roots and light brown tips. The ventrum appeared little lighter, individual hairs white with light brown tips. Compared to the size of the animal (e.g., FA 41.4 mm), the long ears (23.8 mm) were very prominent. The sella was unlike that of any other rhinolophids in India: it was parallel–sided, broad (2.9 mm at base), and the apex was rounded off and deflected downwards (Bates & Harrison 1997). When viewed laterally, our specimen had superior connecting process broadly rounded off, the anterior surface of the sella was slightly emarginated beneath the connecting process (Fig. 10A).

The baculum was 3.60 mm in length and 1.13 mm in width at the base. The baculum was flattened dorsoventrally with a roundish tip. In lateral profile, the distal end was slightly bent forward.

DNA: We obtained the COI sequence of 705 bp from this individual from Himachal Pradesh (M2216/V/M/ERS/564). Compared to other rhinolophids, the least divergent sequence was that of a *Rh. marshalli* from Cambodia at 3.5% (GB MW981437), but this is only slightly lower than other sequences variously labelled as *Rh. siamensis* or *Rh. macrotis* (at 4–5% divergence). To obtain meaningful compraisons with the most recent review of this group (Liu *et al*. 2019), we also sequenced the CYTB (1140 bp) of the same Himachal Pradesh specimen, which was divergent at about 3.1% K2P from a sequence from Nepal (GB MN077655). According to this genetic marker, other taxa within the *macrotis* species complex, e.g., *Rh. siamensis, Rh. osgoodi* or *Rh. episcopus* were slightly more divergent at 3.5–4.5% (Table S2).

Locality records and ecological notes: Uttarakhand: Jharipani (1600 m) and Mussorrie (2000 m), Dehradun district (Blanford 1888–91; Chakravarty *et al.* 2020). Himachal Pradesh: Mount Karol (1850 m), Solan district. This is the first record of this species from Himachal Pradesh.

The specimen was caught in a harp trap set over a forest gully with some puddles at Mount Karol in the outskirts of Solan town. The trapping site was essentially dominated by various species of oak trees (*Quercus* spp.). The harp

trap was set for the whole night and along with this specimen, an individual of *Murina huttonii* was also captured.

The peak frequency was recorded at 62 kHz which overlaps with that of *R. pearsonii* recorded in Uttarakhand (Chakravarty *et al.* 2020).

Taxonomic note: Traditionally, *Rh. macrotis* is characterised by a suite of external and craniodental characters like large ears, well–developed lancet with a rounded tip, weak canines, and long palatal bridge (Csorba *et al.* 2003). However, in recent times it was suggested that *Rh. macrotis* is a species complex with a number of cryptic species (Sun *et al.* 2008; Tu *et al.* 2017). More recent integrative taxonomic assessment of this species from Vietnam and China (Liu *et al.* 2019) indicates that *Rh. macrotis* in continental Asia includes three closely related taxa which are distinguishable from genuine *Rh. macrotis s.s.* i.e. *Rh. episcopus, Rh. osgoodi* and *Rh. siamensis.* The same autors also showed that reticulate evolution through introgressive hybridization was the main cause of several incongruences between phylogenetic reconstructions based on mitochondrial versus nuclear markers.

Due to the lack of sufficient phenotypic, bioacoustic and molecular data from topotypic material and also from specimens across its supposed distribution range in India, the taxonomic status of this complex remains indeterminate in India. Nevertheless, the limited genetic and echolocation call data suggest that our Himachal specimen and the one reported from Uttarakhand (Chakravarty *et al.* 2020) (closer to the type locality in Nepal) may represent true *Rh. macrotis*.

FIGURE 10. Portrait and side profile of *Rh. macrotis* specimen from A) Mount Karol, Himachal Pradesh (ZSI–NERC V/M/ERS/564), and B) Amarsang, Meghalaya (ZSI–NERC V/M/ERS/448).

9. *Rhinolophus sinicus* Thomas, 1915
(Chinese horseshoe bat)

New material: 1 F, 01.06.2017, Salogra cave, Solan District, Himachal Pradesh, V/M/ERS/422; 1 F, 01.06.2017, Saproon cave, Solan District, Himachal Pradesh, V/M/ERS/404.

Morphological description of specimens: Our specimens had a forearm length of 47.9–50.2 mm. Pelage was golden brown dorsoventrally with slightly paler belly. Ears were shorter (17.6–19.1 mm). In specimen V/M/ERS/404, the lancet had a well–defined longish tip immediately followed by a triangular base (Fig. 8B). In lateral view, the superior connecting process of sella was broadly rounded off. The lancet was broad with a well–defined short tip; the superior connecting process of the sella was round with the base of the sella projecting slightly forwards and downwards. Mental grooves were three in number. In the wings, the third and fourth metacarpals were almost equal in length, whereas the fifth was slightly longer. The second phalanx of the third metacarpal was longer at 22.5 mm on average. Thus, externally the Himachal Pradesh *Rh. sinicus* specimens corresponded well with the descriptions given in Thomas (2000) and Csorba *et al.* (2003).

The skulls had average condylocanine length of 17.77 mm. The zygomatic arches were flared with average width of 10.77 mm which was greater than the mastoid breadth (9.54 mm). Average palate length was 2.40 mm. The anterior border of the palate lied at the level of paracone of the first molar and the posterior border lied at the level of metastyle of second molars.

DNA: We obtained COI sequences of 705 bp from two individuals from Himachal Pradesh (M2070 and M2208/V/M/ERS/404), which proved to be almost identical. We also obtained a full length CYTB from one specimen (M2070). Reconsturctions based on both mitochondrial markers consistently grouped all these lineages with sequences from China assigned by Mao *et al.* (2017) to either *Rh. sinicus* or *Rh. thomasi* at about 5 % or less divergence from each other (Figs 3 and 5). Interestingly, these lineages formed a strongly supported monophyletic clade which excluded the other members of the group, *Rh. rouxii* and the Peninsular Indian clade (Chattopadhyay *et al.* 2012).

Locality records and ecological notes: Himachal Pradesh: Happy valley (1550 m), Saproon (1550 m) and Salogra (1440 m) in Solan district (Saikia *et al.* 2011; present study). Uttarakhand: Dharkuri (2700 m), Rudraprayag district (Wroughton 1914 as *Rh. rouxii*).

The peak frequency was recorded at 87 kHz both in Himachal Pradesh (present study) and in Uttarakhand (Chakravarty *et al.* 2020). In Himachal Pradesh, it can be told apart from *Rh. affinis* using acoustic characters (FmaxE 78 Khz) but in Uttarakhand their call frequencies overlap (Chakravarty *et al.* 2020).

Taxonomic note: Based on craniodental and molecular data, Thomas (2000) recognized the Himalayan form *Rh. sinicus* as a species different from peninsular Indian *Rh. rouxii*. Besides some differences in the wing measures and noseleaf structures, shorter palate length (1.9 mm in average) with the anterior border lying adjacent to the metacone of the first molar was cited as one of the distinctive characters of *Rh. sinicus* against *Rh. rouxii* (Thomas 2000). We compared our Himachal specimens in the light of the above characters and observed that the palatal bridge was slightly longer (mean=2.4 mm) with its anterior border extending beyond the metacone of the first molar. The upper canines of our specimens (albeit slightly worn out) were short, their height was at the level of the posterior premolar and did not seem to exceed the height of the second premolar considerably. Csorba *et al.* (2003) mentions this smaller upper canine as a distinguishing character of closely allied *Rh. thomasi* from Thailand. DNA sequences confirm the close phylogenetic relationships of the Indomalayan *Rh. sinicus* and Indochinese *Rh. thomasi* (Figs 3 and 5) but contradict that they are related to morphologically similar *Rh. rouxii* and the Peninsular Indian clade. Indeed, the latter two taxa are much more divergent (>7%) and are phylogenetically unrelated, questioning the monophyly of the *rouxii* group defined by Csorba *et al*. (2003).

Family: Hipposideridae

10. *Hipposideros armiger* Hodgson, 1835
(Great–Himalayan leaf–nosed bat)

New material: 1 M, 30.05.2017, Bank of river Narag, Devthal, Solan District, Himachal Pradesh, V/M/ERS/399.

Morphological description of specimens: The lone male from Himachal Pardesh had a dense dark brown

dorsal pelage with lighter hair bases. The ventral fur was grey brown. The noseleaf had four supplementary leaflets, the fourth one minute. Behind the posterior part of the noseleaf and above the eyes, there were prominent fleshy protuberances with scattered vibrissae, a characteristic feature of the adult males of this species (Soisook 2019). There was a frontal depression with a tuft of dark hairs. The fifth metacarpal was about 6 percent shorter than the third and fourth which were subequal.

The bacula of our specimen was 1.73 mm in length. It had a bilobate base, a constricted shaft and the tip bifurcated to form two ventrally projecting processes.

DNA: The single COI sequences (705 bp) from the Himachal Pradesh (M2201/V/M/ERS/ 399) was identical to a sequence of *Hi. armiger* from Uttarakhand (GB MN339181) and very similar (less than 2% divergence) to others from Indochina (e.g., from Vietnam, Francis *et al*. 2010), suggesting the existence of a single lineage throughout an extensive geographic area.

Locality records and ecological notes: Himachal Pradesh: Devthal (963 m), Mount Karol (2100 m) in Solan district (Saikia *et al.* 2011; present study). Uttarakhand: Bagheswar (950 m) in Bagheswar district (Wroughton 1914); Katarmal (1380 m) in Almora district (Bhat 1974); Mussoorie in Dehradun district (Jerdon 1874).

At Devthal, about 20 individuals of *Hi. armiger* were roosting along with a small number of *Rh. affinis* inside a small, abandoned mine. No sign of any breeding activity of the species was noted. In earlier studies in Himachal, this bat was recorded in the temple cave of Mount Karol sharing the roosting space with *My. longipes* (misidentified as *My. mystacinus* in Saikia *et al.* 2011) and *Rh. affinis*.

Family: Vespertilionidae

11. *Barbastella darjelingensis* (Hodgson, 1855)
(Eastern Barbastelle)

New material: 3 F, 08.06.2019, forest near Narkanda, Himachal Pradesh; 1 M, 08.04.2018, Khalla village, 1 M, 25.04.2019, Chopta village, Chamoli district, Uttarakhand; released after measurements.

Morphological description of specimens: The forearm lengths of the animals were measured at 41.8–42.9 mm. The pelage was long and silky, dark brown dorso–ventrally with silvery tips, the overall appearance looked dark. The ears were large, hairy, and joined over the forehead. Tragus was longish, narrowed gradually with slightly roundish tip. Face and wing membranes were dark brownThe interfemoral membrane was naked. Feet were small and devoid of hairs.

DNA: The COI sequence (705 bp) and CYTB (1140 bp) from one Himachal Pradesh barbastelle (M2230 released) was identical to a sequence of *Ba. darjelingensis* from Uttarakhand (GB MN339178; COI). No other record from the GenBank or BOLD matched these sequences (>6.3% K2P distance), stressing the distinctiveness of this taxon compared to other Asian species of this genus (Figs 4 and 6). Sequences considered by Kruskop *et al.* (2019) as *Ba. cf. darjelingensis* from Vietnam (ABBSI270–11) or from Taiwan (GB LC456144) were the closest relative (at about 6% sequence divergence for both markers). Another COI sequence from Nepal (GB JF442795) and labelled as *Ba. darjelingensis* by the same authors was much more divergent from any other *Barbastella* haplotype (13–20% K2P divergence), including from Indian *Ba. darjelingensis*. As this sequence (available in BOLD) had low quality trace files and many unique mutations compared to other sequences, it might represent a pseudogene and is disregarded here.

Locality records and ecological notes: Uttarakhand: Kapkot (1140 m) in Almora district (Bhat 1974); Khalla village (1667 m) and Chopta (2800 m) in Chamoli district (present study). Himachal Pradesh: Shimla (c.2200 m), Narkanda (2700 m) in Shimla district (Blanford 1888–1891; Ghosh 2008; present study).

Three adult females were caught in a flap trap early in the morning around a pond inside a temperate coniferous forest dominated by *Cedrus deodara* in Narkanda in early June. The lactating individuals indicated the presence of a maternity colony nearby and were released soon after being measured. One male animal was caught in mist net set across a pool of water in secondary oak forest near Khalla village and another female (non parous) was caught over a slow–flowing brook close to an open meadow in Chamoli district of Uttarakhand in April 2018.

As is usual in *Barbastella* bats, we recorded two types of echolocation calls that are emitted orally and nasally (Seibert *et al.* 2015). The oral calls are soft and narrowband (bandwidth=17 kHz) with a peak frequency of 26 kHz. Nasal calls differ from oral calls in having a convex shape with a slightly higher bandwidth (24 kHz) and peak frequency (31 kHz).

Taxonomic note: According to the most recent review of the genus *Barbastella* conducted with an integrative approach (Kruskop *et al.* 2019) and the current genetic results (Figs 4 and 6), the Himalayan species *Ba. darjelingensis* (type locality West Bengal, India) is distinct from both the Central Asian *Ba. caspica* and the Indochinese *Ba.* cf. *darjelingensis*. The later taxon is of uncertain taxonomic affinity because morphologically it is undistinguishable from genuine *darjelingensis*, but genetically differs from other taxa (Kruskop *et al.* 2019). Previous accounts based on morphology (e.g., Bates & Harrison 1997) used to classify all these Asian forms under *Ba. leucomelas*, which has now been shown to be endemic to the Sinai Peninsula (Benda & Mlikovsky 2008).

TABLE 2. Comparative metric data of *Rh. nippon* from western Himalayas and Nepal and that of *Rh. ferrumequinum* and *Rh. bocharicus* from Afghanistan (Benda & Gaisler 2015). Values in bracket indicate the range.

Metric parameter (in mm)	*Rh. nippon tragatus* (n=9)	*Rh. ferrumequinum* s.s. (Afghanistan, n=86)	*Rh. bocharicus* (Afghanistan, n=7)
Wt (g)	16.0 20.0	–	–
HB	58.7 (55.0–67.0)	–	–
TL	35.7 (33.0–43.0)	–	–
FA	60.5 (57.3–62.5)	57.25 (53.5–60.6)	50.64 (48.6–51.9)
HFCL	12.7 (12.3–13.0)	–	–
TIB	26.0 (24.9–26.8)	–	–
E	23.8 (22.3–27.0)	–	–
3MT	40.80, 41.50	–	–
4MT	45.60, 45.70	–	–
5MT	47.80, 47.50	–	–
1PH3MT	22.10, 21.5	–	–
2PH3MT	33.30, 34.60	–	–
GTLi	24.77 (24.10–25.10)	22.41 (21.66–23.21)	19.79 (19.38–20.47)
CBL	22.47 (22.18–23.10)	–	–
CCL	21.88 (21.26–21.88)	19.69 (18.75–20.43)	17.21 (16.98–17.38)
ZW	12.75 (12.20–13.20)	11.53 (11.05–12.08)	10.26 (10.00–10.54)
BW	9.41 (9.03–10.32)	9.16 (8.63–9.92)	8.42 (8.33–8.64)
MAB	10.97 (10.70–11.30)	10.15 (9.75–10.58)	9.31 (9.17–9.47)
PoC	2.82 (2.51 –2.98)	2.60 (2.23–3.58)	2.37 (2.02–2.48)
CM3	9.41 (9.20–9.67)	8.43 (8.02–9.04)	6.98 (6.79–7.13)
M^3–M^3	9.33 (9.15–9.79)	8.56 (8.05–8.92)	7.35 (6.69–7.67)
C^1–C^1	6.90 (6.05–7.15)	6.06 (5.68–6.42)	4.92 (4.44–5.33)
M^1–M^3	5.90 (5.80–6.03)	–	–
MLi	17.31 (17.13 –17.55)	–	–
CM_3	10.29 (10.04–10.55)	9.04 (8.43–9.83)	7.51 (7.03–7.81)
M_1–M_3	6.89 (6.86–6.94)		
COH	4.52 (4.00–4.81)	3.65 (3.28–4.22)	2.86 (2.63–2.98)

TABLE 3. Comparative metric data of *Ep. pachyomus* specimen from the study area and specimens from Kashmir, Iran, and Pakistan (Benda & Gaisler 2015).

Metric parameter (in mm)	Himachal specimens (n=2)	Specimens from Iran, Pakistan, and Kashmir
Wt (g)	20, 28	–
HB	68.0	–
TL	49.0, 55.0	–
FA	50.6, 51.2	52.2 (50.2–52.3)
HFCL	9.9, 10.6	–
TB	19.4, 21.8	–
E	17.2, 18.9	–
TR	7.1, 7.2	–
3MT	46.8	–
4MT	48.9	–
5MT	51.2	–
1PH3MT	19.2	–
2PH3MT	16.0	–
1PH4MT	16.0	–
2PH4MT	14.4	–
GTLI	20.27	20.17 (19.81–21.12)
CBL	18.26	19.28 (18.87–20.11)
CCL	18.09	–
ZW	13.46	14.01 (13.43–14.62)
BW	9.17	9.04 (8.52–9.71)
MAB	10.56	10.63 (10.28–11.16)
PoC	4.77	4.24 (3.83–4.77)
CM^3	7.36	7.57 (7.11–7.95)
M^3M^3	9.07	8.51 (8.15–8.97)
C^1C^1	6.12	6.38 (6.17–6.75)
M^1M^3	4.38	–
MLi	15.37	15.13 (14.68–15.60)
CM_3	8.25	8.29 (7.88–8.64)
M_1M_3	5.65	–
COH	5.70	5.66 (4.92–6.04)

12. *Eptesicus pachyomus* (Tomes, 1857)
(Oriental Serotine)

New material: 1 F, 01.06.2017, Salogra, Solan District, Himachal Pradesh, V/M/ERS/420 and 1 F, 01.06.2017, Salogra, Solan district, Himachal Pradesh, released; 1 F, 09.04.2018; 1 M 19.04.2019 & 1 M 05.05.2021, Mandal, Chamoli district, Uttarakhand, released.

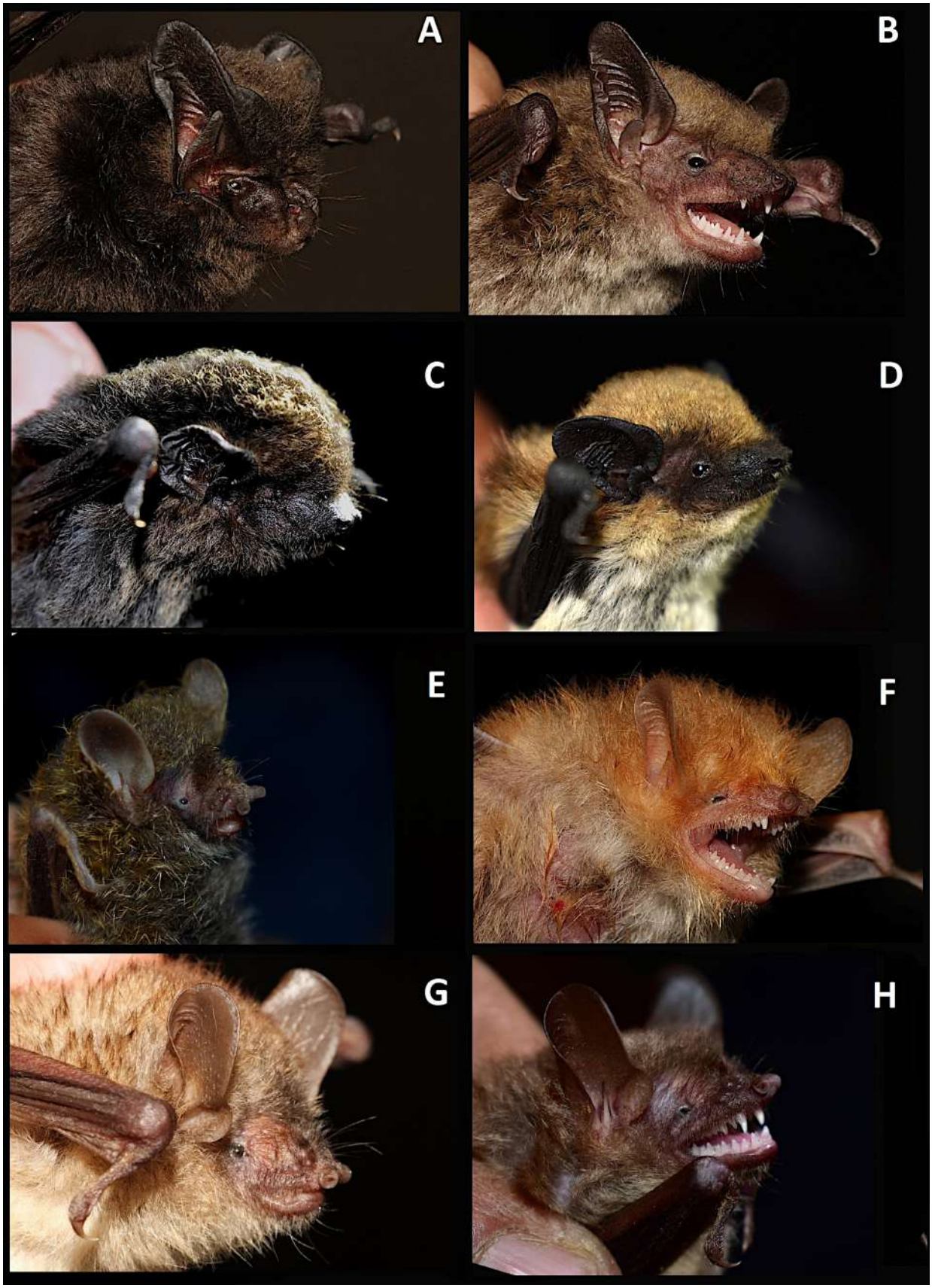

FIGURE 11. Portraits of some bat species recorded from the Western Himalayas during the present study. A) *Ba. darjelingensis* (released animal), B) *Ep. pachyomus* (ZSI–NERC V/M/ERS/420), C) *Hy. affinis* (ZSI–NERC V/M/ERS/638), D) *Hy. savii* (ZSI–NERC V/M/ERS/633), E) *Mu.* cf. *aurata* (released animal), F) *Mu. cyclotis* (ZSI–NERC V/M/ERS/425), G) *Mu. huttonii* (ZSI–NERC V/M/ERS/424), H) *Mu. huttonii* (released animal from Ansuya, Uttarakhand).

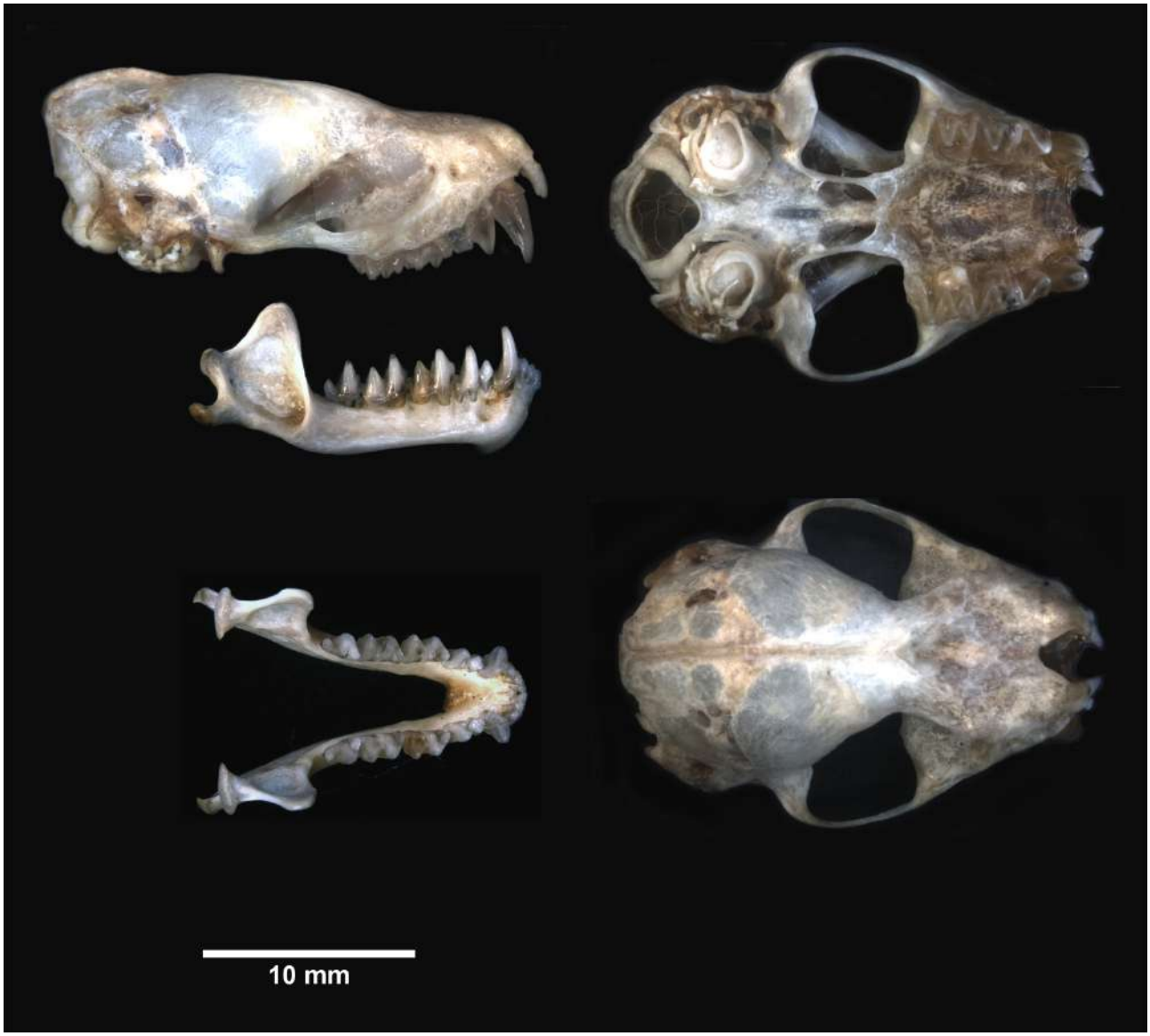

FIGURE 12. Dorsal, ventral, and lateral view of cranium and lateral and ventral view of mandible of *Ep. pachyomus* from Himachal Pradesh (ZSI–NERC V/M/ERS/420).

Morphological description of specimen: Our specimens measured 50.6–51.2 mm in forearm length. The pelage on the dorsal side was light brown with a golden tinge and beige in the ventral side; individual hairs were darker on the roots. The muzzle and lower lips were flesh coloured and sparsely haired. The ears were broadly conical with a roundish tip and six distinct ridges on the inner sides. The tragus was short (7.1–7.2 mm) and blunt, slightly curved inward (Fig. 11B). The wing and interfemoral membrane were dark brown and without hairs. The thumb had a delicate curved claw.

The cranium was robust with greatest length in our Himachal specimen at 20.27 mm. The rostrum was broad (rostral width 7.5 mm), zygomatic arches were widely flared far exceeding the mastoid breadth. The sagittal crest was low, visible only from the parietal region and continued up to lambda. Palate was long and broad; its exterior margin lied at the level of posterior end of canine and the posterior margin spread well behind the 3rd molar. The coronoid process of mandible was high and sharply descended to the condyle (Fig. 12). The dentition was robust, upper toothrow measured 7.36 mm. The first upper incisor was large with a visible secondary cusp, the second one was very small. There was a diastema between the second incisor and the canine. The canine was well developed and exceeds the length of first premolar.

DNA: We obtained COI and CYTB sequences of a specimen from Solan in Himachal Pradesh (M2207/V/M/ERS/420), which proved to be nearly identical (<0.7% divergence) to homologous sequences from a specimen housed at the Field Museum (FMNH 140422) and captured in the Karakar Pass, Pakistan (GB OP157125 and OP137071, respectively). Other Asian lineages in the *serotinus* group assigned by Juste *et al.* (2013) to *Ep. pachyomus*, including those sampled in Laos (GB HM540269, EU786850), China (GB EU786841) or South Korea (GB HQ580342) and curiously one specimen from Uttarakhand (GB MN339179), formed a distinct clade of closely related lineages (i.e. within 2% sequence diveregence). This geographically widespread clade was, however, clearly distant genetically from the Himachal Pradesh and the Pakistani samples by 11–17% sequence divergence (Tables S2 and S3). These two latter samples were collected and sequenced independently for two mitochondrial markers, and both concur in being very divergent from any other known Asian lineages of *Eptesicus*. Other large species of *Eptesicus*, including *Ep. serotinus turcomanus* were also all distinct. Hence, this stricking molecular divergence is certainly not due to a potential laboratory artifact (see e.g., Sangster & Luksenburg 2020) but needs further scrutiny to be properly interpreted in terms of taxonomy.

Locality records and ecological notes: Uttarakhand: Mandal village (1630 m) in Chamoli district; Himachal Pradesh: Salogra (1440 m) in Solan district (Present study).

Two females of this species were caught in mist nets set around an artificial pond at Salogra at an elevation of 1440 m asl during early June. The collection locality is a small hamlet with agriculture fields and *Pinus roxburghii* trees. There is a cave nearby which holds populations of *Rh. sinicus*, *Rh. lepidus* and *My. longipes* although no *Eptesicus* was located there. It was a hot summer evening and a number of individuals of apparently the same species were seen drinking water from the pond. Both caught animals were lactating females which suggest the presence of a maternity colony nearby. In Uttarakhand, specimens were also caught in mist nets set over small streams in Mandal village in April and early May. In Afghanistan, this bat was reported from elevation between 570–830 m and was known to roost in ruins and other synanthropic places (Benda & Gaisler 2015).

Taxonomic note: The largest of all *Eptesicus* species in the Indian subcontinent, *Ep. pachyomus* was traditionally considered to be distributed in the Indian Himalaya from Jammu and Kashmir to northeastern India (as "*Ep. serotinus"* in Bates & Harrison 1997). Based on analyses of morphology and both mitochondrial and nuclear DNA data, Juste *et al.* (2013) limited the distribution of *Ep. serotinus* to Europe and Central Asia whereas the Oriental representatives of the *serotinus* group were assigned to *Ep. pachyomus*, although they lacked any Indian or Himalayan samples in their molecular dataset. This new taxonomy was also supported by extensive morphological comparisons by Benda & Gaisler (2015) who included the Afghani taxon *pashtonus* as a synonym of *Ep. pachyomus*. According to Khandal *et al.* (2022), no precise locality was associated to the type of *pachyomus* described by Tomes (1857) from India and type locality might be somewhere in the Himalayas rather than the arid plains of Rajasthan. The cranial measurements of our Himachal Pradesh specimen appear among the smaller values reported by Benda & Gaisler (2015) for a series of specimens from Iran, Pakistan and Kashmir, but otherwise correspond morphologically to this taxon, including specimens from Afghanistan (op. cit.). Samples from further east and assigned to various other subspecies (i.e., *andersoni*, *pallens* or *horikawai*) are all larger bats. It is therefore puzzling to find a unique and basal mitochondrial lineage from Himachal Pradesh and northern Pakistan (genetically identical for both CYTB and COI genes) (Figs 4 and 6). This lineage was very divergent from all other Oriental samples, including from one released individual from Uttarakhand (Chakravarty *et al.* 2022). As no nuclear marker were tested from the Himachal Pradesh or Pakistani samples, it is unclear whether this divergent mitochondrial lineage represents an introgressed variant inherited from an unsampled species, as has been shown in some Eurasian *Eptesicus* (Juste *et. al.* 2013, Artyushin *et al.* 2009), or whether *Ep. pachyomus* represents a complex of several taxa in the Himalayas.

13. *Hypsugo affinis* (Dobson, 1871)

(Chocolate pipistrelle)

New material: 1 M, 19.04.2019, Mandal, Chamoli district, Uttarakhand, V/M/ERS/638; 1 M, 05.05.2021, Mandal, Chamoli district, Uttarakhand, released.

Morphological description of specimen: An adult male had a forearm of 37.9 mm. The pelage appeared uniform smoky black dorsally and smoky greyish brown ventrally (Fig. 11C). The head appeared flat; the lip

fringes were hairy, ears were small, rhomboidal, and thick at the proximal part with a small tragus. The wings were essentially naked which join at the base of the digits. There were seven caudal vertebrae, the terminal one projecting out of the tail membrane. A prominent calcar lobe was present. Penis was pendulus and hairy on the distal part.

The skull had a broad and elongated rostrum and gradually rised to lambda in a straight line (Fig. 13A). There was a midline depression in the orbital region. The zygoma was thin with a distinct process in the jugal bones. The upper canine was only moderately exceeding the height of the last corresponding premolar (in contrast with the conspicuously long canines of *Hy. dolichodon*; see Fig. 3. in Görföl *et al*. 2018). The first upper premolar was small and intruded. Lower molars were myotodont. The baculum was small (2.5 mm), broad in the middle and slightly constricted at both ends (Fig. 14F). The distal end was slightly groved but without any expansion. This corresponds well to the depiction of the baculum of *Hy. affinis* in Hill & Harrison (1987) and differs sharply from the baculum of *Hy. dolichodon* (Fig. 5 in Görföl *et al*. 2018).

DNA: no biological material was obtained from this species.

Distribution and ecological notes: At present, two localities in Western Himalayas are known: Uttarakhand: Kumaon division and Mandal (1500 m) in Chamoli district (Bates & Harrison 1997; present study). Both individuals were caught over a stream at the edge of an oak forest near human habitation. *Hy. affinis* is known to be an upland species with all records being within 1250–2530 m (Görföl *et al.* 2018) and our present record also corroborates it. The echolocation call was recorded on release. We recorded narrowband (bandwidth=40.74 kHz) calls, ending at 25.89 kHz, and having a peak frequency of 30.51 kHz (Table 6).

Taxonomic note: *Hypsugo affinis* is reportedly distributed in southern and northern parts of South Asia (India, Nepal and Sri Lanka), southern China (Xizang, Yunnan, and Guangxi), and Southeast Asia (Myanmar and Cambodia) (Chheang *et al.* 2013; Srinivasulu & Srinivasulu, 2019a). However, Görföl *et al.* (2018) showed that recent records of this species from lowland Myanmar (Bates *et al*. 2005) and Cambodia (Chheang *et al.* 2013) actually represent the recently described species *Hy. dolichodon*. The type specimen of *Hy. affinis* was collected from Bhamo (ca. 24°15'N; 97°14'E) in Kachin State of northern Myanmar at an elevation of 1363 m (Dobson 1871) and further records of the species all came from higher altitudes between 1250–2530 m (Görföl *et al.* 2018). However, the skull of the type specimen of *Hy. affinis* in ZSI, Kolkata is not traceable, so final taxonomic assignation to either species is still problematic (op. cit.).

14. *Hypsugo savii* (Bonaparte, 1837)

(Savi's Pipistrelle)

New material: 1 F, 31.03.2018, Mandal village, Chamoli district, Uttarakhand, V/M/ERS/633.

Morphological description of specimen: The Uttarakhand specimen had a forearm of 37.7 mm. The pelage was light brown dorsally and creamy–white ventrally, with thick and silky fur. Dorsal hairs were unicoloured whereas ventral hairs had darker roots and whitish tips. The ears, muzzle, patagium and feet were dark, contrasting against its light pelage colouration (Fig. 11D). The wing and tail membranes were black and essentially naked on both sides. The shape of the ear was rather like a *Pipistrellus* but with a short and wide tragus. Wing membrane joined at the middle of the metatarsus. A small calcar lobe was present, and the tail tip projected out of the tail membrane by about 4 mm.

The skull and dentition were relatively robust. The rostrum was broad and with two frontal depressions and elevated to the braincase in almost a straight line (Fig. 13B). A weak sagittal crest was present. The palate was concave and very deep. The zygomatic arches were delicate. The upper incisors were bicuspid. Only one upper premolar was present which was equal to the canine in basal area and almost reaching the height of the canine. The coronoid process was situated much higher than the condylar process. Lower molars were myotodont. These morphological features and mensural data agree well with the Central Asian, sand–coloured subspecies *Hy. s. caucasicus* found in Afghanistan (Benda & Geisler 2015) or Tajikistan (Benda *et al.* 2024).

DNA: COI sequence from an Uttarakhand specimen (V/M/ERS/633) proved to be very similar (within 1.8% sequence divergence) to *Hy. savii*'s lineage D described recently by Gojznikar & Mayer (2024) for Central Asia. This lineage D included sequences from southern Mongolia (GB OM370825 and MW367769) labelled as "*Hy. stubbei"* or "*Hy. alaschanicus"* (Fig. 4). These *savii*'s lineage D sequences were more distant (>7%) from various other lineages of *Hy. savii* from the Western Palearctic region (e.g., OQ706648, see Gojznikar & Mayer 2024)

and even more so (>9%) from sequences of true *Hy. alaschanicus* from Mongolia or China (GB OR467319 or MF459671).

Distribution and ecological notes: *Hy. savii* is primarily a Palaearctic species with a supposed intrusion into northern India (Juste & Paunović 2016). However, the records of this species from Pune in Maharashtra (Korad & Yardi 2004) and from Ambala in Haryana (Neuhauser 1970) were regarded as misidentifications because *Hy. savii* is unlikely to be found in the hot plains (Benda & Gaisler 2015). The report of a specimen from Gilgit in Pakistan administered Kashmir (Chakraborty 1983) which was collected and initially identified by J. Scully as *Vesperugo borealis* was also considered by John Hill as doubtful. It was therefore suggested that the Oriental limit of distribution of the species could be the Hindu Kush barring aside a single record from Kamu, Nuristan province in eastern Afghanistan (Benda & Gaisler 2015). Our specimen from Mandal (1600 m) therefore represents the first authentic record of this species from the Western Himalayas and India as a whole, extending its distribution to the southeast by about 900 km.

The adult female was caught in a mist net set over a shallow, shaded stream along the edge of an oak forest. We recorded short frequency–modulated (FM) calls with a bandwidth of 53.14 kHz with an end frequency of 29.2 kHz. The peak frequency was recorded at 42.11 kHz (Table 6). The call frequencies were superficially similar to those recorded in European *Hy. savii* (Russo & Jones 2002). The echolocation calls were recorded inside a room so that the bat could be collected after recording. Therefore, the call may resemble the ones emitted in dense clutter. Natural search phase calls are likely to have distinct FM and QCF components, with lower bandwidth and longer duration. In the study area (Kedarnath Wildlife Sanctuary), its calls overlap with those of *Mirostrellus joffrei* (Chakravarty *et al.* 2020).

Taxonomic note: Dobson (1871) described *Pipistrellus austenianus* from the Khasi Hills in north–eastern India, which has been regarded as a possible synonym of *Hy. savii* (e.g., Bates & Harrison 1997). However, as no critical evaluation of the only known specimen from Cherrapunjee with other *Hypsugo* spp. has been made so far, this taxonomic assignement is best considered as doubtful. The high lineage diversity found in the mitochondrial DNA of *Hy. savii* (Fig. 4) further questions the taxonomic rank to be assigned to these divergent clades (Gojznikar & Mayer 2024). We indeed concur that in the absence of nuclear genetic markers, it is currently impossible to decide whether each major clade represent distinct species or subspecies, or simply reflect the complex phylogeographic history of a single polytypic and widespread species (Benda & Gaisler 2015). We can only support that the Uttarakhand specimen is part of *Hy. savii*'s lineage D and has external morphology corresponding well to *Hy. savii caucasicus*.

15. *Mirostrellus joffrei* (Thomas, 1915)

(Joffre's Pipistrelle)

New material: 1 M, 06.04.2021, Mandal village, Chamoli District, Uttarakhand, V/M/ERS/ 650.

Morphological description of specimen: This was a small bat with a forearm length of about 38 mm. It had a glossy, dark brown dorsal pelage with a slight reddish tinge and the ventral fur was light golden brown with a sharp demarcation between these two colours. Dorsal hairs had darker roots and lighter tips while the ventral hairs were uniformly coloured throughout their length. Wings and patagium were dark brown and naked, except for the region closer to the body. The sides of the muzzle between nostrils and eyes were characteristically swollen with a few long vibrissae. The ears were broad and short with rounded tip and roughly matching a right triangle in lateral profile. The tragus was short and rounded, with a basal lobe, inner margin concave and the outer margin convex. The wing membrane attached to the mid metatarsus and a small unkeeled calcar lobe was present. The two terminal caudal vertebrae projected out of the membrane.

The skull was stout with a short rostrum and bulbous braincase, with traces of occipital and sagittal crest present. Supraorbital processes were large and directed sideways. The first incisor was bifid, the second was also bifid and reached about two third the length of the first. In frontal view, the canines were divergent. Lower molars were myotodont.

DNA: no biological material was obtained from this species.

Locality records and ecological notes: Uttarakhand: Mandal village (1500 m), Chamoli district (Chakravarty *et al.* 2020; present study). Individuals were caught flying over an open stream at the edge of an oak forest. The current specimen was collected at a shaded stream in the same spot described in Chakravarty *et al.* (2020). It has not been recorded from any other part of Western Himalayas, although not uncommon in Mandal area.

Taxonomic note: See Görföl *et al.* (2020) for the correct generic classification of *Mi. joffrei*, which used to be included within *Pipistrellus* (e.g., Bates & Harrison 1990) or *Hypsugo* (e.g., Saikia *et al.* 2017).

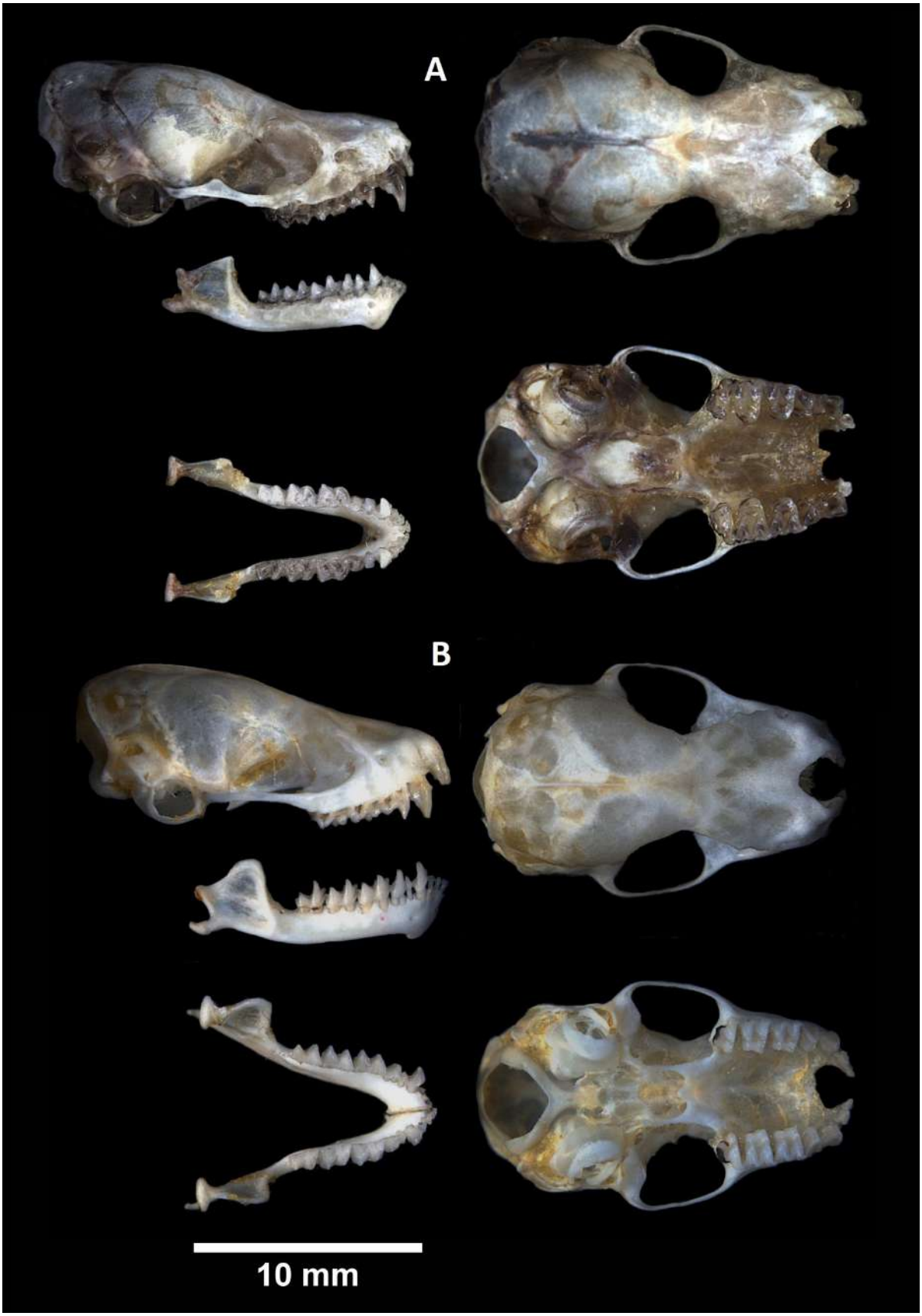

FIGURE 13. Dorsal, ventral, and lateral view of cranium and lateral and ventral view of mandible of A) *Hy. affinis* (ZSI–NERC V/M/ERS/638), and B) *Hy. savii* (ZSI–NERC V/M/ERS/633) from the Western Himalayas.

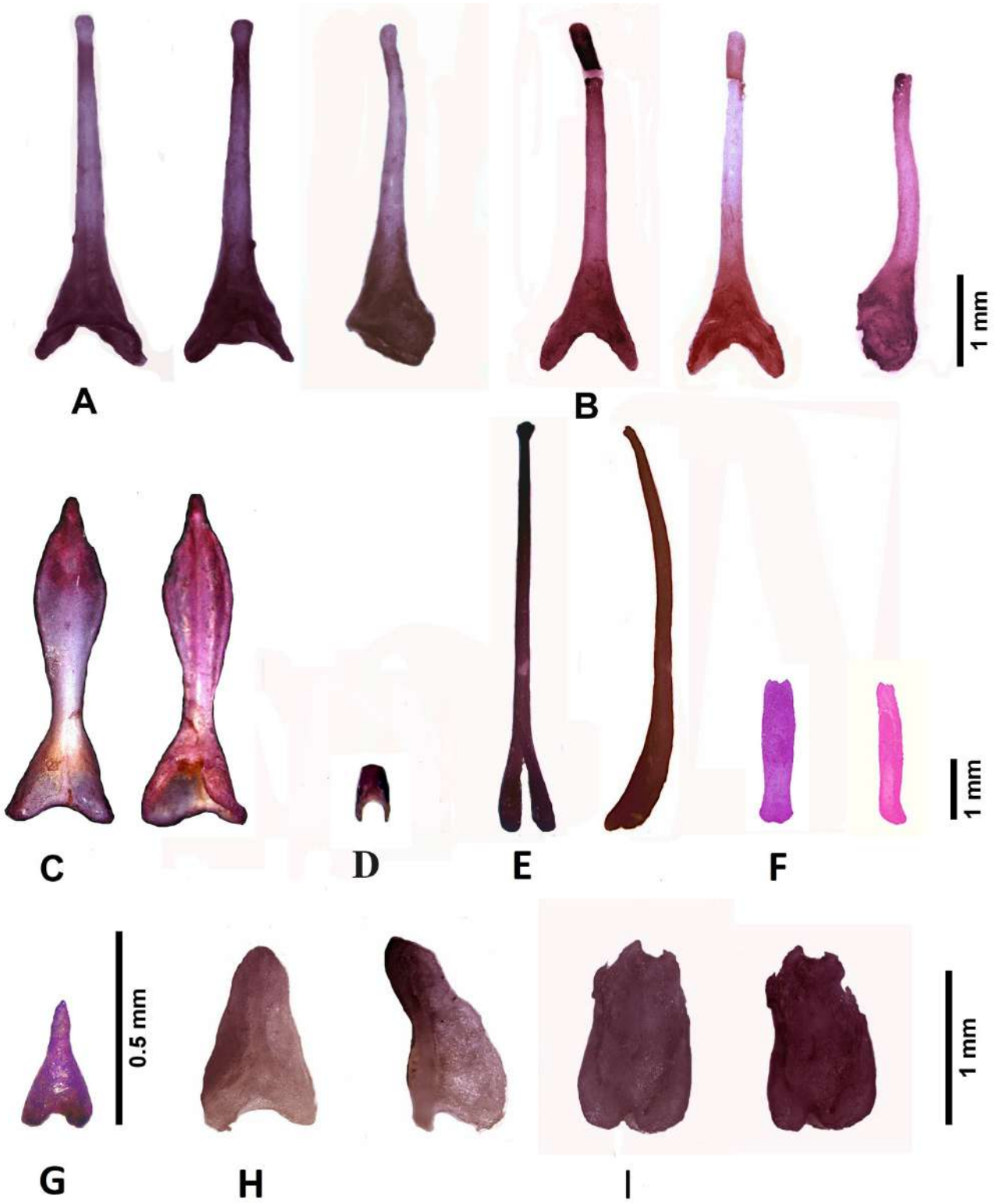

FIGURE 14. Dorsal (D), ventral (V) and lateral (L) profile of bacula of some bat species from the study area. A) *Rh. macrotis* (D, V, L, ZSI–NERC V/M/ERS/564), B) *Rh. lepidus* (D, V, L, ZSI–NERC V/M/ERS/449), C) *Rh. nippon* (D, V, ZSI–NERC V/M/ERS/402), D) *My. himalaicus* **sp. nov.** (D, ZSI–NERC V/M/ERS/653), E) *Ny. leisleri* (D, L, ZSI–NERC V/M/ERS/413), F) *Hy. affinis* (D, L, ZSI–NERC V/M/ERS/638), G) *My. longipes* (D, ZSI–NERC V/M/ERS/ 438), H) *My. blythii* (D, L, ZSI–NERC V/M/ERS/405), I) *Mu. huttonii* (D, V, ZSI–NERC V/M/ERS/ 443). Note, bacula B, D and I are partially damaged.

16. *Myotis blythii* (Tomes, 1857)
(Lesser Mouse–eared Bat)

New material: 1 M, 31.05.2017, Barog Tunnel, Solan District, Himachal Pradesh, V/M/ERS/ 405.

Morphological description of specimen: A single individual was captured from a crevice inside Barog tunnel. Largest amongst all Indian *Myotis*, this male had a weight of 16 g and forearm length of 58.4 mm. The wings were long and broad with a wingspan of 380 mm. The dorsal fur was grey–brown, and the venter was beige. Hairs were darker at the base with paler tips. Belly fur was shorter (c. 4 mm) than on the back (c. 6 mm) as also noted by Bates & Harrison (1997). The muzzle was pointed, flesh coloured and covered with scattered hairs. Unlike in most European *My. blythii*, there was no apparent patch of white fur on the forehead between ears. Ears were elongated, light brown. The tragus was half the length of ear and narrowed down towards the tip (Fig. 15A). The wings attached to the outer metatarsal of each foot.

The cranium was robust with the greatest length of 21.2 mm in our specimen. The rostrum was short and broad; the braincase elevated gently above the rostrum. Distinct supraorbital ridges were present. Sagittal crest was not very prominent. Lambda formed the posterior extremity of the skull. The coronoid process of each mandible was tall and triangular. Compared to the skull size, dentition was weak. The upper incisors were bicuspidate, the second one slightly shorter than the first. Canine was relatively short, only slightly exceeding the level of third premolar. The first and second upper premolars were similar in surface area and the second one was slightly intruded. The first two lower incisors were tricuspidate while the third one had four cusps. Lower molars were myotodont.

The baculum of *M. blythii* is variable in shape although the overall structure matches to an arrowhead (Albayrak & Asan 2001). The baculum length of our specimen was 1 mm and 0.6 mm wide at the base. In dorsal view, the broad shape corresponded to that of an isosceles triangle with a rounded tip and arched base. The baculum was curved upward in dorsal profile (Fig. 14H).

DNA: The COI (GB MW054901) and CYTB (GB MW054872) sequences from this Himachal Pradesh specimen were reported in a previous account (Ruedi *et al.* 2021). These sequences were very similar (<2% sequence divergence) to specimens collected in Pakistan (GB MK799658) or in Central Asia (e.g., GB MT588108 or AF376840), but more divergent (about 6%) from other taxa such as *My. b. oxygnathus* from Europe (e.g., GB OQ885387).

Taxonomic note: The taxon *Myotis blythii* was originally described by Tomes (1857) as *Vespertilio blythii* from an unprecise locality called Nassenabad; its exact geographic location is far from clear but logically should be considered as "Himalayas" (Topál 1971; Khandal *et al.* 2022). Another taxon, *Vespertilio murinoides* was subsequently described from Chamba area of Himachal Pradesh (Dobson 1873), but Thomas (1915) considered it as a synonym of *My. blythii*. Based on examination of the type series of Dobson (1873) in the Zoological Survey of India, Kolkata, Topál (1971) also confirmed the above view of synonymy and opined that the Western Himalayas is inhabited by a single form *My. blythii*. This nominate form *My. b. blythii* occurs south of the Himalayas from Nepal to Afghanistan (Benda & Gaisler 2015) and parts of Central Asia (Benda *et al.* 2011).

17. *Myotis* sp.

New material: 1 M, 02.05.2021, Ansuya, Chamoli District, Uttarakhand, V/M/ERS/653.

Morphological description of specimen: This specimen proved to be an undescribed species within the *My. frater* species complex (Tsytsulina & Strelkov 2001), we therefore describe its morphological characters in a section below.

DNA: Due to degraded condition of DNA, we only obtained a short fragment (182 bp) of the COI of the vouchered specimen V/M/ERS/653. This fragment was almost identical (one single transition mutation) compared to two other COI sequences (GB MN714904 and MN339184) of the same species from Uttarakhand reported in Chakravarty *et al.* (2020) under the name "*Myotis* cf. *frater*". No other matching sequence was available in the GenBank, the closest one being that of *My. soror* from Taiwan (at 9.8%). Other sequences issued from species in the *My. frater* species complex were all more divergent (>12 %).

Locality records and ecological notes: all records and ecological notes related to that species are given below in the formal description.

Taxonomic notes: The *My. frater* species complex is comprised of several (mainly allopatric) taxa: *My. frater* from eastern China and Taiwan, *My. longicaudatus* from central and south–eastern Siberia, Korea and Japan

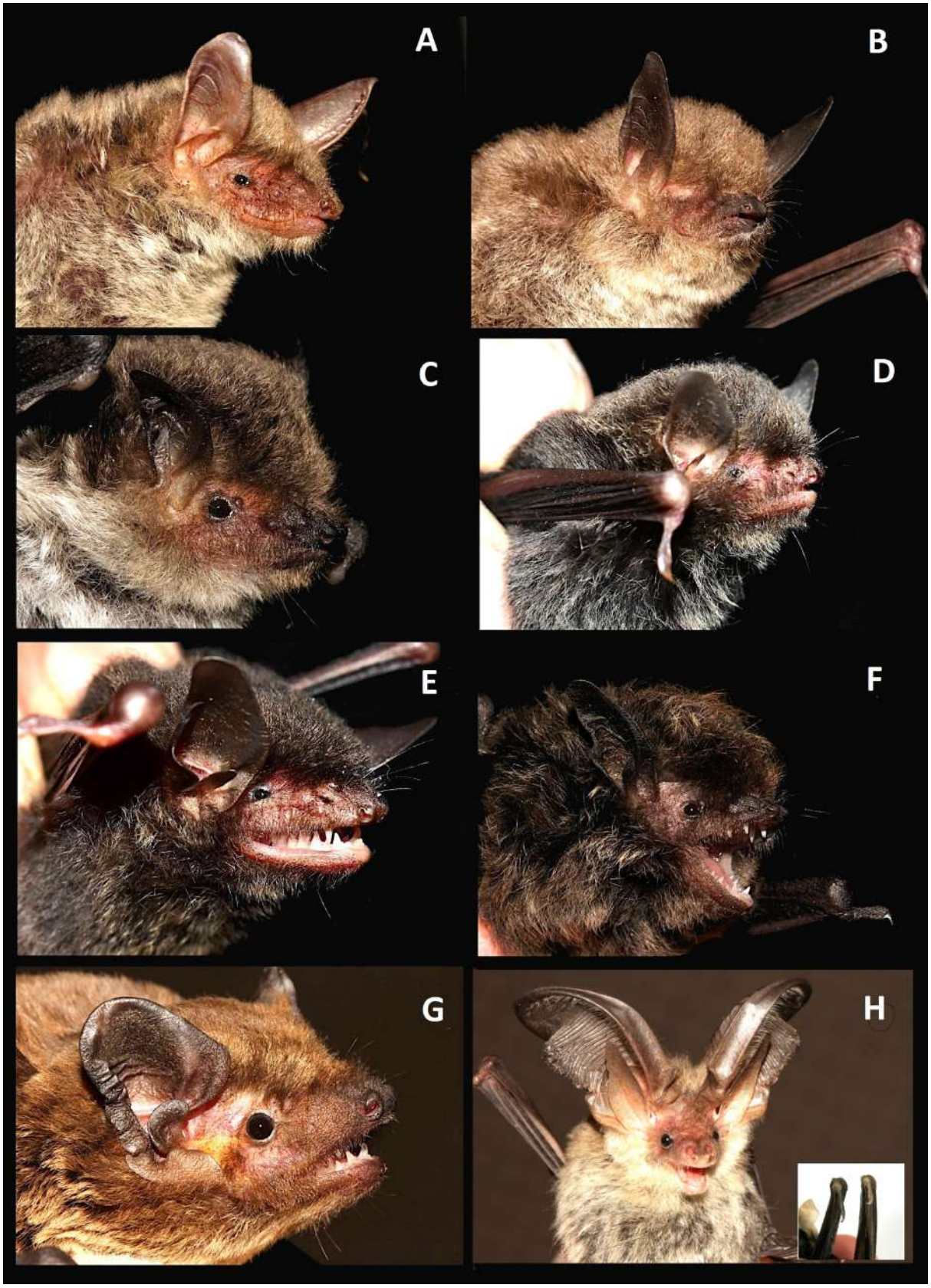

FIGURE 15. Portraits of A) *My. blythii* (ZSI–NERC V/M/ERS/405), B) *My. longipes* (ZSI–NERC V/M/ERS/441), C) *My. nipalensis* (ZSI–NERC V/M/ERS/445), D) *My. muricola* (released animal), E) *My. sicarius* (released animal), F) *Su. caliginosus* (ZSI–NERC V/M/ERS/417), G) *Ny. leisleri* (ZSI–NERC V/M/ERS/413), and H) *Pl. wardi* (ZSI–NERC V/M/ERS/415). Inset: Direct comparison of thumb length between *Pl. wardi* (ZSIS–NERC V/M/ERS/658, left) and *Pl. homochrous* (ZSIS–NERC V/M/ERS/654, right).

(including *kaguyae* and *eniseensis* as subspecies), *My. bucharensis* from Tajikistan and Uzbekistan (Horácek *et al.* 2000; Tsytsulina & Strelkov 2001; Benda *et al.* 2024; Kazakov *et al.* 2025), and *My. soror*, a Taiwan endemic which lives in sympatry with *My. frater* (Ruedi *et al.* 2015). All these taxa are morphologically quite similar but genetically distinct. According to mitochondrial markers, however, they do not form a monophyletic clade but include other, morphologically unrelated species such as *My. daubentonii* and *My. bechsteinii* (Ruedi *et al.* 2013, 2015; Kazakov *et al.* 2020). Genetically, the Uttarakhand specimens are indeed part of the *My. frater* species complex (according to COI; Chakravarty *et al.* 2020) but owing to a distinct combination of unique genetic and morphological traits, specimens from Uttarakhand certainly represent a new taxon. A very similar specimen was caught in Pakistan about 700 km to the west of this Uttarakhand individual. Since both are externally and cranially indistinguishable, and because they were found in the same continuous montane forests commonly found at these altitudes, we conclude that both individuals are conspecific and include them in the following description.

***Myotis himalaicus* sp. nov. Ruedi, Chakravarty, Saikia & Csorba**

Himalayan long–tailed Myotis

ZooBank Life Science Identifier (LSID): urn:lsid:zoobank.org:pub:98354CF6-78A5-4CCD-84FE-E220B722DE9

Synonyms:

Myotis cf. *frater* (Chakravarty *et al*. 2020)

Holotype: adult male collected by R. Chakravarty on 2nd of May 2021 in Ansuya, Chamoli District, Uttarakhand, India. It is deposited in the collection of the Zoological Survey of India at Shillong under accession number V/M/ERS/ 653. The specimen is conserved in alcohol with skull and baculum prepared separately. Part of the mitochondrial cytochrome oxydase subunit 1 gene (COI) was sequenced from tissue extracts taken on the holotype. This nucleotide sequence is deposited in the GenBank under accession number PQ776313.

Paratype: Adult female, collected by G. Csorba and L. Ronkay on 22nd of July 1998 in Kaghan Valley (34°36'48" N, 73°27'0.97"8 E, 2300 m), Khyber Pakhtunkhwa, Pakistan. It is deposited in the collection of the Hungarian Natural History Museum under accession number HNHM–MAM 99.14.5. The specimen is conserved in alcohol with skull prepared separately.

Type locality: The holotype was caught in a mist net set above a water pond surrounded by dense evergreen forests, at Ansuya, Chamoli District, Uttarakhand (30°29’15.5” N, 79°17’29” E), at an elevation of 2000 m above sea level.

Etymology: The epithet *himalaicus* refers to the current distribution of the species, which appears to be endemic to the southern slopes of the western part of the Himalayan mountains and extending to Hindu Kush Range in the west. Suggested vernacular name is Himalayan long–tailed Myotis.

Measurements of the holotype: Measurements are in mm and were taken on the prepared specimen. Head and body length, 43; tail length, 45.8; forearm length, 41.1; hind foot length (including claw), 8.2; Tibia length, 21.3; ear length, 13.5; tragus length, 6.1; greatest skull length, including incisors, 13.8; condyle–basal length, 13.3; greatest zygomatic breadth, 9.2; postorbital breadth, 4.1; mastoid breadth, 7.6; greatest braincase width, 7.1; skull height, 5.6; upper canine–molar toothrow, 3.4; width across upper canines, 4.1; width across 3rd upper molars, 6.0; mandible length, including incisive, 10.3; lower canine–molar toothrow, 5.9.

Diagnosis: Medium–sized (6.5 g body mass), dark brown *Myotis*; dorsal hair tips slightly more golden brown; ventral fur with dark bases of hairs and lighter tips. Colour of face flesh coloured; other bare parts darker brown. Ears relatively short, brown and naked; anterior margin initially straight, then convex leading to a rounded tip; posterior margin deeply notched at mid–height. Tragus brown, straight, and reaching beyond posterior ear notch. Thumb and claw robust. Wing membranes attached close to base of outer toe, on the distal part of the metatarsus. Feet smaller than or equal half tibia length. Tail longer than head and body length combined. Calcar straight, with a very narrow, elongated lobe. Skull globose, with short rostrum and abruptly raised frontal part of braincase, very weak sagittal and moderate lambdoid crests. Dentition relatively weak with second upper premolars small and partly or fully intruded from toothrow. Height of upper and lower canines exceed that of the corresponding third premolars. Lower molars myotodont.

Description: Pelage dense, soft and relatively long at 8 mm on the dorsum; dorsal hairs dark brown, becoming progressively lighter towards the tips. Ventral parts clearly paler, with hairs brown along their proximal middle, becoming lighter, yellowish or creamy towards the tip (Fig. 16A). Bare parts, including ears and patagium, dark

FIGURE 16. Two views of the side profile and dentition of *My. himalaicus* **sp. nov.** Notice the conspicuous ear notch and the relative length of the tragus, which reaches beyond the notch height.

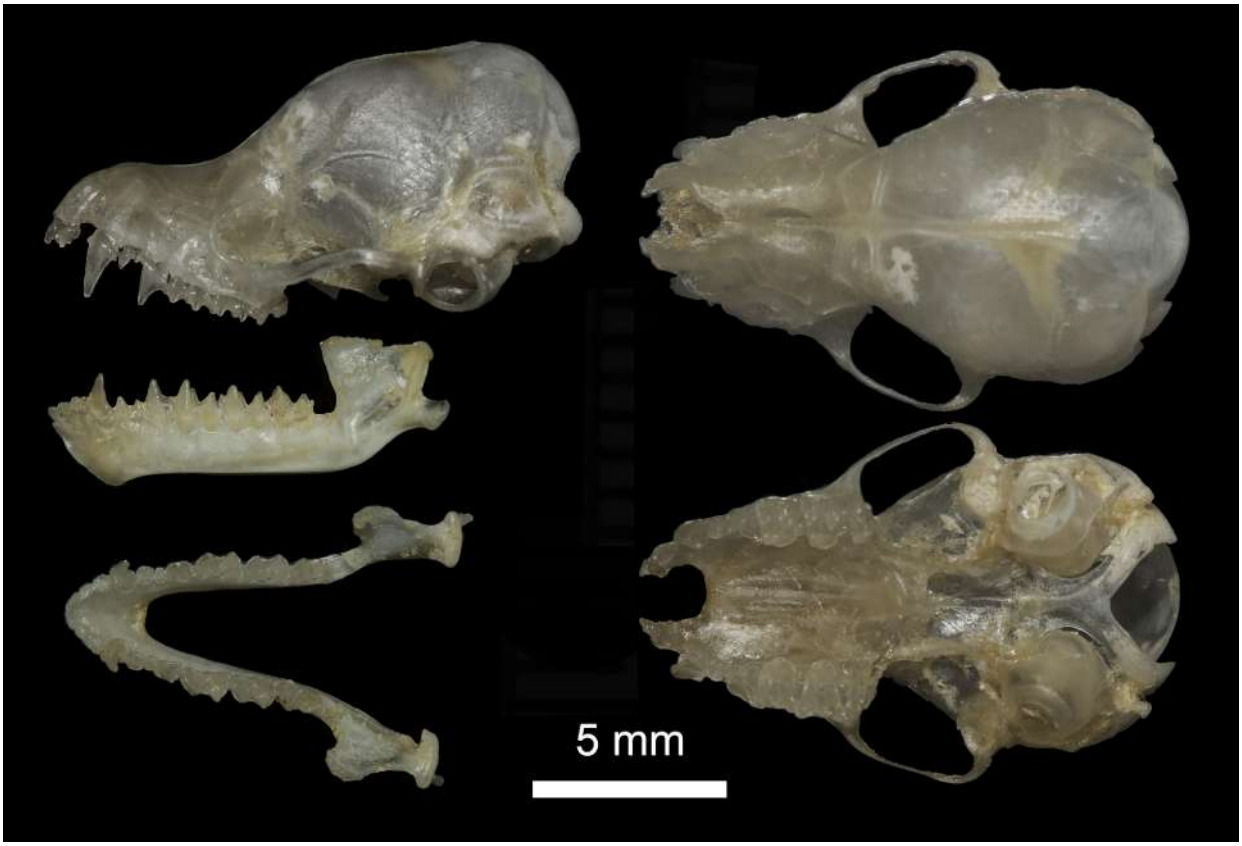

FIGURE 17. Dorsal, ventral, and lateral view of cranium and lateral and ventral view of mandible of the holotype of *My. himalaicus* **sp. nov.** from Uttarakhand (ZSI–NERC V/M/ERS/653).

brown. Face lighter, flesh–coloured and bare around the eyes; muzzle hairier and long whiskers present around the lip fringes. Ears mostly naked except for a few scattered hairs on the inner side, medium–sized and broad, not reaching the nose tip when laid forward, with a conspicuous notch at half height along posterior margin. Tragus straight, with near parallel edges, but anterior margin slightly concave, reaching few millimetres beyond ear notch on the posterior margin (Fig. 16B). Wing membranes naked (except the underparts, close to the body), and attached to the distal parts of the metacarpus, near the bases of the outer toe. Feet delicate, approximately half the size of tibia length and covered with sparse hairs along the toes. Uropatagium broad, naked; tail almost fully included in the membrane. Calcar long and straight, extending halfway to the free edge of uropatagium, with a very narrow, elongated, indistinct keel. Tail long slightly longer than the size of head and body length combined. Thumbs relatively long (about 6 mm including claw), about same diameter throughout and terminating with a strong but short claw.

When viewed in profile, the skull has a relatively short rostrum, and an abruptly raising frontal part of braincase (Figs 17 and 18A). Braincase globose, with very weak sagittal and moderately developed lambdoid crests. Like in most species of *Myotis*, dental formula is I 2/3 C 1/1 PM 3/3 M 3/3 = 38 teeth. Teeth rather delicate, upper and lower canines exceed third premolars in height. Upper incisors of comparable height and crown area; both bicuspidate. Short diastema present between incisors and upper canine. Upper canine gracile and angular in section, with distinct medio–labial and antero–lingual groove and wide posterior emargination on the lingual side, a situation akin to *My. f. kaguyae* (see Fig. 3. of Tsytsulina & Strelkov 2001).

First upper premolar small, similar in height to incisors, and aligned in toothrow; second premolar minute and fully (Pakistani specimen) or partly displaced inwards and still visible in lateral view (Uttarakhand specimen) (Fig. 17). Third premolar and molars more robust, but low. Lower incisors of similar height; the first and second tricuspidate, the third with four cusps. The three lower premolars are in a row, not particularly crowded, the second being shorter than first. Three lower molars robust, taller than upper ones and all myotodont; entoconid much higher than hypoconoid. Mandible robust; angular process short and nearly as long as high; coronoid process low, linked to condyloid process by an almost horizontal ridge.

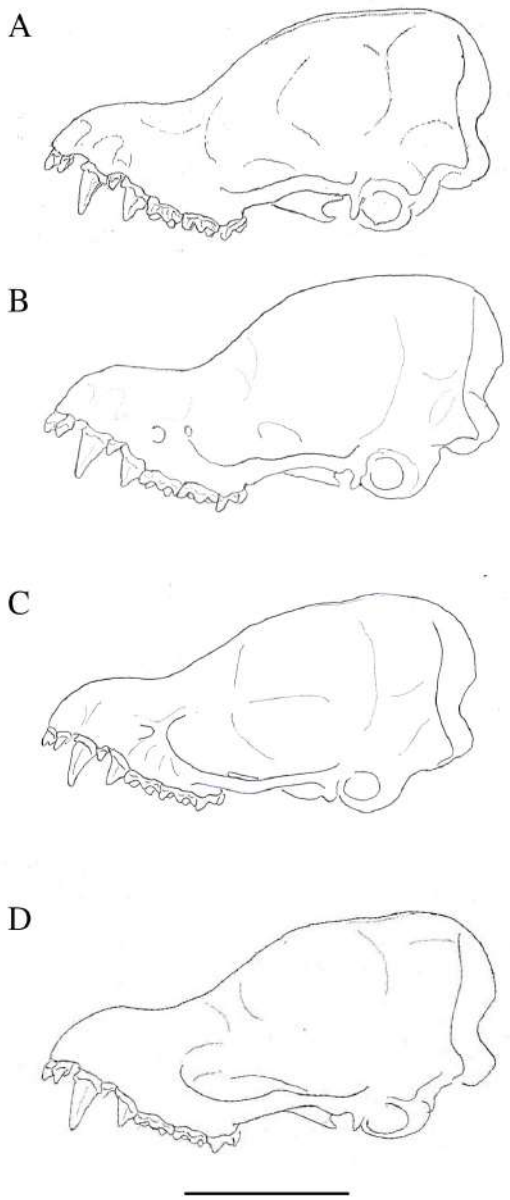

FIGURE 18. Lateral views of skulls of A) *My. himalaicus* **sp. nov**. (holotype, ZSI–NERC V/M/ERS/653), B) *My. soror* (holotype, HNHM–MAM 2003.36.20., C) *My. frater* (holotype, AMNH 48039), and D) *My. longicaudatus* (South Korea, HNHM–MAM 2003.37.44.) Scale= 5 mm.

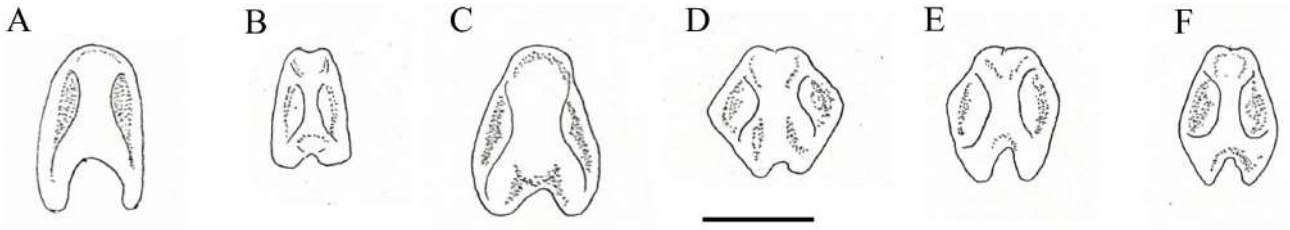

FIGURE 19. Dorsal views of bacula of A) *My. himalaicus* **sp. nov.** (holotype, ZSI–NERC V/M/ERS/653), B) *My. frater* (holotype, AMNH 48039), C) *My. l. longicaudatus* (Primorskij Kraj, Russia, collection and number unknown), D) *My. l. eniseensis* (holotype, ZIN 59603), E) *My. l. kaguyae* (Hokkaido, Japan, NSMT M18562), F) *My. bucharensis* (Samarkand, Uzbekistan, ZIN, collection number unknown). B= after Tsytsulina & Strelkov (2001), C, D, F= after Strelkov (1989), E= after Yoshiyuki (1989). Scale= 0.5 mm.

TABLE 4. Comparative measurements of *My. himalaicus* **sp. nov.** and other members of the *My. frater* species complex (from Tsytsulina and Strelkov 2001; Ruedi *et al.* 2015; our own data).

Metric parameter (in mm)	*My. himalaicus* **sp. nov.** V/M/ERS/653 & HNHM-MAM 99.14.5.	*My. bucharensis* (n=6–10)	*My. frater* (n=5)	*My. longicaudatus* (n=15–20)	*My. soror* (type)
Wt (g)	6.5		–	–	
HB	44.7, 43.8	48.7 (46–51)	–	44.5 (43–46)	48
TL	45.8, 49.9	49.5 (46–55)	–	44.7 (38–50)	41
FA	41.3, 41.7	41.4 (38–43)	–	37.9 (34.8–40)	42.1
HFCL	8.8, 9.9	8.4 (7.8–9.2)	–	7.46 (6–8.8)	7.6
TIB	21.3, 20.9	20.33 (19–22)	–	18.9 (17.7–20.5)	17.2
E	11.1, 13.1	12.9 (11.3–14)	–	10.8 (9.5–12.5)	11
TR	6.8, 7.4	–	–	–	6.0
3MT	39.7, 38.7	38.6 (37.4–39.1)	–	35.0 (32–36.8)	–
4MT	37.2, 36.8	37.0 (35.7–37.7)	–	33.6 (31–36)	–
5MT	36.7, 35.7	35.6 (34.7–36.7)	–	33.2 (30.1–35.7)	–
1PH3MT	14.1, 14.2	–	–	–	–
1PH4MT	10.9, 10.1		–	–	–
GTLi	13.98, 13.95	–	13.52 (13.19 –13.97)	13.89 (13.45 –14.47)	13.78
CBL	13.40	14.25 (13.9–14.6)	–	13.25 (12.9–13.6)	13.48
CCL	12.75, 12.51	13.40 (13.17–13.62)	12.29 (11.83 –12.71)	12.51 (12.18–12.84)	12.54
ZW	9.15, 9.08	–	8.73 (8.46–9.07)	9.01 (8.66–9.43)	8.91
BW	6.95,7.03	7.52 (7.2–7.7)	7.1 (6.82–7.33)	7.18 (6.82 –7.55)	7.21
MAB	7.26, 7.44	–	7.47 (7.25–7.84)	7.61 (7.07–7.83)	7.77
PoC	4.14, 4.05	4.25 (3.9–4.8)	4.02 (3.79–4.21)	3.99 (3.9–4.3)	4.07
AOB	0.94, 0.71	–	0.41 (0.25–0.59)	0.62 (0.46 –0.82)	
SKH	5.75, 5.35	–	5.31 (4.98–5.61)	5.39 (5.13–5.71)	5.23
CM^3	5.15, 5.40	5.44 (5.3–5.6)	5.01(4.76–5.19)	5.15 (5.0 –5.4)	5.20
M^3–M^3	5.99, 5.86	6.27 (6.0–6.72)	5.69 (5.59–5.85)	5.84 (5.6–6.0)	5.70
C^1–C^1	3.47, 4.13	4.16 (4.0–4.4)	3.9 (3.63–4.29)	4.06 (3.7–5.2)	4.20
M^1M^3	2.87	–	–	–	–
MLi	10.64, 10.31	–	9.88 (9.68–10.23)	10.0 (9.35 –10.67)	–
CM_3	6.00, 5.81	6.05 (6.0–6.2)	5.38 (5.07–5.60)	5.56 (5.2–6.0)	–
COH	3.06, 3.11	–	2.96 (2.90–3.01)	3.10 (2.65–3.29)	–

TABLE 5. Comparative measurements of the holotype of *Pi. babu* and that of Western and Central Himalayas, and topotypic material *Pi. javanicus* from Java. The external measurements and bacular length of the holotype of *Pi. babu* are based on Thomas (1915); data for the central Himalayan specimens are based on Csorba *et al.* (1999).

Metric parameter (in mm)	*Pi. babu* (type; Muree)	*Pi. babu* (Western Himalayas)	*Pi. babu* (Central Himalayas)	*Pi. javanicus* (Java)
Wt (g)	–	6.2 (5.7–6.8)	5.6 (5.0–6.0)	–
HB	46	45.8 (45–48)		–
TL	36	38.4 (36–40)	38.3 (37.0–41.0)	–
FA	33.5	34.1 (33.2–35.2)	34.5 (32.9–36.6)	–
HFCL	6.4	6.1 (5.9–6.7)	5.7 (5.3–6.2)	–
TB	12.3	13.2 (12.2–13.9)	13.6 (13.3–14.2)	–
E	11.5	13.1 (12.4–13.6)	13.0 (12.7–13.2)	–
TR	–	5.6 (4.9–6.3)	–	–
3MT	32	33.2 (32–34.1)	–	–
4MT	–	33.2 (32–33.6)	–	–
5MT	30	32.2 (31–33.6)	–	–
1PH3MT	12.7	13.8 (12.9–14.3)	–	–
2ph3MT	–	17.4 (16.3–18.8)	–	–
1PH4MT	–	12.9 (12.3–13.9)	–	–
2PH4MT	–	9.9 (9.4–10.9)	–	–
GTLi	13.62	13.6 (13.4–13.9)	13.0–13.7	13.02
CCL	12.48	12.4 (12.0–12.7)	12.5–13.2	11.66
ZW	–	8.6 (8.1–9.0)	–	8.26
BW	6.59	6.5 (6.4–6.7)	–	6.61
MAB	7.52	7.4 (7.3–7.5)	7.3–7.7	7.43
PoC	3.6	3.7 (3.7–3.8)	–	3.78
CM^3	5.04	4.9 (4.8–5.1)	4.9–5.3	4.61
M^3M^3	5.76	6.1 (5.9–6.1)	–	5.60
C^1C^1	4.39	4.4 (4.2–4.7)	–	4.46
M^1M^3	–	3.2 (3.1–3.4)	–	–
MLi	9.73	9.9 (9.7–10.2)	9.8–10.2	9.03
CM_3	5.24	5.1 (5.1–5.4)	5.3–5.4	4.95
M_1M_3	–	3.5 (3.3–3.7)	–	–
COH	2.63	2.8 (2.7–2.9)	–	2.78
Baculum length	c. 6	5.5–5.8	–	–

The baculum is minute, about 0.5 x 0.7 mm. It is shovel shaped and highly convex on the dorsal surface where a well defined and wide medial dorsal ridge is present. The tip tapers abruptly and ends flat; base with a wide, deep, and rounded emargination (Figs 14D and 19A).

Comparisons: The long tibia and tail, short and broad ears and a skull with short rostrum, raised frontal parts of braincase and inward displaced second upper premolars of *My. himalaicus* **sp. nov.**, are typical morphological characters defining taxa in the *My. frater* species complex (Tsytsulina & Strelkov 2001). We therefore restrict our comparisons within this group of *Myotis* species.

TABLE 6. Echolocation call parameters of selected bat species from the Western Himalayas.

Species	N	Start frequency (kHz)	End frequency (kHz)	Peak frequency (kHz)	Bandwidth (kHz)	Duration (ms)
Rh. affinis	1			79.65		46
Rh. lepidus	1			100		24.42
Rh. perniger	1			31.06		36
Rh. macrotis	1			62.36		18
Rh. sinicus	1			86.91		33
Ba. darjelingensis	3	42.73 ± 4.8	21.44 ± 2.15	32.62 ± 5.96	21.28 ± 4.5	6.37 ± 1.71
Hy. affinis	1	66.63 ± 3.88	25.89 ± 0.63	30.51 ± 0.45	40.74 ± 3.81	4.67 ± 0.52
Hy. savii	1	82.34	29.2	42.11	53.14	2.75
Ep. pachyomus	1	57.87	23.48	32.017	34.38	2.71
My. sicarius	1	71.96	33.14	37.41	38.81	5.125
Mu. cf. *aurata*	2	159.8 ± 6.7	51.74 ± 11.74	88.91 ± 6.68	108.05 ± 5.16	3.44 ± 2.34
Mur. huttonii	1	117.5	49.82	62.82	67.68	2
My. muricola	1	110.11	43.37	55.17	66.37	3
Su. caliginosus	1	115.01	53.6	58.28	61.41	5.62
Ny. leisleri	5	24.35 ± 2.04	52.95 ± 9.34	27.3 ± 2.32	28.59 ± 8	11.56 ± 2.8
Pi. babu	36	82.26 ± 6.69	35.28 ± 1.91	40.16 ± 2.62	46.98 ± 6.30	5.69 ± 1.77

Externally, *My. himalaicus* **sp. nov.** is easily distinguished from the arid form *My. bucharensis* by its much darker pelage, both above and below (see e.g., Kazakov *et al.* 2020) and by its darker bare parts of skin. *My. bucharensis* also differs by the distinct fronto–labial groove in the upper canine and relatively long rostrum (e.g., CCL >13 mm; Tsytsulina & Strelkov 2001) vs. without such groove, and shorter rostrum in *My. himalaicus* **sp. nov.** (e.g., CCL<12.8 mm; Table 4).

The Taiwan endemic *My. soror* is distinctive by having a rich cinnamon and grizzled fur, a tragus that does not reach the posterior notch of ear, and shorter (<20 mm) tibia (Ruedi *et al.* 2015).

The thick and dark brown fur of *My. himalaicus* **sp. nov.** is, however, similar to the more temperate–distributed taxa *My. frater* and *My. longicaudatus* (Kazakov *et al.* 2025). Nevertheless, based on field measurement reported in Chakravarty *et al*. (2020), overall size of *My. himalaicus* **sp. nov.** (e.g., FA 39.5–43 mm, tibia 20.1–21.6 mm) is larger than that of *My. longicaudatus* (FA typically <40 mm, tibia <20.5 mm; Tsytsulina & Strelkov 2001). *My. frater* also has a shorter forearm length (FA <40 mm) as compared with *My. himalaicus* **sp. nov.**

The distal part of the baculum of *My. himalaicus* **sp. nov.** (Fig. 19A) is unique for the species–group having a deep and wide emargination (versus much more reduced posterior emargination in the other species; see Fig. 5 in Tsytsulina & Strelkov 2001; Figs 19B-F).

The short sequence of the COI mitochondrial gene obtained from the holotype is almost identical (one single transition mutation) to longer sequences reported previously for *My. himalaicus* **sp. nov.** (GB MN339184 and MN714904, labelled as *My*. cf. *frater*, Chakravarty *et al*. 2020) and divergent from any other homologous sequences in the *frater* group (and of any *Myotis*), except *bucharensis,* which has not been investigated for this gene. According to another mitochondrial locus (CYTB), *My. bucharensis* is phylogenetically sister to *My. longicaudatus* (Kazakov *et al.* 2020), whereas according to the COI marker, *My. himalaicus* **sp. nov.** appears sister to *My. soror* (Chakravarty *et al.* 2020) or more basal to the whole group (Fig. 4). The resolution of current molecular reconstructions is, however, still insufficient to place this new species in a definitive phylogenetic position within the *frater* species complex.

Distribution and ecology: *My. himalaicus* **sp. nov.** is the only species of the *frater* complex known so far to inhabit the Indian subcontinent. Apparently, it is endemic to the southern slopes of the Western Himalayas and Hindu Kush mountains and recorded so far only in Uttarakhand, India and Khyber Pakhtunkhwa, Pakistan. According

to Chakravarty *et al*. (2020) *My. himalaicus* **sp. nov.** was caught in primary oak and oak forest edge in Mandal, whereas in Devalsari, a female was caught at the intersection of scrub–covered hills and cedar forest. The Khyber Pakhtunkhwa record came from an old–grown pine forest. Going by these records, it occurs in a variety of forested habitats at elevations between 1500–2300 m but appears uncommon. Other species of bats caught in the same area on the nights when the holotype of *My. himalaicus* **sp. nov.** was caught include *My. muricola, Mu. cyclotis, Ep. pachyomus* and *Pi. babu.* The Khyber Pakhtunkhwa specimen was mist–netted together with *Mu. tubinaris*. Nothing is known about its natural history besides that none of the individuals caught during July in Pakistan and May in Uttarakhand were in breeding condition. The echolocation calls recorded from four released individuals in Mandal emitted frequency modulated calls starting at 96.8 ± 3.15 kHz and ending at 47.9 ± 3.13 kHz, with maximum energy at 68.0 ± 3.86 kHz (Chakravarty *et al*. 2020). Its calls are hard to distinguish from the syntopic *My. muricola.*

18. *Myotis sicarius* Thomas, 1915

(Mandelli's Mouse–eared Bat)

New material: A released male caught at Mandal, Chamoli district, Uttarakhand in mid–April 2019.

Morphological description of specimen: An adult male was caught in a mist net set over a shallow, shaded stream along the edge of an oak forest. This relatively large *Myotis* had a forearm of 50.9 mm and 10 g body weight. The specimen was identified in the field by its size, the ratio of the lengths of hindfoot to tibia and relatively large ears (but not as large as in *My. altarium*). The pelage consisted of short hairs that were dark brown to black above and smokey greyish black below (Fig. 15E), with a conspicuous yellowish patch surrounding the belly. These fur characteristics also differentiate it from the similar-sized *My. altarium*. The naked portion of the muzzle was flesh coloured while ears and wing membranes were dark brown. The wings were attached to the base of the toe which were covered with a few scattered hairs.

DNA: No biological material was obtained for this released specimen. However, Chakravarty *et al.* (2020) reported a COI sequence (GB MN339187) of another individual caught in the same place and provisionally identified as "*M.* cf. *annectans"*. This sequence was almost identical (a single mutation) to one *My. sicarius* from Nepal (GB OR413180) deposited recently by Győrössy *et al.* (2024), which confirmed their taxonomic identity as *sicarius*. Reference sequences from Indochinese *My. annectans* were genetically very distinct from *M. sicarius* (e.g., HM541011; Francis *et al.* 2010; Győrössy *et al*. 2024; Fig. 4).

Locality records and ecological notes: The present datum constitutes the first record of this species from the Western Himalayas, which is a significant geographic extension of this rare and vulnerable (Srinivasulu & Srinivasulu 2019b), so far localised species known from the Central and Eastern Himalaya (Bates & Harrison 1997) and (with a single record) from North Vietnam (Győrössy *et al*. 2024).

The call structure of the released specimen was narrowband (38.81 kHz bandwidth) with prominent FM and QCF components, resembling those of *Pipistrellus* sp. The release call had duration of 5.12 ms, an ending frequency of 33.14 kHz and peak frequency of 37.41 kHz (Table 13). In the study area its calls overlapped with those of *Pi. babu* (Chakravarty *et al.* 2020; see below).

Taxonomic notes: We correct here a previous preliminary identification of a bat reported as "*My.* cf. *annectans"* in Chakravarty *et al*. (2020) to *My. sicarius* in the light of the new specimen analyzed morphologically here, and to the COI sequence of a previous individual from Mandal which is nearly identical compared to a sequence from Nepal (i.e., close to the type locality in Sikkim, India).

19. *Myotis muricola* (Gray, 1864)

(Nepalese Whiskered Bat)

New material: Two released males caught at Chopta, Chamoli district, Uttarakhand, April 2018 and April 2019.

Morphological description of specimens: Two adult males were caught over a brook at the edge of a meadow in Chopta (2800 m). They were provisionally identified by their small size (FA= 36.3–37.7 mm), sooty black dorsal pelage and dark ventral pelage with silvery tips. The ears were slightly elongated with a rounded tip but without a prominent notch on the posterior margin and also lacking the projected arched lobe near the base of the ear that

are characteristics of *Su. caliginosus* with which the species was often mistaken (Ruedi *et al.* 2021). Tragus was straight, slightly bent forward, but not spatulated as in *Su. caliginosus* (compare Figs 15D and 15F). Hind feet were small (in comparison to tibia) and the wing attached to the base of the toe.

DNA: no biological material was obtained from this species.

Locality records and ecological notes: Uttarakhand: Ansuya (2000 m), Chopta (2800 m) and Mandal (1600 m) in Chamoli district of Uttarakhand (Chakravarty *et al.* 2020; present study). The record from Chirot (Thirot) in Lahaul & Spiti district of Himachal Pradesh (Lindsay 1927) and included as "*My. mystacinus"* in Bates & Harrison (1997) might either represent this species or other taxa (see below).

We recorded broadband (bandwidth= 66.37 kHz), short–duration (3 ms) echolocation calls with end frequency of 43.37 kHz. Passive recordings of free–flying bats in the site of capture show similar call characteristics but with longer duration and prominent QCF components (R. Chakravarty unpublished data).

Taxonomic notes: A constituent species of the *My. mystacinus* morphogroup, the taxonomic status of *My. muricola* in the Western Himalayas was obscure till recently. The species was believed to be widely distributed in the Oriental Region with a large number of taxa included in its synonymy (Bates & Harrison 1997; Srinivasulu & Srinivasulu 2019c). However, more recently it has been shown that at least in the Western Himalaya, *My. muricola* was confused with other similar looking but distinct species, *My. nipalensis* and *Su. caliginosus* (Ruedi *et al.* 2021). All three species were found to occur in sympatry, but the latter one appeared to be more common and widespread.

20. *Myotis nipalensis* (Dobson, 1871)
(Nepal Myotis)

New material: 1 M, 30.05.2017, over river Narag, Devthal, Solan district, Himachal Pradesh V/M/ERS/445.

Morphological description of specimen: An adult male was caught with a flap–net. This specimen had a walnut brown dorsum, and the ventral fur was grayish white (Fig. 15C). Dorsal hairs had a dark base and slightly lighter tip while the ventral hairs had light brown roots and whitish tips. The ears and patagium were dark brown. The ears were relatively long and with a broadly rounded tip, but devoid of notch at the rear edge. The tragus was slightly less than half the length of ear, almost straight on the inner side and convex on the outer margin. The thumb was long and slender with sharp claws. No visible calcar lobe was present, and the wing attached to the base of the toes.

Condylocanine length of our specimen measured 11.98 mm; the skull had a bulbous braincase with elevated rostrum compared to more flattened skull profile in *My. muricola* (Ruedi *et al.* 2021). The incisors were bicuspidate. The canine exceeded the height of the third upper premolar although not greatly. The anterior upper premolars lie within the toothrow contrary to the intruded second upper premolar in *My. muricola* (examined specimens from northeastern India).

DNA: The COI (GB MW054918) and CYTB (GB MW054881) sequences of this specimen were already reported in Ruedi *et al*. (2021) and showed closest genetic similarities with *My. annatessae* from Southeast Asia (Figs 4 and 6), but not with *My. muricola* or *My. mystacinus* with which *My. nipalensis* had often been confused (e.g. Kruskop *et al.* 2012).

Locality records and ecological notes: Uttarakhand: Pawalgarh (495 m) in Nainital district (Chakravarty *et al.* 2020). Himachal Pradesh: Devthal (963 m) in Solan district (present study). Because of the confusing taxonomic situation of *My. nipalensis* in classical accounts (e.g., Ellerman & Morrison–Scott 1966; Corbet & Hill 1992; Bates & Harrison 1997), the exact distribution of this Himalayan species is not precisely known (Ruedi *et al.* 2021). The adult male was caught with a flap–net while foraging over the river Narang in the early evening.

Taxonomic notes: The taxonomy of *My. nipalensis* has been much discussed since its description from Nepal by Dobson in 1871. It was variously included in the synonymy of *My. mystacinus*, *My. muricola* or more recently within *My. siligorensis* or *My. davidii* (see review in Ruedi *et al.* 2021). However, obvious external (e.g., strongly contrasting whitish ventral fur; unnotched ears), cranial (e.g., globose braincase) and genetic differences support species status for this distinctive bat (*op. cit*.).

21. *Myotis longipes* Dobson, 1873
(Kashmir Cave Myotis)

New material: 2 M, 01.06.2017, Salogra cave, Solan District, Himachal Pradesh, V/M/ERS/ 438, 439; 1 M, 1 F, 01.06.2017, Saproon cave, Solan District, Himachal Pradesh, V/M/ERS/ 440, 441; 1 M, 03.06.2017, Temple cave Karol, Solan district, Himachal Pradesh, V/M/ERS/ 442.

Morphological description of specimens: A number of individuals of this small *Myotis* (FA 36.6–37.2 mm) were caught in three different caves of Solan district. The overall pelage appeared brownish dorsally and buff coloured verntrally (Fig. 15B). Dorsal hair basis were darker brown while the tips were light brown. Muzzle, ears, and wing membranes were dark brown. Ears were tall, narrow and pointed with a straight and pointed tragus, little less than half of pinna length. Feet were comparatively large at 8.5 mm and covered with scattered hairs. The wings joined to the base of metatarsus, not to the base of toes as in other small Myotinae from the area. The skull had a maximum length of 14 mm, and the bulbous braincase was distinctly elevated from the flat rostrum. Teeth were weak, especially canines which barely exceeded the height of third premolars (Fig. 20A).

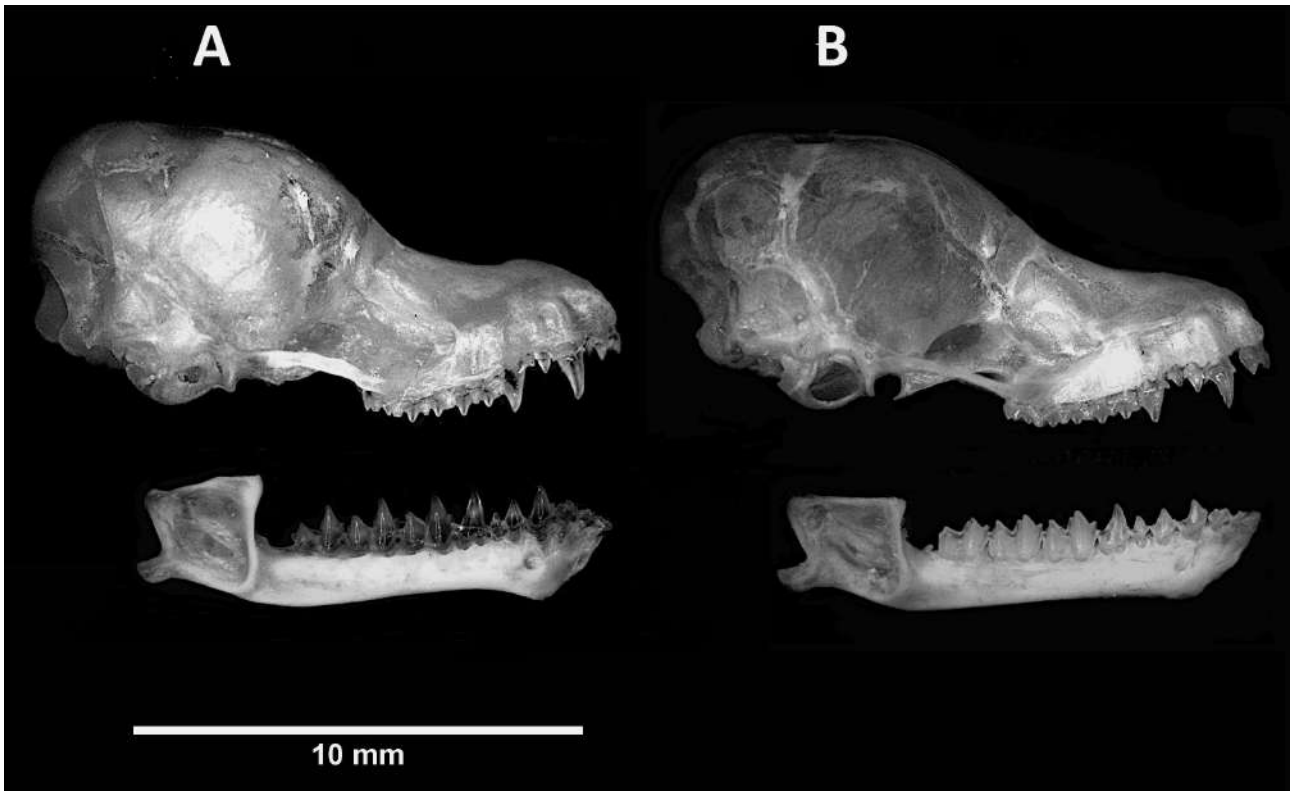

FIGURE 20. Lateral view of cranium and mandible of A) *My. longipes* from Himachal Pradesh (ZSI–NERC V/M/ERS/438), and B) *My. laniger* from Meghalaya (ZSI–NERC 371).

The baculum was minute with a length of 0.32 mm and width of 0.12 mm at the base. It had a pointed tip which gradually widened proximally for about 0.15 mm and then markedly so for the rest of its length to form a triangular shape. The base was arched (Fig. 14G).

DNA: The COI (GB MW054907 and MW054908) and CYTB (GB MW054878 and MW054879) sequences of two specimens from Himachal Pradesh (M2210/V/M/ERS/440 and M2219/V/M/ERS/442) were already reported in Ruedi *et al*. (2021). Genetic comparisons showed that they were nearly identical to topotypic material of *My. longipes* from Kashmir or to the paratypes of *My. csorbai* from Nepal, indicating that all these sequences represent a well supported clade of a single species. They were, however, distinct from *My. laniger*.

Locality records and ecological notes: Uttarakhand: Benog WLS (1755 m) and Woodstock School (1787 m), Dehradun district and Mandal (1530 m), Chamoli district. Himachal Pradesh: Cave at Mount Karol (1980 m); Saproon (1550 m) and Salogra (1440 m), Solan district (present study). Saikia *et al.* (2011) reported "*My. mystacinus"* from these localities in Himachal Pradesh, but the referred specimens were re–identified as *My. longipes* (Ruedi *et al.*

2021). All Himachal Pradesh specimens were collected from day roosts inside caves which were also being shared with other species. In two of these caves, the colony size was estimated to exceed over 500 individuals whereas in Karol temple cave, there were smaller numbers intermixed with *Rh. sinicus* and *Rh. lepidus*. Some of the females were carrying pups. In Uttarakhand, this bat was caught in mist nets while trawling over stream or brooks in oak forest (Chakravarty *et al.* 2020).

Taxonomic notes: Morphologically, *My. longipes* and *My. laniger* are very similar large–footed bats and were often associated to other trawling *Myotis* such as the European *My. capaccinii* or *My. daubentonii* in early accounts (Ellerman & Morrison–Scott 1966; Corbet & Hill 1990). Topál (1997) clarified the situation based on careful comparisons with topotypical material of all these species and showed that all were externally similar but cranially distinct. This morphological resemblance, however, resulted in erroneous reporting of *My. longipes* in northeastern India (Bates & Harrison 1997; Sinha 1994; Ruedi *et al.* 2012; Saikia *et al.* 2018) or further east throughout China (Liu *et al.* 2023). To clarify this issue further, we critically examined the recent specimens of "*My. longipes"* (=*laniger*) from Meghalaya in the collection of V/M/ERS/ (which formed the basis for records in northeastern India) and compared them with series of true *My. longipes* from the Western Himalayas. We noted that the dorsal coat colour of *longipes* was little lighter than *laniger* with the latter having a dark glossy sheen. The ventral fur of *My. longipes* looked beige compared to the greyish ventrum of *My. laniger*. For both species, wings joined at the base of the metatarsus. However, while the feet of *My. longipes* were covered with a few scattered hairs, they were much hairier in *My. laniger*. External dimension of *My. longipes* were very similar to *My. laniger* except for larger ears in *My. longipes* (average 15.5 mm against 12.8 mm in *My. laniger*). Compared with *My. laniger*, the cranial dimensions of *My. longipes* were slightly smaller **(**Table S4**).** The braincase in both species were bulbous but more so in *My. laniger* (Fig. 20B) with wider post–orbital constriction (3.5–3.9 mm against 3.3 mm in *My. longipes*). *My. longipes* also had a wider lachrymal bridge (1.06 mm) than *My. laniger* (0.93 mm) as noted by Topál (1997). The anterior dentition was weak in both species with a small canine which was almost at the level of third premolar's height (Fig. 20). However, the molars in *My. longipes* appeared wider and stronger than in *My. laniger*. Lower molars were myotodont in both species.

The baculum structure of the two species differed significantly. In *My. longipes*, the baculum was minute and resembled to an arrowhead with a slightly roundish tip. There was a roundish indentation at the base, which was more pronounced dorsally. The length of baculum varied from 0.32–0.36 mm and 0.17–0.20 mm in breadth. This conforms well to the bacular description of specimens from the type locality (Bumzov cave, Kashmir) in Srinivasulu *et al.* (2020). In contrast, the baculum of *My. laniger* was shovel shaped and dorsally convex and measured 0.75 mm in length (V/M/ERS/371).

These comparisons confirmed earlier claims of Topál (1997) that *My. longipes* in the Western Himalayas and *My. laniger* in Eastern Himalaya (and further east to China) are morphologically distinct. This conclusion was also strongly supported by molecular analyses (Ruedi *et al.* 2021). As far as we know, *My. longipes* is distributed in the western Himalayan states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand, the easternmost recorded locality being Ansuya Devi in Kedarnath WLS (Chakravarty *et al.* 2020). However, according to the above–mentioned genetic results, records of *My. csorbai* from Nepal (Topál 1997; Dahal *et al.* 2024) might also represent *My. longipes* (as a distinct subspecies) and would be its most oriental occurence. The exact geographic boundary between *My. longipes* and the similar looking *My. laniger* in the Himalaya clearly needs further investigations based on vouchered or genetically identified specimens.

22. *Murina* cf. *aurata* Milne–Edwards, 1872

(Little Tube–nosed Bat)

New material: Five released individuals: 1 M, 04.04.2018, Mandal village; 1 F, 13.04.2018, Ansuya; 1 M, 31.03.2019, Mandal; 1 M and 1 F, 27.04.2021, Kanchula, Chamoli district, Uttarakhand.

Morphological description of specimen: All individuals were identified in the field by their small size (FA=27.0–30.5 mm), long, dense, blackish hairs with golden tips, and lack of emargination on the posterior border of the ear.

DNA: no biological material was obtained from this species.

Locality records and ecological notes: An adult male was caught over a pool of water in dense primary oak

forest in April 2018 in Mandal village (1600 m) in Chamoli district. Another male was caught over a shallow, shaded stream at the edge of an oak forest in the same area. In Ansuya and Kanchula, several individuals were caught in clearings in oak and mixed oak–maple forests respectively. Chakravarty *et al.* (2020) reported the occurrence of a further individual from Ansuya (2000 m). The two females caught in Ansuya and Kanchula were pregnant. These Uttarakhand records are the only known from Western Himalayas, while the species was reported in Nepal, Sikkim, and further east in China (Bates & Harrison 1997; Wang *et al.* 2025). The Laos and Vietnam records of *Mu. aurata* (Kruskop 2005; Francis *et al.* 1999; Francis *et al.* 2010) were based on mis–identified specimens (Kruskop 2013; Thomas *et al.* 2013).

Taxonomic notes: There are several small species of *Murina* (*Mu. aurata*, *Mu. balaensis*, *Mu. chrysochaetes*, *Mu. eleryi*, *Mu. gracilis*, *Mu. harpioloides*, *Mu. yushuensis*) with different intensity of shiny golden colour in the dorsal pelage; the diversity of this group is only just beginning to be understood. Their identification is only possible by integrated analysis of cranial and dental traits and DNA sequences. Since no such data are available for the specimens reported here, their classification as *Mu.* cf. *aurata* is tentative and based solely on the known distribution of the species described so far in the *aurata* group; the question can only be decided by detailed examination of additional specimens.

23. *Murina cyclotis* Dobson, 1872

(Round–eared tube–nosed bat)

New material: 1 M, 10.06.2017, Kandaghat, Solan District, Himachal Pradesh, V/M/ERS/425.

Morphological description of specimen: Our specimen had a forearm length of 31.7 mm. The pelage was long and woolly, the dorsal colouration was bright orange, and the ventral fur was beige–white with slightly darker roots (Fig. 11F). The ears were light brown, the anterior border was concave and the posterior one slightly convex without emergination. Ears had broadly rounded tip. The outwardly protruding nostrils were very prominent. The muzzle was flesh coloured with a few whiskers on both lips. The dorsal side of the interfemoral membrane was densely covered with hairs. The feet were also covered with long orange hairs.

DNA: The COI sequence of this specimen (M2260 /V/M/ERS/425) was very distinct from any *Murina* sequence available in the GenBank, the closest match being a series of *Mu. guilleni* haplotypes from Peninsular Thailand (e.g., GB KY034137) at over 10% sequence divergence (Table S2). All other *Mu. cylotis* s.l. were separated by over 13% K2P distance from the Himachal Pradesh individual. The same pattern was observed with a CYTB sequence of this Himachal Pradesh individual, which was closest to one sequence of *Mu. cyclotis* from Cambodia (GB GQ168916) at 13.2% K2P (Table S3).

Locality records and ecological notes: Chakravarty *et al.* (2020) recorded this bat from Devalsari (1698 m) in Uttarakhand which was the first report of this species from Western Himalayas. The present new specimen is the first record from Himachal Pradesh (at Kandaghat, 1560 m) extending the distribution of *Mu. cyclotis* westwards in the Western Himalayas. This individual was caught in a harp trap which was set in an opening of mixed pine forest (*Pinus roxburghii* and *Quercus* spp) along a railway track where *Mu. huttonii* was also caught in the same night. In Uttarakhand, this species was caught in a mist net in the intersection of *Cedrus deodara* dominated forest and scrub–covered hills (Chakravarty *et al.* 2020).

Taxonomic notes: *Mu. cyclotis* belongs to a clade consisting of several mitochondrial lineages but showing surprisingly uniform morphology including external and craniodental features. New taxa recently described from the Indomalayan Region and the Nicobar Islands (e.g., Francis & Eger 2012; Soisook *et al.* 2013) are no exceptions. The craniodentally similar *Mu. pluvialis* from Meghalaya can be easily distinguished by its very dark bases in dorsal and ventral hairs (Ruedi *et al*. 2012) and is also very distinct genetically (>20% K2P, e.g., from specimen M2052/V/M/ERS/353). Eastern India (Darjeeling) being the type locality for *Mu. cyclotis*, the available records from Meghalaya could best represent the nominal species, but the CYTB sequence of one of these specimens (GB JQ044691) differed by 15.1% K2P from the Himachal Pradesh haplotype (Table S2). Other sequences available and labelled as "*cyclotis*" in the GenBank and sampled further east were also quite divergent (>13% K2P). Compared to mammalian standards (Bradley & Baker 2001) these divergence values are considerable and suggest additional taxonomic diversity. Other workers also found high genetic diversity of *Mu. cyclotis* within Southeast Asia and opined that the form found in Indochina is not the same as that from the type locality in India (Francis & Eger 2012).

23. *Murina huttonii* (Peters, 1872)
(Hutton's tube–nosed Bat)

New material: 1 M, 10.06.2017, Kandaghat, Himachal Pradesh, V/M/ERS/424; 1 M, 2.06.2017, Mount Karol, Solan District, Himachal Pradesh V/M/ERS/443; one released male, Ansuya (KWLS), Uttarakhand, 01.05.2019.

Morphological description of specimens: The pelage of the two examined Himachal Pradesh specimens was thick and soft. The Kandaghat specimen had a light brown dorsal fur with lighter tips while the ventral fur was grayish white with faint brown roots (Fig. 11G). The ears and muzzle were light brown. The specimen from Mount Karol was also similar in appearance except for the muzzle which was little darker with dark brown hairs and the ventral hairs had brownish roots. The pelage of one released animal from Uttarakhand was darker dorsally and had fawn coloured venter (Fig. 11H). Such colour variation among individuals of this species was noted earlier and calls for further studies for possible cryptic diversity (Son *et al.* 2015). The anterior border of the ears was slightly concave while the posterior border was little concave in both morphotypes. The interfemoral membranes were naked below but the feet were hairy.

The cranium was comparatively large with an average GTLi of 18.3 mm and dentition was robust. The mandibles were strong with a highly elevated coronoid process (Fig. 21A).

The baculum was almost rectangular with slightly narrower distal end which was broadly rounded off (Fig. 14I). There were concavities at both the ends but the one at the base was more acute. In dorsal profile, it was convex while the ventral surface was concave, partly damaged in our specimen). The baculum of specimen V/M/ERS/443 was 1.11 mm long and 0.61 mm wide at the base.

DNA: The COI sequences from the two Himachal Pradesh individuals (M2261/V/M/ERS/424 and M2218/V/M/ERS/443) were identical to each other and were also identical or very similar to two sequences from near the type locality in Uttarakhand (GB MN339182 and MN339183; Chakravarty *et al.* 2020). These genuine *Mu. huttonii* haplotypes diverged more extensively (> 6.8%; Table S2) from sequences of bats assigned to *M. huttonii* from China (e.g. GB KU521385 or MN549054) or Indochina (e.g., GB KF772784; Fig. 4). The CYTB of the same two individuals from Himachal Pradesh likely diverged considerably from other sequences, the closest match being haplotypes of *Mu. puta* from Taiwan (e.g., GB GQ168901) at 8% sequence divergence (Table S3 and Fig. 6).

Locality records and ecological notes: Uttarakhand: Ansuya (2000 m) in Chamoli district; Dhanaulti (2114 m) in Tehri–Garhwal district; Lansdowne (1615 m) in Pauri–Garhwal district; Khati (2320 m) in Bagheswar district (Wroughton 1914; Chakravarty *et al.* 2020). The earlier records of *Mu. leucogaster* from Devalsari (1698 m) in Tehri–Garhwal district (Chakravarty *et al.* 2020) also possibly belongs to this species. Himachal Pradesh: Kandaghat (1560 m) and Mount Karol (1850 m) in Solan district (present study); unspecified locality in Chamba district (photographic evidence). We caught one specimen in a harp–trap set in a gully amongst pine forests while another was caught in harp trap set in a pine forest opening. Tube–nosed bats are known to be forest dwellers and our catches in Solan also point to this habitat preference. Interestingly, the Chamba animal was caught while entering a village house surrounded by farmlands and some tree strands. Few bats have reportedly been living in the space between stone slates and wooden roof of the house for a couple of years and returned to the same place even after evicted once by the owner (R. Kapoor, *pers. comm*.). In Uttarakhand also, these bats were mist netted in pine or oak forests (Chakravarty *et al.* 2020).

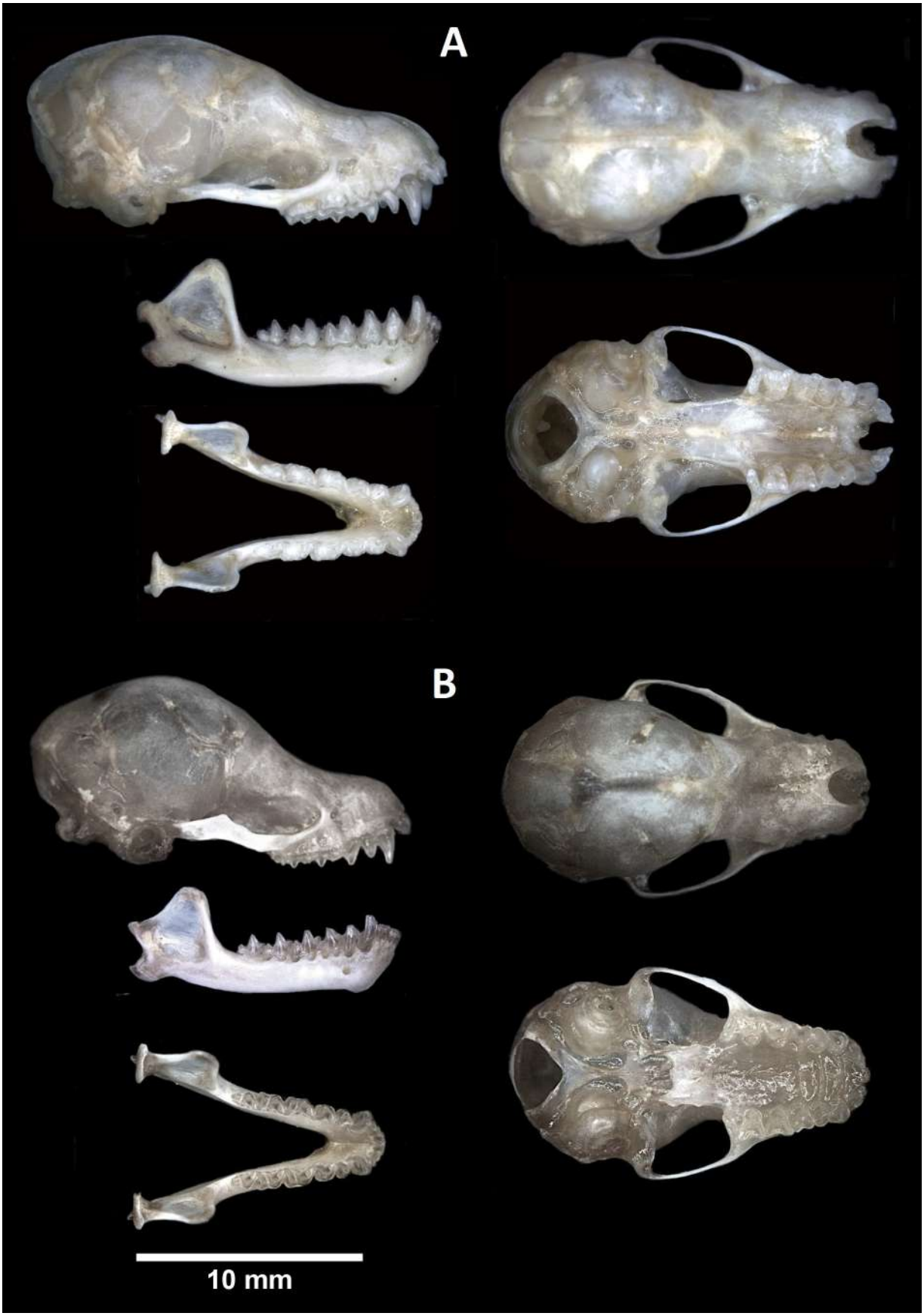

FIGURE 21. Dorsal, ventral, and lateral view of cranium and lateral and ventral view of mandible of A) *Mu. huttonii* (ZSI–NERC 443), and B) *Mu. cyclotis* (ZSI–NERC V/M/ERS/425) from the Western Himalayas.

Taxonomic notes: The relatively large genetic distance (>6.8% K2P) measured between the topotypic material from Western Himalayas and numerous specimens sequenced from China and Indochina certainly underscores further taxonomic diversity in this Oriental Region (Chakravorty *et al.* 2020). Interestingly, the Taiwanese endemic *Mu. puta* is genetically the least divergent (about 8% K2P) from Indian samples of *Mu. huttonii* for both COI and CYTB markers (Figs 4 and 6).

24. *Nyctalus leisleri* (Kuhl, 1817)

(Lesser Noctule)

New material: 2 M, 07.06.2017, Narkanda, Shimla District, Himachal Pradesh, V/M/ERS/413, 414; two released individuals from Narkanda, nine released individuals from Ansuya, and one released individual from Kanchula, Chamoli district, Uttarakhand.

Morphological description of specimens: A medium sized species with an average forearm length of 44.7 mm in the measured Himachal specimens. The dorsal pelage was rufous brown with dark hair roots while the ventrum was distinctly lighter brown but also with darker roots. The ears were triangular in profile with a short, curved tragus and dark brown in colour (Fig. 15G). The space between ears and eyes were sparsely haired. The interfemoral membrane was also dark brown and hairless. It joined the feet at the base of the digits. There was a prominent calcar lobe. The fifth metacarpal was distinctly shorter than the third and fourth.

In the upper jaw, the first upper premolar was small and slightly intruded so that the canine and the second premolar were almost in contact, a character that is more akin to *Ny. montanus* than to *leisleri* (Bates & Harrison 1997). However, the first premolar of the lower mandible is similar in size to the second, which is typical of *leisleri*, not of *montanus* (op. cit.).

The baculum was thin and long (6.8 mm). The shaft was straight with a slightly enlarged roundish tip while the proximal end enlarged and bifurcated by a deep emergination into two halves. The width at the base was 0.91 mm. In lateral view, the distal and proximal ends were bent to produce a curved appearance (Fig. 14E).

DNA: The COI sequence of one specimen from Himachal Pradesh (M2226 /V/M/ERS/413) was not only very similar (about 1% K2P) to haplotypes from Uttarakhand (GB MN339189 and MN714905) or Pakistan (GB MK091913), but also to *Ny. leisleri* sampled in the Western Palaearctic region (e.g., from Switzerland GB OQ706660; Table S2; Fig. 4). The same pattern of low genetic divergence was obtained with a sequence of the CYTB from this Himachal individual (Fig. 6), which proved to be very similar (1.3% K2P) to European samples as well (e.g., GB OQ885404; Table S3). Unfortunately, there are no sequences of *Ny. montanus* available in public repositories, so its genetic distinctness from *Ny. leisleri* cannot be evaluated.

Locality records and ecological notes: Uttarakhand: Bajawala (638 m) in Dehradun district; Devalsari (1698 m), Dhanaulti (2114 m) and Maldevta (846 m) in Tehri–Garhwal district; Dogalbita (2370 m) in Rudraprayag district; Mandal (1600–1800 m), Ansuya (2000–2200 m), and Kanchula (2500 m) in Chamoli district; Katarmal (1380 m) in Almora district; Pangot in Nainital district (Bhat1974; Chakravarty *et al.* 2020; present study). Himachal Pradesh: Kothi, Kullu district and Narkanda (ca. 2700 m), Shimla district (present study; Bhat *et al.* 1983; Saikia *et al.* 2011). In Narkanda, a number of these bats were caught in a mist net set across an artificial waterhole while coming for drinking. Except for two male individuals, all the over 20 captured animals were either pregnant or lactating females which were released. Another 17 animals were also harp trapped and released from a nearby location including 16 pregnant or lactating females which indicate the presence of a maternity colony nearby. In Uttarakhand, these bats were caught flying over open streams or brooks in oak forest (Chakravarty *et al.* 2020). In Europe, foraging habit of this species over water bodies like drainage canals, streams and lakes is well documented (Shiel 2006; Spada *et al.* 2008).

25. *Pipistrellus babu* Thomas, 1915

(Babu's Pipistrelle)

New material: 2 M, 08.06.2017, Narkanda, Shimla district, Himachal Pradesh, V/M/ERS/434, 486; 1 F, 13.06.2017, Salogra, Solan District, Himachal Pradesh, V/M/ERS/452; 1 F, 10.06.2017, Derghat, Solan District, Himachal

Pradesh, V/M/ERS/483; 2 M, 4.06.2017, Sangla, Kinnaur District, Himachal Pradesh, V/M/ERS/484, 485; 1 M, 09.06.2017, Narkanda, Shimla District, Himachal Pradesh, V/M/ERS/486; 1 F, 11.06.2017, Kandaghat, Solan District, Himachal Pradesh, V/M/ERS/487; 1 M, 08.03.2019, Mandal, Chamoli district, Uttarakhand, V/M/ERS/639; 1 M, 10.04.2021, Mandal, Chamoli District, Uttarakhand, V/M/ERS/652.

Morphological description of specimens: All individuals had dark brown dorsal pelage speckled with russet brown hairs, especially on the flanks. The ventrum was lighter brown. Individual hairs on both sides were dark brown except for the tips which were slightly lighter (Fig. 22). The muzzle and ear were dark brown. The ears had four distinct ridges and were broadly triangular in shape. The tragus was of medium length and width, the anterior margin was almost straight while the posterior border was curved inward. The wings were attached to the base of the toes. Well–developed keels on calcars were present. All the examined males had a comparatively long (8–8.4 mm) pendulous penis, hirsute at the distal end (Fig. 22).

The skull had a relatively broad rostrum with a linear depression in the midline. The nasal notch was V shaped. In lateral view, the skull profile was straight except for the frontal region which gently elevated and then descended (Fig. 23A). The basisphenoid pits were deep and oval in shape. The posterior border of the palate had a small, pointed projection. The coronoid processes of mandibles were gently elevated from the condyle, however in one of our specimens (V/M/ERS/484), the coronoid process was raised at a higher angle although it did not exceed the lower canine in height.

The first upper incisors did not have an obvious secondary cusp. The second incisor was slightly shorter than the first. A strong secondary cusp in the canine was visible on all specimens. The first premolar was small and intruded in the tooth row, although visible from outside. The canine and second upper premolar were not in contact. All these characteristics conformed well to the descriptions and type of *Pi. babu* Thomas, 1915.

The bacula of three specimens (V/M/ERS/639, 484 and 486) from three different localities in Himachal Pradesh were thin and long (5.5–5.8 mm). The distal end bifurcated into a fork with prongs of variable length and the proximal ends gradually enlarged and divided into two halves by a deep grove. In lateral view, they appeared almost straight with forward curving ends (Fig. 24). The width at the base was 0.8–0.9 mm.

DNA: We sequenced the COI and CYTB of six individuals of *Pi. babu* from Himachal Pradesh (M2222/ V/M/ERS/485, M2223/V/M/ERS/484, M2225/V/M/ERS/486, M2264/V/M/ERS/483, M2265/ V/M/ERS/487and M2266/V/M/ERS/452). These sequences were all very similar (<1% K2P), and clearly represented a single species (Tables S2 and S3). COI sequences from an unidentified pipistrelle from Uttarakhand and reported by Chakravorty *et al*. (2020) as "*Pi.* cf. *ceylonicus"* was in fact identical to these Himachal specimens and thus also assigned here to *Pi. babu*. Furthermore, multiple sequences of both genes and labelled as "*javanicus*" in the GenBank were clustered in very distinct (>12% K2P distance) and non–monophyletic clades; (Figs 4 and 6). The Western Himalayan *Pi. babu* is thus genetically very distinctive from any other sequenced pipistrelle.

Echolocation call: We recorded the calls of 36 released individuals in KWLS. Echolocation calls were typical of *Pipistrellus* species with distinct FM and QCF components. On average the release calls were 5.7 ms long, with average bandwidth of 47 kHz, end frequency of 35 kHz and peak frequency of 40 kHz. These call characteristics overlapped with those of the much larger *My. sicarius* and may also be confusable with *Mirostrellus joffrei* calls emitted in clutter (Chakravarty *et al.* 2020).

Locality records and ecological notes: The type specimen of *Pi. babu* was collected from Murree (C. 3.9070°N, 73.3943°E, 2400 m) in Punjab province, Pakistan, in the Pir Panjal Range of Western Himalayas (Thomas 1915) and certainly represents its westernmost occurence. In India, this bat was reported in "Northern India and lower Himalayas. Other specimens were recorded from Gharial, Masuri, Simla, Kumaon, Nepal, Darjeeling, Sylhet, central Provinces" (Thomas 1915). Bhat (1974) recorded this species from Sukhidhang (1380 m) in Almora district, Srinagar (550 m) in Pauri, and Ghonti (920 m) in Tehri districts of Uttarakhand. We caught many individuals of this pipistrelle at several localities in Solan, Shimla and Kinnaur districts of Himachal Pradesh and in Chamoli district of Uttarakhand during the present surveys. The species is apparently common and widespread in the region. Csorba *et al.* (1999) reported specimens of *Pi.* "*javanicus" babu* from Sudame and Banthanti in Central Nepal with a note that they should be considered specifically distinct from *Pi. javanicus*. Hill & Harrison (1987) reported specimens of *Pi. babu* from Nepal and from Pashok in Darjeeling in Eastern Himalaya of India. Das (2003) reported the dimensions of a few specimens of *Pi. babu* from Darjeeling. The external characters and cranial measurements of Darjeeling specimens conform well to our present specimens from Himachal Pradesh. The Field Museum of Natural History, Chicago and the Natural History Museum, London hold specimens of this species from Sikkim,

Eastern and Western Assam (as *Pi. javanicus babu* in Bates & Harrison 1997). Our Western Himalayan specimens were recorded between elevations of 1500–3000 m whereas in Nepal, the species was recorded within elevations of 1500–2200 m (Csorba *et al.* 1999).

Taxonomic notes: The diagnosis of *Pi. babu* by Thomas (1915) was based on a suite of characters including the presence of a distinct post–calcarial lobe, moderately long penis and well developed baculum (about 6 mm in length), flatter muzzle, deep basial pits, faint secondary cusp to the first upper incisor and small, intruded first premolars; all these characters perfectly matched the examined specimens from Himachal Pradesh. However, Corbet & Hill (1992) were in the opinion that *babu* "cranially and dentally agrees with *javanicus*" and relegated the former as a subspecies of the latter. Most subsequent authors accepted this taxonomic arrangement and considered the two taxa as conspecific (i.e., Bates & Harrison 1997; Simmons 2005). Our direct comparison of the type specimen of *Pi. babu* and topotypic *Pi. javanicus* (BMNH 1907.11.21.2 and 1909.1.5.296, respectively) revealed the following distinctive cranial features between both taxa: rostrum flatter, cranial profile more evenly ascending in *Pi. babu* (vs. rostrum deeper, profile more sharply ascending forming a bulbous anterior neurocranium in *Pi. javanicus*; compare Figs 23A and 23B); first upper incisor without evident secondary cusp (vs. present); anteorbital bridge wider (vs. narrow); basisphenoid pits well outlined and deep (vs. shallow, less demarcated). These traits were already noted by Csorba *et al.* (1999) in specimens of *Pi. javanicus* from Vietnam versus *Pi*. cf. *javanicus* [= *Pi. babu*] from Central Nepal. We show here that the Himalayan specimens not only match the morphological description of *Pi. babu*, but also that they are genetically very distinct from any other sequenced pipistrelle (Figs 4 and 6) and thus represent an independent species. Although the specific distinctness of Himalayan *Pi. babu* is clear, the taxonomic status of the pipistrelles called "*javanicus*" in northeastern India and elsewhere in the Oriental Region is far from resolved and reflects the difficulties to assign an appropriate species name to these Asian pipistrelles (e.g., Francis *et al*. 2010; Kruskop 2013). For instance, a series of sequences labelled "*Pipistrellus javanicus*" from Pakistan (e.g., GB MT081426) were in fact 99% identical to multiple European samples of *Pi. kuhlii*, indicating identification errors. Other haplotypes for various genes labelleld " *Pipistrellus javanicus*" in GenBank also form multiple independent clusters which probably represent a taxonomic morass rather than a real polyphyly of a single species (Francis *et al*. 2010). To solve which of those clusters corresponds to genuine *Pi. javanicus*, topotypic material from Indonesia should be investigated.

26. *Plecotus homochrous* Hodgson, 1847

(Hodgson's long–eared bat)

New material: 1 M, 26.04.2021, Chopta, Chamoli District, Uttarakhand (V/M/ERS/654); 1 M, 27.04.2021, Kanchula Kharak, Chamoli District, Uttarakhand (V/M/ERS/655).

Morphological description of specimens: This is a medium–sized vespertilionid with forearm length of 36.2–39.4 mm in our measured specimens. As for all the congeneric species, it was instantly recognizable from its very distinctive long ears. The fur was long, buffy brown on the back and shorter ginger brown on the belly. The oval shaped ears joined over the forehead through a thin membrane. The ears were semi–translucent and had many prominent horizontal ridges and a semi–circular lobe projected from the base of the anterior border. The wings and tail membrane were light brown, hairless and the long tail was fully enclosed within the membrane. The wing attacheed to the mid metatarsus and calcar lobe was absent.

DNA: No biological material was obtained from these specimens, but COI haplotypes of *Pl. homochrous* from Uttarkhand (GB MN339194 and MN339195) were already reported by Chakravarty *et al.* (2020) and differed considerably from sympatric *Pl. wardi* (>12% K2P) or from *Pl. auritus* (>15% K2P; Table S2) with which it was previously associated (e.g., Bates & Harrison 1997). Fukui *et al.* (2020) obtained similar phylogenetic results with other mtDNA markers.

Locality records and ecological notes: Uttarakhand: Devalsari (1698 m), Dhanaulti (2114 m) in Tehri Garhwal district; Ansuya Devi (2000 m), Chopta (2800 m) and Kanchula Kharak (2510 m) and Shokharakh (3065 m) in Chamoli district; Phurkia (c. 3250 m) in Bagheswar district (Chakravarty *et al.* 2020; present study). Himachal Pradesh: Ratandi (2700 m), Shimla district (Bhat *et al.* 1983).

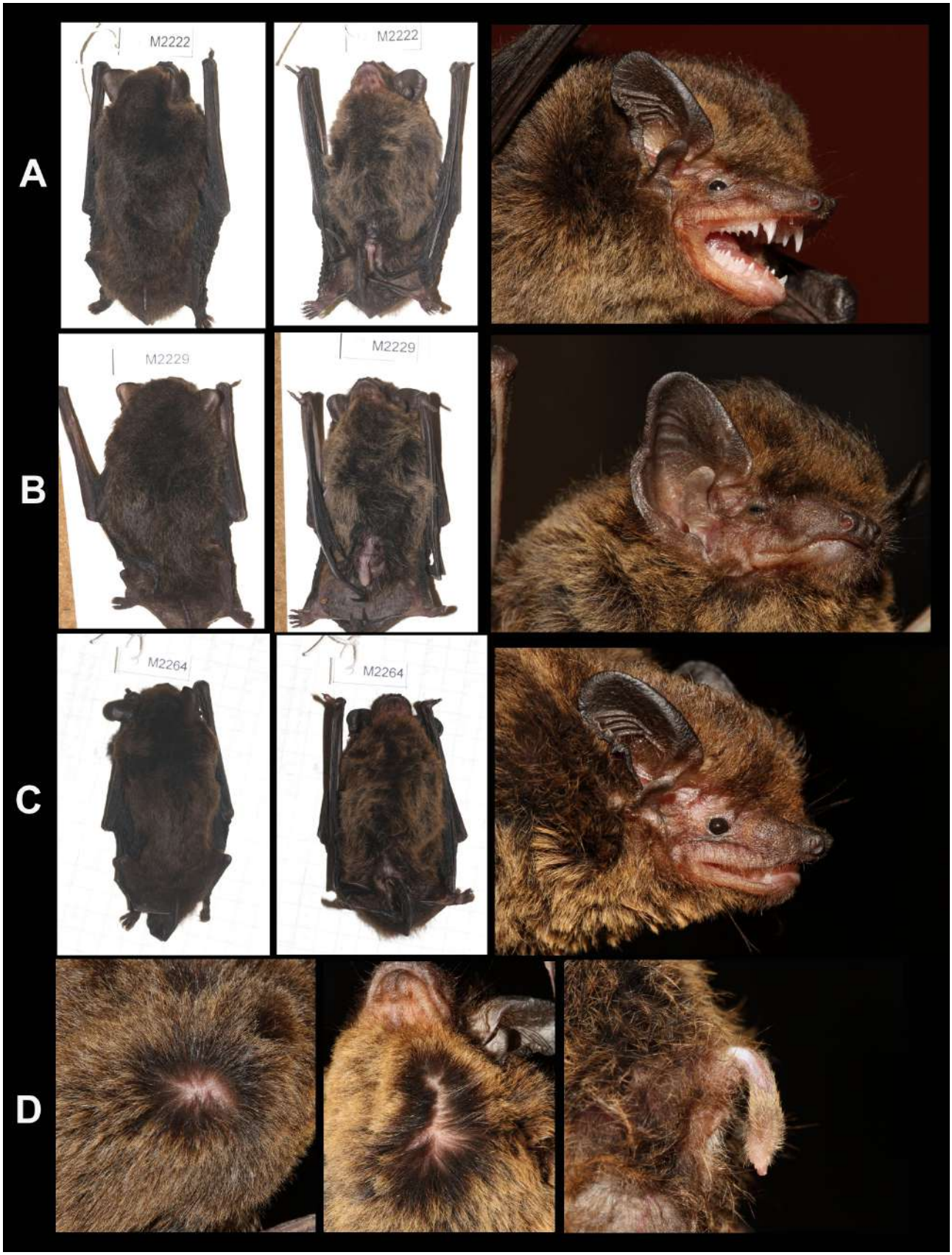

FIGURE 22. Pictures showing dorso–ventral pelage colouration and side profile of *Pi. babu* specimens from localities in different physiographic zones of Himachal Pradesh. A) Greater Himalaya: Sangla (ZSI–NERC V/M/ERS/485), B) Lesser Himalaya: Narkanda (ZSI–NERC V/M/ERS/435), C) Siwalik Himalaya: Kandaghat (ZSI–NERC V/M/ERS/487), D) Close–up view of dorsal, ventral pelage and the penis of ZSI–NERC 487 and calcar lobe of ZSI–NERC V/M/ERS/485 specimens.

The current specimens were taken from mixed temperate broadleaf forests and sub–alpine rhododendron forests. Previously in Uttarakhand, individuals were also caught in dense primary forests of oak, cedar, or sub–alpine rhododendron (Chakravarty *et al.* 2020). Although according to Spitzenberger *et al.* (2006), *Pl. homochrous* has been recorded in the southern slopes of the Himalayas generally at lower elevations than *P. wardi*, records of *Pl. homochrous* from Western Himalayas indicate it to be a highland species that often occurs in syntopy with *Pl. wardi* (Chakravarty *et al.* 2020). Additionally, four individuals were also collected at high elevation sites (2200 m) in northern Vietnam, suggesting that throughout its geographical range *Pl. homochrous* is a highland species (Fukui *et al.* 2020; Chakravarty *et al.* 2024).

27. *Plecotus wardi* Thomas, 1911
(Ward's long–eared bat)

New material: 1 F, 08.06.2017, Narkanda, Shimla District, Himachal Pradesh (V/M/ERS/415); 2 F, 10.05.2019 Tungnath, KWLS, Uttarakhand (V/M/ERS/632 and 634); 1 M, 26.04.2021, Chopta, Chamoli district, Uttarakhand (V/M/ERS/658).

Morphological description of specimens: A very distinctive bat with huge ears (32.5–42.6 mm) and medium–sized forearms (FA 41.9–45.6 mm). Tragus was spindle shaped and just short of half the length of ear. Dorsal fur (9.5 mm long) was beige or brown with darker roots while the ventral fur was creamy white with darker roots. Muzzle was flesh–coloured covered with scattered hairs. The patagium, interfemoral membranes were essentially naked except for the proximal ends. Feet were also covered with short hairs. The thumb was long (>7 mm) which can be used to differentiate externally this species from sympatric *Pl. homochrous* (thumb <5 mm) (Fig. 15H).

The braincase was slim, longish (GTLi ≥ 17.0 mm). From the rostrum, the braincase elevated almost in a straight line till the frontal region. The braincase was slightly bulbous in the frontal region and constricted in the parietal region. The tympanic bullae were quite enlarged (maximal diameter 4.75 mm) and frontally extended almost to the level of hamular process. The zygomatic arches were not flared, thin, and enlarged mid–dorsally. As compared with *Pl. homochrous*, *Pl. wardi* was considerably larger in craniodental measurements (Table S4) and had stronger dentition (compare Figs 25A-C).

DNA: The COI sequence of one specimen from Himachal Pradesh (M2259 V/M/ERS/415) was very similar (about 1.5% K2P) to haplotypes from Uttarakhand (GB MN339196) and proved to be unique among the plecotine bats analyzed so far (Fig. 4). They were most closely related to Central Asian *Pl. strelkovi* (Chakravarty *et al.* 2020), but very distinct from those of *Pl. austriacus* (>20% K2P) with which *wardi* had earlier been synonymized (e.g., Bates & Harrison, 1997).

Locality records and ecological notes: Uttarakhand: Martoli (3575 m) and Milam (3740 m) in Pithoragarh district; Shokharakh (3065 m) in Chamoli district and Tungnath (3500 m) in Rudraprayag district (Spitzenberger *et al.* 2006; Chakravarty *et al.* 2020). Himachal Pradesh: Narkanda (2700 m), Shimla district (present study). One lactating female was caught in a harp trap inside pine–fir forest in Narkanda. Another lactating female was caught near an artificial waterhole early in the morning in a flap net and was released. Capture of lactating females again indicates the presence of a maternity colony nearby. The Uttarakhand specimen was caught in a mist net in alpine meadow in mid–May and did not show any apparent sign of lactation. This is a high–elevation species with records so far from altitudes ranging between 1700 m (Hari Parbat, Srinagar, India) and 3750 m (Milam, Uttarakhand). In Uttarakhand, it occured in sympatry with *Pl. homochrous* at 3000 m. This species was not recorded below 3000 m in Kedarnath Wildlife Sanctuary (Chakravarty *et al.* 2020).

Taxonomic notes: The systematics of long eared bats of the genus *Plecotus* has been marred with uncertainity. Based on a global morphological and molecular revision Spitzenberger *et al.* (2006) distinguished at least 19 main lineages, most of which requiring species status. A recent review, however, indicated that the above study might have overestimated the species diversity and actually only two species, *Pl. homochorus* and *Pl. wardi* (including *Pl. ariel*) occur in the whole Himalayan region (Fukui *et al.* 2020). The former species is distributed from Pakistan, via northwestern India, Nepal, Tibet, and Yunnan, to northern Vietnam, whereas the latter is presently known from Pakistan, northwestern India, Tibet, Szechwan, and Nepal (Spitzenberger *et al.* 2006; Benda & Gaisler 2015; Fukui *et al.* 2020).

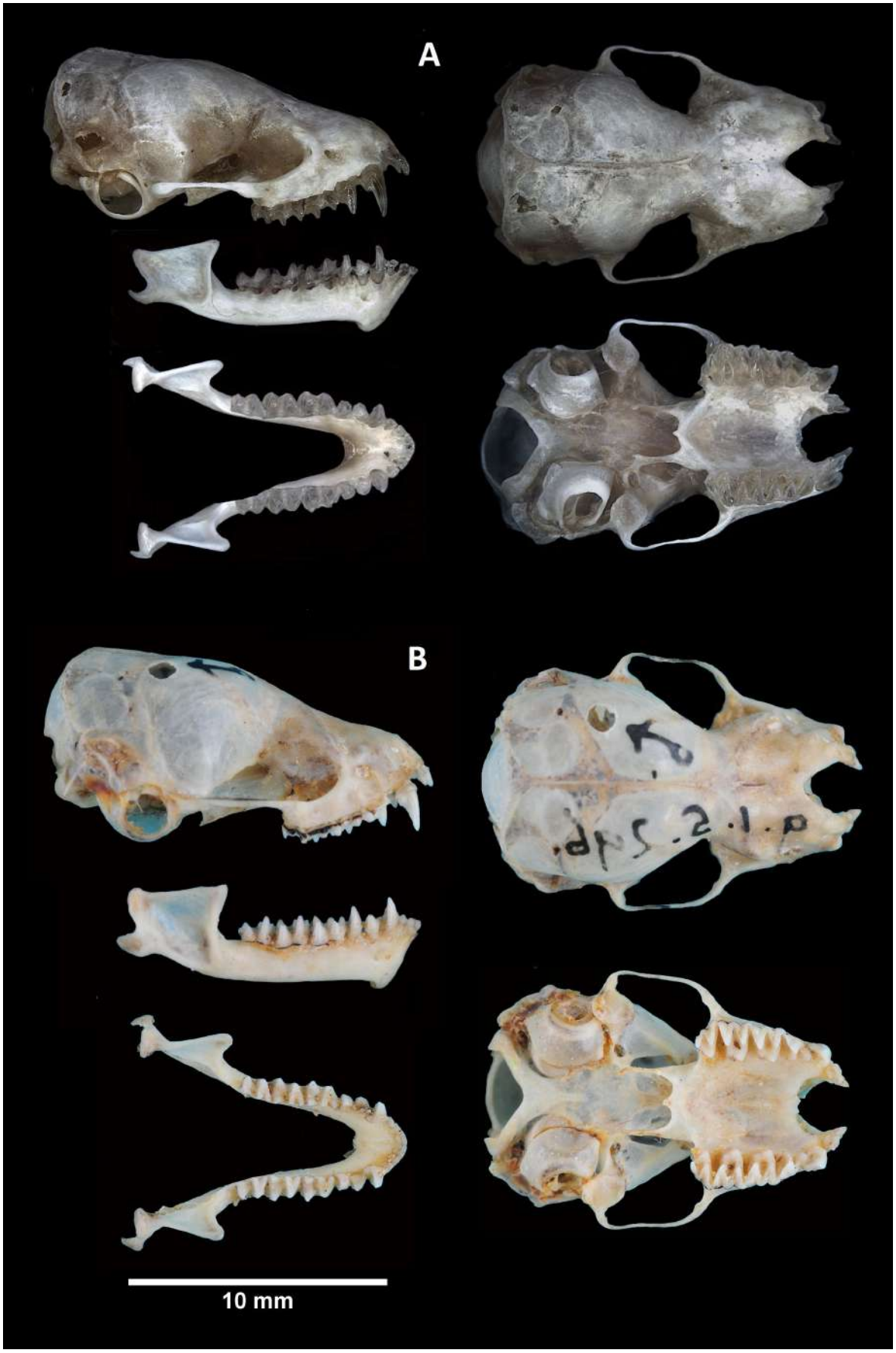

FIGURE 23. Dorsal, ventral, and lateral view of cranium and lateral and ventral view of mandible of A) *Pi. babu* from Himachal Pradesh (ZSI–NERC 486), and B) *Pi. javanicus* s.str. from Java (BMNH 1909.1.5.296).

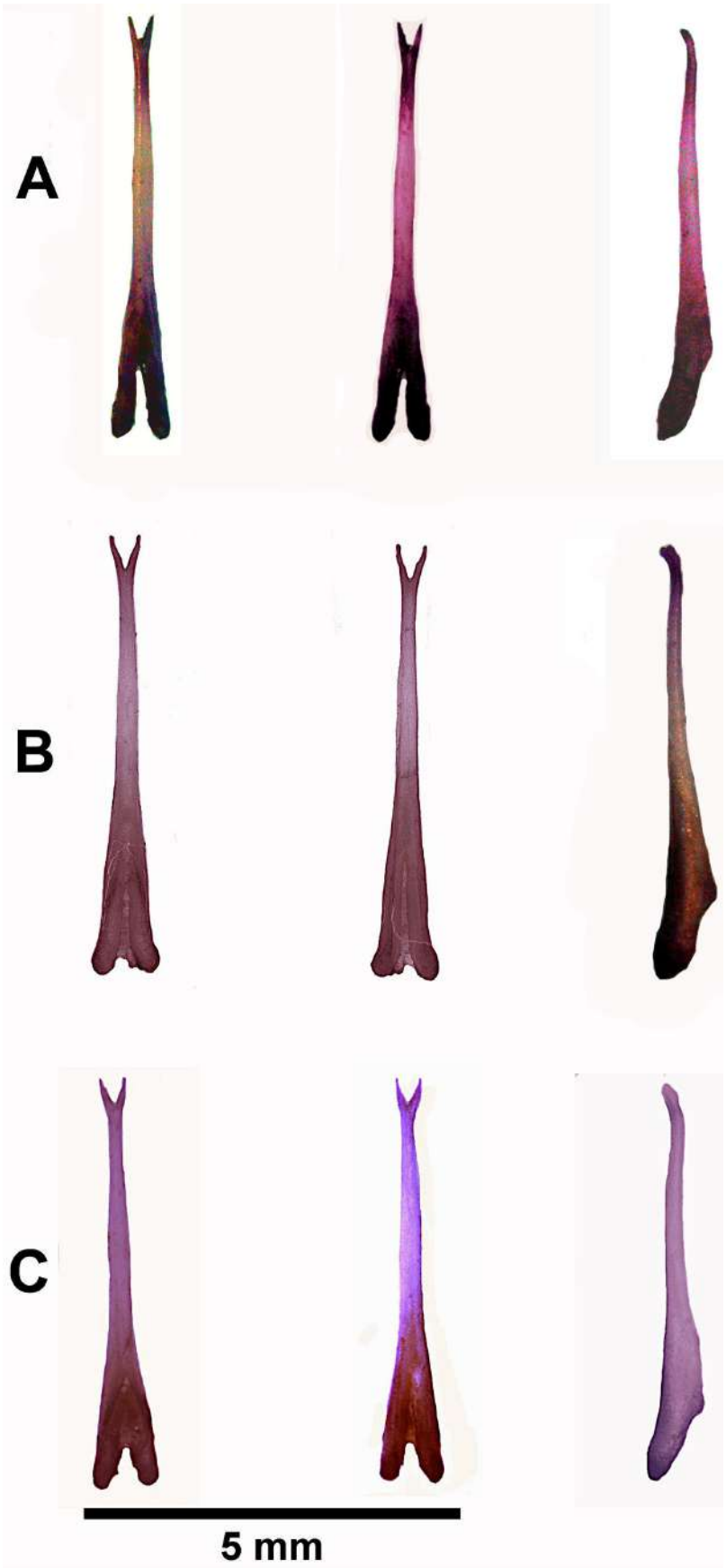

FIGURE 24. Dorsal, ventral, and lateral view of the bacula of *Pi. babu* specimens from the Western Himalayas A) ZSI–NERC V/M/ERS/638, B) ZSI–NERC V/M/ERS/484, and C) ZSI–NERC V/M/ERS/486.

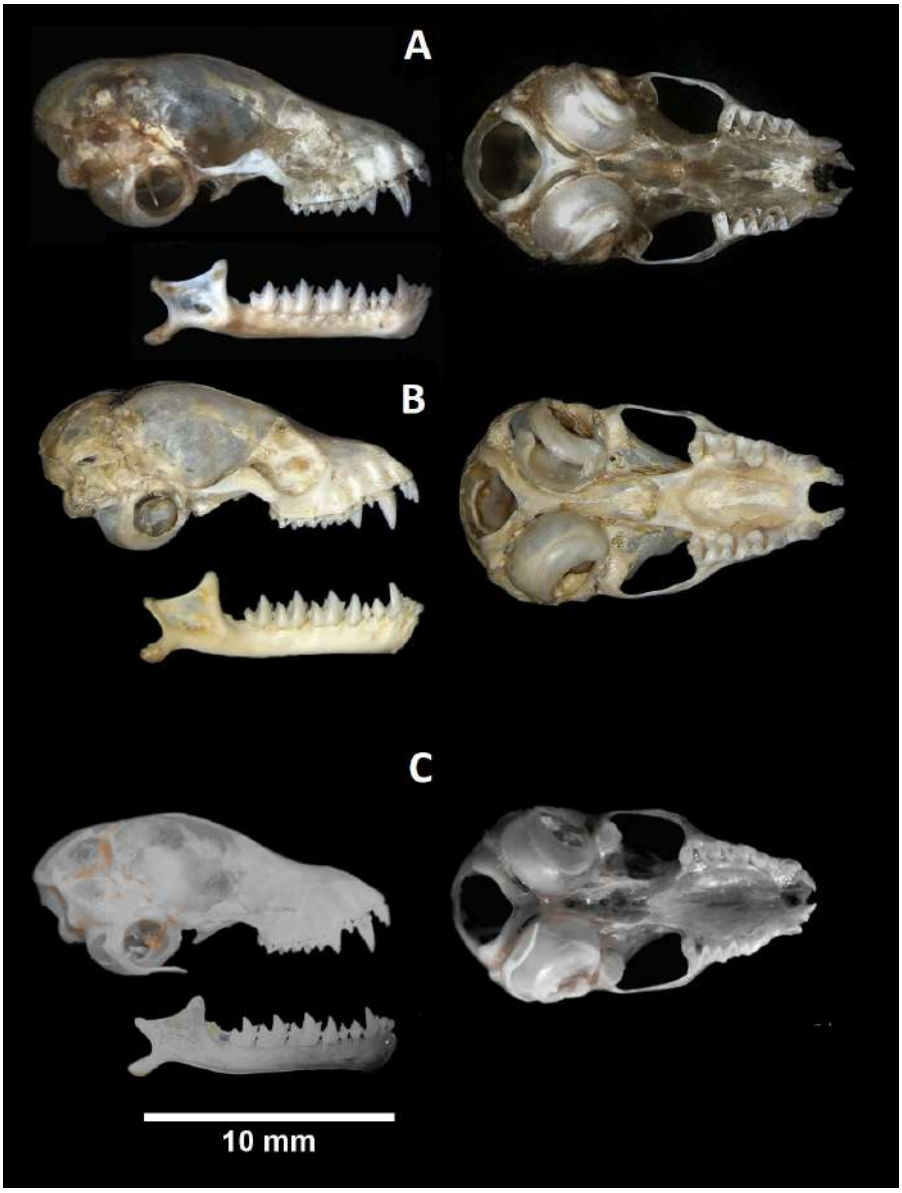

FIGURE 25. Lateral view of cranium and mandible of *Pl. wardi* from A) Himachal Pradesh (ZSI–NERC V/M/ERS/415), B) Pakistan (HNHM 99.14.3), and C) *Pl. homochrous* from Uttarakhand (ZSIS– NERC V/M/ERS/654).

28. *Submyotodon caliginosus* (Tomes, 1859)

New material: 1 M, 16.04.2019, Ansuya, Chamoli district, Uttarakhand (V/M/ERS/637).

Morphological description of specimen: Externally, this bat resembled other small whiskered *Myotis* occurring in the Himalayas i.e., *My. nipalensis* and *My. muricola*. It had a dense, glossy dark brown fur. Individual hairs on the dorsum had light brown tips with dark roots; the ventral hairs had dark roots and greyish brown tips, resembling more to those of *My. muricola*. The face was hairy with prominent bristle–like hairs. The small feet had a wing insertion to the base of toe. However, the deep emargination on the posterior margin of the ears which projected forwards as an arched lobe near the base of the ear (Fig. 15F) was characteristic of this taxon and conveniently separated this genus from any *Myotis* species (Ruedi *et al.* 2021). The shape of the tragus was also different in being curved forwards and only tapering near the tip, a character more akin to *Pipistrellus* than *Myotis*.

In lateral view, the braincase appeared particularly flattened (SKH 4.21 mm) when compared to other Myotinae in the region and corresponded well to other congeners i.e., *Su. moupinensis* from southern China and *Su. latirostris* from Taiwan (Ruedi *et al.* 2021). Lower molars were nyctalodont as against myotodont state in most other *Myotis*.

DNA: No biological material was obtained here, but COI and CYTB haplotypes (GB MW054921 and MW054885, respectively) of specimens from Himachal Pradesh were reported in Ruedi *et al*. (2021) and confirmed that *Submyotodon* and *Myotis* were very divergent, the former being the most basal lineage of Myotinae.

Echolocation call: We recorded broadband echolocation calls (bandwidth=61.41 kHz) of short duration (5.6 ms), ending at 53.6 kHz. The calls had a short QCF component. Echolocation calls appeaedr to be separable from those of *My. muricola* on the basis of a higher end frequency. However, they may be confused with certain calls of *My. longipes*. The calls of *My. longipes* typically ended above 60 kHz but may stretch below 55 kHz where they overlap with the ending frequency of *Su. caliginosus* (Chakravarty *et al.* 2020).

Locality records and ecological notes: Uttarakhand: Ansuya Devi (2000 m), Mandal (1530 m) and Shokharakh (3065 m) in Chamoli district; Pindar Valley (elevation unknown), Bageshwar District (Chakravarty *et al.* 2020; present study). Himachal Pradesh: Chatri (1820 m) in Chamba district; Mount Karol (1950 m) in Solan district; Narkanda (c. 2700 m), Shimla (c. 2200 m) in Shimla district; Sangla (2725 m) in Kinnaur district; Samayala (c.1500 m) in Kangra district (Lindsay 1927; Ruedi *et al.* 2021; present study). The records of *My. muricola* from Kalatop Khajjiar (2480 m) in Chamba district (Saikia *et al.* 2011) also belong to this species. In Uttarakhand, this species was caught over a stream at an oak forest edge in and in a primary broadleaved forest. They were also mist netted over a small stream in sub–Alpine habitat in Shokharakh (Chakravarty *et al.* 2020). In Himachal Pradesh, individuals were commonly caught in oak and fir forest in similar elevation areas and apparently distributed across all physiographic zones (Ruedi *et al.* 2021).

So far, *Su. caliginosus* is known from northern Pakistan (Dunga Gali, Khyber Pakhtunkhwa Province; c. 34°3'N; 73°24'E, 2300 m) and along the Himalayas from Kashmir, Himachal Pradesh, Uttarakhand, Nepal, and Sikkim in India (Benda 2010; Chakravarty *et al.* 2020; Ruedi *et al.* 2021).

Taxonomic notes: Tomes (1859) described *Vespertilio caliginosus* from an unspecified locality in India. Most subsequent workers considered it as a synonym of *My. muricola*, *My. nipalensis* or *My. siligorensis* (Thomas 1915b; Hill 1983; Bates & Harrison 1997; Simons 2005) leading to its uncertain taxonomic status. Ruedi *et al.* (2021) clarified the situation by reviewing the morphological and genetic differences between these forms and concluded that each of these taxa represent well defined biological species and confirmed the generic distinction of *Submyotodon* from *Myotis.* During current investigations, all vouchers in ZSI Solan labelled as "*My. muricola"* from Himachal Pradesh (Saikia *et al.* 2011) were re–identified as *Su. caliginosus* (Ruedi *et al.* 2021). Consequently, the occurrence of *My. muricola* in Himachal Pradesh is yet to be confirmed, although in Uttarakhand both species were found to occur in symparty (see above and Chakravarty *et al.* 2020).

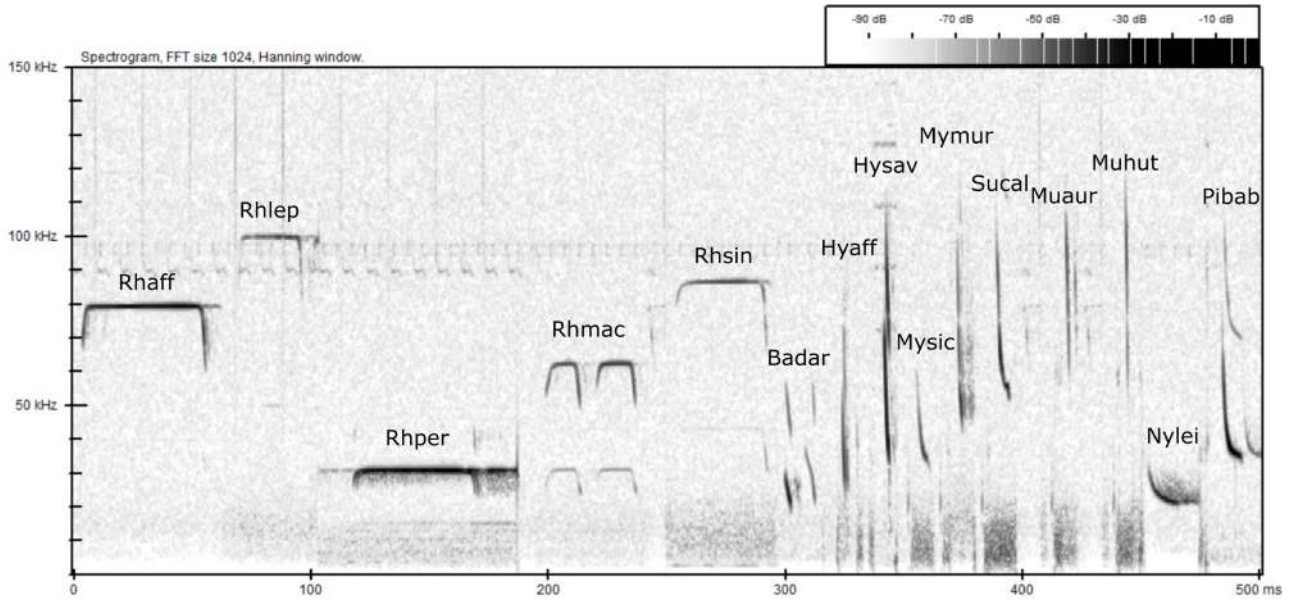

FIGURE 26. Spectrogram of ultrasonic calls of a few bat species from the Western Himalayas recorded in this study. Species names: Rhaff–*Rh. affinis*, Rhlep–*Rh. lepidus*, Rhper–*Rh. perniger*, Rhmac–*Rh.* cf. *macrotis*, Rhsin–*Rh. sinicus*, Badar–*Ba. darjelingensis*, Hyaff–*Hy. affinis*, Hysav–*Hy. savii*, Mysic–*My. sicarius*, Sucal–*Su. caliginosus*, Muaur–*Mu.* cf. *aurata*, Muhut–*Murina huttonii*, Nylei–*Ny. leisleri* and Pibab–*Pi. babu*.

Family: Miniopteridae

29. *Miniopterus fuliginosus* Hodgson, 1835
(Eastern long winged bat)

New material: 2 F, 11.06.2017, Derghat, Solan District, Himachal Pradesh, V/M/ERS/411, 412 and one released female at Mandal, Uttarakhand.

Morphological description of specimen: The individuals from the Western Himalayas had a light brown dorsal pelage intermixed with darker hairs whereas the ventral fur was uniform lighter brown with darker roots. Ears, muzzle and patagium were lighter brown. There was a small patch of dark brown hairs in the forehead just over the muzzle. Overall colour pattern was similar to specimens of the larger *Mi. magnater* from northeastern India.

As previously reported, *Mi. fuliginosus* had an average forearm length of 48.4 mm which was smaller than in *Mi. magnater* (50.6 mm) for Indian specimens (Saikia *et al.* 2020). The cranial dimensions of *Mi. fuliginosus* were also smaller (e.g., GTLi <16.2 mm or CM^3 <6. 5 mm) with no overlap with those of *Mi. magnater* (e.g., GTLi >16.9 mm or CM^3 >6.7 mm).

DNA: No new biological material was obtained here but the CYTB and COI haplotypes (GB MW054886 and MW054924, respectively) of one of these Himachal Pradesh specimens (M2262/ V/M/ERS/ 411) was reported in Ruedi *et al.* (2021).

Locality records and ecological notes: Uttarakhand: Bajawala (638 m), Dehradun district; Dhanaulti (2114 m), Tehri–Garhwal district**;** Ramnagar (330 m), Nainital district (Wroughton 1914; Chakravarty *et al.* 2020); Mandal (1600 m), Chamoli district (present study). Himachal Pradesh: Barog Tunnel (1560 m), Brewery Tunnel (1480 m); Kandaghat (1560 m); Chambaghat (1450 m), Solan district (labelled as *Mi. schreibersii* in Saikia *et al.* 2011).

Two adult females in non–reproductive state were caught in a harp–trap set near a concrete pond amidst a farmland bordering an oak forest patch. Earlier studies in Himachal Pradesh reported its common occurrence in the crevices of several dark, humid railway tunnels along Kalka–Shimla track (Saikia *et al.* 2011). Our collection site was also located near a railway tunnel where these animals were likely to be roosting. In Uttarakhand, this bat was recorded in a variety of habitats like open streams, shrub–covered hills to oak forests and pregnant individuals were caught in the month of May (Chakravarty *et al.* 2020). The minimum and maximum echolocation call frequency recorded was 47.0 kHz and 88.9 kHz respectively (Chakravarty *et al.* 2020).

Taxonomic notes: For several decades, many Asian, African, and Australasian taxa of mid–size *Miniopterus* were considered to represent a single polytypic species, *Mi. schreibersii* s.l. As such, this species name was associated to most reports from the Old World, including from India (e.g., Bates & Harrison 1990). New approaches combining morphology and molecular methods clearly demonstrated that *Mi. schreibersii* s.s. is in fact restricted to the Western Palearactic and eastward does not range beyond the Caucasus. Indeed, recent accounts using such integrative approaches evidenced that the Indian Subcontinent was home to five species of *Miniopterus*, i.e. *Mi. magnater*, *Mi. fuliginosus*, *Mi. phillipsi, Mi. pusillus* and *Mi. srinii* (Kusuminda *et al.* 2022; Srinivasulu & Srinivasulu 2023). In the Western Himalayas, current genetic and morphologic evidence support only the occurrence of *Mi. fuliginosus*, while the larger *Mi. magnater* (and the much smaller *Mi. pusillus*) are found further east and south of this region (see e.g., Saikia *et al.* 2020), the last species (*Mi. phillipsi* and *Mi. srinii*) being endemic to southern India and Sri Lanka.

Discussion

The Himalayan Mountain is recognized for sustaining rich biodiversity and endemism (Sharma *et al.* 2009; Shrestha *et al.* 2012). The Western Himalayan states of Uttarakhand and Himachal Pradesh support well over 40 percent of the total bat species of India in mere 3.3 percent of the geographic area of the country. Being at the crossroads of Palearctic and Oriental zoogeographic realms, faunal elements of both realms could colonize the region (Schaller 1977). Understanding the true nature of species diversity is a fundamental scientific endeavour and has tremendous conservation significance. Till recent times, species delineation was primarily based on morphological distinctions which served as a proxy for reproductive isolation. However, in many species groups across phyla, conservative morphology has resulted in morphologically similar species (Morales *et al.* 2024) rendering morphological delineation problematic. Bats are no exceptions and a number of genera occurring in the Himalayas like *Eptesicus,*

Murina, Myotis or *Rhinolophus* show a high degree of cryptic diversity. To address the taxonomic inconsistencies arising out of solely morphology–based approaches, we reassessed the taxonomic positions of a number of bat species occurring in the western Himalayan region of India through genetics (mtDNA) and bioacoustics coupled with morphology. Such critical new reassessment of species occurring in this diverse region led to significant taxonomic changes, including raising to species status previous taxa variously synonymized with other, apparently widespread species (e.g., *My. nipalensis*, *My. longipes*, *Pi. babu, Rh. nippon*, *Su. caliginosus*; Ruedi *et al.* 2021 and present study), or even to the discovery of a yet underscribed species (*My. himalaicus* **sp. nov.**). This revised inventory of Chiroptera from the region included 53 species in 24 genera and seven families, representing a remarkable 40 percent of the total 134 bat species known from India (Saikia 2018; Chakravarty *et al.* 2020; Raman *et al.* 2020; Ruedi *et al.* 2021; Saikia *et al.* 2021; Saikia *et al.* 2022; Kusuminda *et al.* 2022; Srinivasulu & Srinivasulu 2023). These informed taxonomic revisions will have considerable implication for the conservation of the Himalayan bats, as some of these revised taxa have a restricted distribution.

However, despite these efforts of intregrative approaches, several species complexes are still not satisfactorily resolved and will need further taxonomic scrutiny and more extensive genetic sampling. For instance, we found morphologically similar bats (e.g., *Ep. pachyomus*, *Mu. cyclotis, Rh. pusillus* s.l. or *Rh. macrotis* s.l.) that were genetically very divergent (over 10% K2P) even within the Himalayas, while others showed remarkable genetic conservatism over vast geographic areas and across several distinct morpho–species (e.g., *Ta. insignis* vs *Ta. latouchei*), thus questioning their species status. An important limitation of our approach is that only one or two mitochondrial markers were characterised, which might not reflect the evolution of the organisms but only the history of that organelle DNA (Ballard & Whitelock 2004). Clearly, nuclear markers will be necessary to further resolve open questions, such as the status of *Ep. pahyomus*, *Hy. savii* or *Mu. cyclotis* in the Oriental Region. One important contribution of our new surveys is that some specimens were collected from close to type localities in northern India, meaning that they represent topotypes and will serve as important comparative specimens to solve these potential species complexes. Examples include *Rh.* [*l.*] *monticola*, *My. longipes,* or *Mu. huttonii*, all of which resulted in very distinct haplotypes from those labelled with the same species name in the GenBank, but issued from far from their respective type localities.

Echolocation calls

A recent report on the echolocation calls of several species of bats from the Western Himalayas is available (Chakravarty *et al.* 2020). We supplement them with additional data and detail the call structures of the three newly reported bats from Western Himalayas i.e., *Hy. affinis, Hy. savii* and *My. sicarius* along with *Pi. babu* (Table 6). The Western Himalayas has one of the most comprehensive documentations of bat echolocation calls in India. However, as pointed out by Chakravarty *et al.* (2020), there is high overlap in the frequencies of many species, especially those having end frequencies between 25 and 35 kHz. Unfortunately, all the three newly recorded species from the region fall within this range of end frequencies, complicating further the field discrimination of species based solely on bioacoustics. Furthermore, while Eurasian species of *Myotis* typically have broadband frequency–modulated (FM) calls (Russo & Jones 2002), some Himalayan and Southeast Asian species (and the Neotropical *My. nigricans*) (see Siemers *et al.* 2001) have been recorded with short quasi–constant frequency (QCF) tails as well. Our recordings of *My. sicarius* suggest that it also has a short QCF tail making the echolocation calls potentially confusable with those emitted in clutter by species belonging to the genera *Pipistrellus*, *Arielulus,* and *Mirostrellus* among others.

While we encourage using acoustics to study the ecology of poorly known Himalayan bats, we recommend exercising caution where species–level identification is of utmost importance. To exemplify the diversity of ultrasonic calls from the Western Himalayas recorded in this study, we provide spectrograms of a few representative species (Fig. 26). However, given our current knowledge of bat echolocation in the Himalayas, only rhinolophids and hipposiderids can be identified with a high level of certainty to the species level. For the FM–QCF species, we recommend trying methods such as ziplining to record the calls of different species in different levels of habitat clutter (Szewczak 2000). This will allow researchers to capture the natural variation in the calls and detect potential differences in frequencies or duty cycles.

Acknowledgement

A part of the work was conducted under institutional collaboration between ZSI, Kolkata and MHNG, Geneva vide MoU No 236–1/2017/Tech/5457 dated 22nd May 2017. US is grateful to Dr. Dhriti Banerjee, Director, Zoological Survey of India, Kolkata for institutional support and facilities and US and MR acknowledge Dr. Kailash Chandra, ex Director, ZSI for supporting this collaboration. They also acknowledge the support form Dr. A. K. Sidhu, Officer–in–Charge, ZSI, Solan for permitting access to the Centre's bat collections. US gratefully acknowledges logistical support provided by officials of Himachal Pradesh Forest Department during field surveys. RC's fieldwork was supported by a doctoral scholarship from the Deutscher Akademischer Austauschdienst (DAAD) and small grants from Rufford Foundation, Idea Wild, Wildlife Acoustics, and Elisabeth Kalko Stiftung. RC acknowledges support and survey permission from the Uttarakhand Forest Department. He also acknowledges Zareef Khan Lodha, Baseer Baniya, Shamshad Ali Baniya, Saddam Husain Lodha, Ram Mohan, Omkar Khache, Jaskirat Kaur, Prabhat Singh Bisht, and Pritha Dey for their help, support, and companionship during fieldwork. RC also thanks Dr. Francisco Amorim for sharing social calls of *Tadarida teniotis.* Manifold laboratory and cartographic assistances rendered by Dr. Abhijit Das and his team at the Wildlife Institute of India, Dehradun is also gratefully acknowledged. The work of GC was supported by the National Research, Development, and Innovation Fund of Hungary (NKFIH FK137778). GC acknowledges Dr. Dai Fukui for sharing morphometric data of *Plecotus* specimens. MAL acknowledges support from Dr. A.L. Dkhar, Ex Principal, St. Anthonys College, Shillong for utilizing the institutional molecular facility. We greatly appreciate field assistances rendered by Dr. Adora Thabah, Oana Chachula and Pawan Thakur in Himachal Pradesh and Ram Mohan in Uttarakhand.

Online supplementary information

Four files are available online at the figshare online data repository.

Supplementary Information (https://doi.org/10.6084/m9.figshare.28936868).—MS Excel spreadsheet containing GenBank numbers and the results of the data analyses.

Table S1: Origin and GenBank numbers of sequences.

Table S2: Pairewise K2P distance of the COI mitochondrial gene.

Table S3: Pairewise K2P distance of the CYTB mitochondrial gene.

Table S4: Metric data of 45 specimens.

References

Ahmed, A., Rajput, J.S. & Rai, S.C. (1990) An analysis of the Himalayan environment and guidelines for its management and ecologically sustainable development. *The Environmentalist*, 10 (4), 281–298. https://doi.org/10.1007/BF02239722

Albayrak, I. & Asan, N. (2001) The structure of baculum in *Myotis myotis* and *Myotis blythi* (Chiroptera: Vespertilionidae) from Turkey. *Turkish Journal of Zoology*, 25, 229–233.

Allen, G.M. (1908) Notes on Chiroptera. *Bulletin of the Museum of Comparative Zoology*, 52, 25–61.

Andersen, K. (1905) On some bats of the genus *Rhinolophus*, with remarks on their mutual affinities, and descriptions of twenty-six new forms. *Proceedings of the Zoological Society of London*, 2, 75–145. https://doi.org/10.1111/j.1469-7998.1905.tb08381.x

Appleton, B.R., McKenzie, J.A. & Christidis, L. (2004) Molecular systematics and biogeography of the bent-wing bat complex *Miniopterus schreibersii* (Kuhl, 1817) (Chiroptera: Vespertilionidae). *Molecular Phylogenetics and Evolution*, 31, 431–439. https://doi.org/10.1016/j.ympev.2003.08.017

Artyushin, I.V., Bannikova, A.A., Lebedev, V.S. & Kruskop, S.V. (2009) Mitochondrial DNA relationships among North Palaearctic *Eptesicus* (Vespertilionidae, Chiroptera) and past hybridization between Common Serotine and Northern Bat. *Zootaxa*, 2262 (1), 40–52. https://doi.org/10.11646/zootaxa.2262.1.2

Ballard, J.W.O. & Whitlock, M.C. (2004) The incomplete natural history of mitochondria. *Molecular Ecology*, 13, 729–744. https://doi.org/10.1046/j.1365-294X.2003.02063.x

Barrett-Hamilton, G.E.M. (1906) Description of two new species of Pterygistes. *Annals and Magazines of Natural History*, 17, 89–100.
https://doi.org/10.1080/00222930608562496
Bates, P.J.J. & Harrison, D.L. (1997) *Bats of the Indian Subcontinent*. Harrison Zoological Museum, Sevenoaks, 252 pp.
Bates, P.J.J., Nwe, T., Bu, S.S.H., Mie, K.M., Swe, K.M., Nyo, N., Khaing, A.A., Aye, N.N., Toke, Y.Y., Aung, N.N., Thi, M.M. & Mackie, I. (2005) A review of the genera *Myotis*, *Ia*, *Pipistrellus*, *Hypsugo* and *Arielulus* (Chiroptera : Vespertilionidae) from Myanmar (Burma), including three species new to the country. *Acta Chiropterologica*, 7, 205–236.
https://doi.org/10.3161/1733-5329(2005)7[205:AROTGM]2.0.CO;2
Benda, P. (2010) On a small collection of bats (Chiroptera) from western Sabah (North Borneo, East Malaysia). *Vespertilio*, 13–14, 45–76.
Benda, P. & Gaisler, G. (2015) Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 12. Bat fauna of Afghanistan: revision of distribution. *Acta Societatis Zoologicae Bohemicae*, 79, 267–458.
Benda, P., Hanák, V. & Červený, J. (2011) Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 9. Bats from Transcaucasia and West Turkestan in collection of the National Museum, Prague. *Acta Societatis Zoologicae Bohemicae*, 75, 159–222.
Benda, P. & Mlikovsky, J. (2008) Nomenclatural notes on the Asian forms of *Barbastella* bats (Chiroptera: Vespertilionidae). *Lynx*, 39, 31–46.
Benda, P., Ševčík, M., Horáček, I., Uvizl, M., Reiter, A. & Uhrin, M. (2024) Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 17. New records of bats and their ectoparasites from Tajikistan with a review of these faunas of the country including a description of a new species of horseshoe bat. *Acta Societatis Zoologicae Bohemicae*, 88, 1–213.
Bhat, H.R. (1974) Records and observations on bats of Himalayan region of Uttar Pradesh and West Bengal, India. *Journal of the Bombay Natural History Society*, 71 (1), 51–57.
Bhat, H.R., Kulkarni, S.M. & Mishra, A.C. (1983) Records of Mesostigmata, Ereynetidae and Pterygosomidae (Acarina) in Western Himalayas, Sikkim and hill districts of West Bengal. *Journal of the Bombay Natural History Society*, 80 (1), 91–110.
Bhatt, D., Chandra Sekar, K., Rawal, R.S., Nandi, S.K. & Dhyani, P.P. (2016) *Tree Diversity of Western Himalaya*. G.B. Pant Institute of Himalayan Environment & Development, Almora, Uttarakhand, 178 pp.
Blanford, W.T. (1988–1991) *The Fauna of British India: Mammalia*. Taylor & Francis, London, 599 pp.
Boratyn, G.M., Camacho, C., Cooper, P.S., Coulouris, G., Fong, A., Ma, N., Madden, T.L., Matten, W.T., McGinnis, S.D., Merezhuk, Y., Raytselis, Y., Sayers, E.W., Tao, T., Ye, J. & Zaretskaya, I. (2013) BLAST: a more efficient report with usability improvements. *Nucleic Acids Research*, 41, 29–33.
https://doi.org/10.1093/nar/gkt282
Borisenko, A.V. (1999) A mobile trap for capturing bats in flight. *Plecotus*, 2, 10–19. [in Russian, with English summary]
Bradley, R. & Baker, R. (2001) A test of the genetic species concept: cytochrome b sequences and mammals. *Journal of Mammalogy*, 82, 960–973.
https://doi.org/10.1644/1545-1542(2001)082%3C0960:ATOTGS%3E2.0.CO;2
CEPF [Critical Ecosystem Partnership Fund] (2024) Himalaya. Available from: https://www.cepf.net/our-work/biodiversity-hotspots/himalaya (accessed 25 July 2024)
Chakravarty, R. (2017) A new distribution record of the European Free-tailed Bat *Tadarida teniotis* (Chiroptera: Molossidae) from the western Himalaya, India. *Journal of Threatened Taxa*, 9 (7), 10463–10467.
https://doi.org/10.11609/jott.3462.9.7.10463-10467
Chakravarty, R., Ruedi, M. & Ishtiaq, F. (2020) A recent survey of bats with descriptions of echolocation calls and new records from the western Himalayan region of Uttarakhand, India. *Acta Chiropterologica*, 22 (1), 197–224.
https://doi.org/10.3161/15081109ACC2020.22.1.019
Chakravarty, R., Radchuk, V., Suryawanshi, K. & Voigt, C. (2024) Mountains host significantly more data deficient and threatened bat species than lowlands. *Biodiversity and Conservation*, 33, 4355–4370.
https://doi.org/10.1007/s10531-024-02958-y
Chakraborty, S. (1983) *Contribution to knowledge of the mammalian fauna of Jammu and Kashmir, India*. *Records of the Zoological Survey of India, Occasional Paper 381*. Zoological Survey of India, Kolkata, 129 pp.
Chattopadhyay, B., Garg, K.M., Vinoth Kumar, A.K., Paramanantha Swami Doss, D., Ramakrishnan, U. & Kandula, S. (2012) Sibling species in South Indian populations of the rufous horseshoe bat *Rhinolophus rouxii*. *Conservation Genetics*, 13, 1435–1445.
https://doi.org/10.1007/s10592-012-0361-y
Chheang, S., Bates, P.J.J., Boughey, K., Csorba, G., Hayes, B., Ith, S., Mould, A., Phauk, S. & Furey, N.M. (2013) Further new country records of four bat species (Chiroptera) from Cambodia and a call for information. *Cambodian Journal of Natural History*, 2013, 73–82.
Corbet, G.B. & Hill, J.E. (1992) *The mammals of the Indomalayan region: a systematic review*. Oxford University Press, Oxford, 488 pp.
Csorba, G., Kruskop, S.V. & Borisenko, A.V. (1999) Recent records of bats (Chiroptera) from Nepal, with remarks on their natural history. *Mammalia*, 63, 61–78.
https://doi.org/10.1515/mamm.1999.63.1.61

Csorba, G., Ujhelyi, P. & Thomas, N. (2003) *Horseshoe bats of the world (Chiroptera: Rhinolophidae)*. Alana Books, Shropshire, 160 pp.
Cuvier, P.F. (1832) Essai de classification naturelle des vespertilions et description de plusieurs espèces de ce genre. *Annales du Museum*, 1, 1–21.
Dahal, D.R., Thapa, S. & Singh, N.B. (2024) Species Diversity and Elevational Distribution of Bats in Nepal. *Acta Chiropterologica*, 26 (11), 101–111. https://doi.org/10.3161/15081109ACC2024.26.1.009
Das, P.K. (2003) Studies on some Indian Chiroptera from West Bengal. *Zoological Survey of India occasional paper*, 217, 1–164.
Deshpande, K. & Kelkar, N. (2015) Acoustic identification of *Otomops wroughtoni* and other free-tailed bat species (Chiroptera: Molossidae) from India. *Acta Chiropterologica*, 17 (2), 419–428. https://doi.org/10.3161/15081109ACC2015.17.2.018
Dobson, G.E. (1871) Notes on nine new species of Indian and Indo-Chinese Vespertilionidae, with remarks on the synonymy and classification of some other species of the same family. *Proceedings of the Asiatic Society of Bengal*, 1871, 210–215.
Dobson, G.E. (1872) Notes on some bats collected by Captain W.G. Murray, in the North-western Himalaya, with description of new species. *Proceedings of Asiatic Society of Bengal*, 1872, 208–210.
Dobson, G.E. (1873) Description of a new species of Vespertilio from the Northwestern Himalaya. *Journal of Asiatic Society of Bengal*, 42 (2), 205–206.
Dobson, G.E. (1878) *Catalogue of the Chiroptera in the collection of the British Museum*. Taylor & Francis, London, 567 pp.
Dodsworth, P.T.L. (1913) Notes on some mammals found in Simla districts, the Simla hill states, and Kalka and adjacent country. *Journal of the Bombay Natural History Society*, 22 (3), 726–748.
Dool, S.E., Puechmaille, S.J., Foley, N.M., Allegrini, B., Bastian, A., Mutumi, G.L., Maluleke, T.G., Odendaal, L.J., Teeling, E.C. & Jacobs, D.S. (2016) Nuclear introns outperform mitochondrial DNA in inter-specific phylogenetic reconstruction: Lessons from horseshoe bats (Rhinolophidae: Chiroptera). *Molecular Phylogenetics and Evolution*, 97, 196–212. https://doi.org/10.1016/j.ympev.2016.01.003
Ellerman, J.R. & Morrison-Scott, T.C.S. (1966) *Checklist of Palaearctic and Indian mammals, 1758 to 1946. 2nd Edition*. Alden Press, Oxford, 810 pp.
Evin, A., Baylac, M., Ruedi, M., Mucedda, M. & Pons, J.M. (2008) Taxonomy, skull diversity and evolution in a species complex of *Myotis* (Chiroptera: Vespertilionidae): a geometric morphometric appraisal. *Biological Journal of the Linnaean Society*, 95, 529–538. https://doi.org/10.1111/j.1095-8312.2008.01076.x
Forest Survey of India (2017) *India State of Forest Report 2017*. Forest Survey of India, Dehradun, 51 pp.
Francis, C.M., Borisenko, A.V., Ivanova, N.V., Eger, J.L., Lim, B.K., Guillen-Servent, A., Kruskop, S.V., Mackie, I. & Hebert, P.D.N. (2010) The role of DNA barcodes in understanding and conservation of mammal diversity in Southeast Asia. *PLoS One*, 5, e12575. https://doi.org/10.1371/journal.pone.0012575
Francis, C.M. & Eger, J.L. (2012) A review of tube-nosed bats (Murina) from Laos with description of two new species. *Acta Chiropterologica*, 14 (1), 15–38. https://doi.org/10.3161/150811012X654231
Francis, C.M., Guillén, A. & Robinson, M.F. (1999) Order Chiroptera: bats. *In*: Duckworth, J.W., Salter, R.E. & Khounboline, K. (Eds.), *Wildlife in Lao PDR: 1999 status report*. IUCN, WCS and CPAWM, Vientiane, pp. 225–235.
Funakoshi, K. & Kunisaki, T. (2000) On the validity of *Tadarida latouchei*, with reference to morphological divergence among *T. latouchei*, *T. insignis* and *T. teniotis* (Chiroptera, Molossidae). *Mammal Study*, 25, 115–123. https://doi.org/10.3106/mammalstudy.25.115
Fukui, D., Tu, V.T., Thanh, T., Arai, S., Harada, M., Csorba, G. & Son, N.T. (2020) First Record of the Genus *Plecotus* from Southeast Asia with Notes on the taxonomy, karyology and echolocation call of *P. homochrous* from Vietnam. *Acta Chiropterologica*, 22 (1), 57–74. https://doi.org/10.3161/15081109ACC2020.22.1.006
Gaisler, J. (1970) The bats (Chiroptera) collected in Afghanistan by the Czechoslovak Expeditions of 1965–1967. *Acta Scientiarum Naturalium Academiae Scientiarum Bohemoslovacae Brno*, 4 (6), 1–56.
Ghosh, M.K. (2008) *Catalogue of Chiroptera in the collection of the Zoological Survey of India, Part II: Microchiroptera. Records of the Zoological Survey of India, Occasional Paper No. 281*. Zoological Survey of India, Kolkata, 339 pp.
Gojznikar, J. & Mayer, F. (2024) Mitochondrial DNA reveals the impact of Pleistocene glaciations on a widespread palearctic bat species. *Mammalian Biology*. [published online] https://doi.org/10.1007/s42991-024-00449-9
Görföl, T., Furey, N.M., Bates, P.J.J. & Csorba, G. (2018) The identity of '*Falsistrellus' affinis* from Myanmar and Cambodia and new records of *Hypsugo dolichodon* from these countries. *Acta Chiropterologica*, 20 (2), 301–309. https://doi.org/10.3161/15081109ACC2018.20.2.002
Görföl, T., Kruskop, S.V., Tu, V.T., Estók, P., Son, N.T. & Csorba, G. (2020) A new genus of vespertilionid bat: the end of a long journey for Joffre's Pipistrelle (Chiroptera: Vespertilionidae). *Journal of Mammalogy*, 101 (2), 331–348. https://doi.org/10.1093/jmammal/gyz202

Gray, G.E. (1838) A revision of genera of bats (Vespertilionidae) and the descriptions of some new genera and species. *Magazine of Zoology and Botany*, 2 (12), 483–505.
Győrössy, D., Tu, V.T., Csorba, G., Thapa, S., Estók, P., Földvári, G. & Görföl, T. (2024) The grey zone of taxonomy—the case of the Sikkim Myotis (*Myotis sicarius*) (Chiroptera: Vespertilionidae), first recorded from Southeast Asia. *Vertebrate Zoology*, 74, 737–749.
https://doi.org/10.3897/vz.74.e127269
Hassanin, A., Delsuc, F., Ropiquet, A., Hammer, C., van Vuuren, B.J., Matthee, C., Ruiz-Garcia, M., Catzeflis, F., Areskoug, V., Nguyen, T.T. & Couloux, A. (2012) Pattern and timing of diversification of Cetartiodactyla (Mammalia, Laurasiatheria), as revealed by a comprehensive analysis of mitochondrial genomes. *Comptes Rendus Biologies*, 335, 32–50.
https://doi.org/10.1016/j.crvi.2011.11.002
Hill, J.E. (1963) Occurrence of the European free-tailed Bat [*Tadarida teniotis* (Rafinesque)] (Chiroptera: Molossidae) in India. *Journal of the Bombay Natural History Society*, 60, 723–725.
Hill, J.E. & Harrison, D.L. (1987) The baculum in the Vespertilioninae (Chiroptera: Vespertilionidae) with a systematic review, a synopsis of *Pipistrellus* and *Eptesicus* and the description of a new genus and subgenus. *Bulletin of the British Museum (Natural History)*, Zoological Series, 52, 225–305.
https://doi.org/10.5962/p.18307
Horácek, I., Hanák, V. & Gaisler, J. (2000) Bats of the Palearctic Region: a taxonomic and biogeographic review. *In*: Woloszyn, B.W. (Ed.), *Proceedings of the VIIIth European Bat Research Symposium 1, Approaches to Biogeography and Ecology of Bats, Krakow, Poland*, 2000, pp. 11–157.
Hutson, A.M., Rossiter, S.J. & Csorba, G. (2019) Species account of Rhinolophidae. *In*: Wilson, D.E. & Mittermier, R.A. (Eds.), *Handbook of the Mammals of the World*. *Vol. 9*. *Bats*. Lynx Editions, Barcelona, pp. 260–332.
Hutton, T. (1872) On the bats of the North-western Himalayas with notes and corrections in nomenclature by Prof. W. Peters. *Proceedings of the Zoological Society of London*, 1872, 690–714.
Huynh, D.H., Tien, D.V., Sung, C.V., Anh, P.T. & Khien, H.M. (1994) *Checklist of mammals in Vietnam*. Science and Technics, Hanoi, 168 pp. [in Vietnamese]
Ibáñez, C., García-Mudarra, J.L., Ruedi, M., Stadelmann, B. & Juste, J. (2006) The Iberian contribution to cryptic diversity in European bats. *Acta Chiropterologica*, 8, 277–297.
https://doi.org/10.3161/1733-5329(2006)8[277:TICTCD]2.0.CO;2
Ikeda, Y., Jiang, T., Oh, H., Csorba, G. & Motokawa, M. (2020) Geographic variations of skull morphology in the *Rhinolophus ferrumequinum* species complex (Mammalia: Chiroptera). *Zoologischer Anzeiger*, 288, 125–138.
https://doi.org/10.1016/j.jcz.2020.08.004
Ivanova, N., Zemlak, T., Hanner, R. & Hebert, P. (2007) Universal primer cocktails for fish DNA barcoding. *Molecular Ecology Notes*, 7, 544–548.
https://doi.org/10.1111/j.1471-8286.2007.01748.x
Jerdon, T.C. (1874) *The Mammals of India: a natural history of all the animals known to inhabit continental India.* J. Wheldon, London, 335 pp.
https://doi.org/10.5962/bhl.title.20569
Joshi, R. (2016) Mammalian fauna of Rajaji National Park, India: a review on ecological observations and checklist. *Check List*, 12, 1–11.
https://doi.org/10.15560/12.3.1892
Juste, J., Benda, P., Petr, J., García-Mudarra, J.L. & Ibáñez, C. (2013) Phylogeny and systematics of Old World serotine bats (genus Eptesicus, Vespertilionidae, Chiroptera): An integrative approach. *Zoologica Scripta*, 42 (5), 441–457.
https://doi.org/10.1111/zsc.12020
Juste, J. & Paunović, M. (2016) *Hypsugo savii*. *The IUCN Red List of Threatened Species*, 2016, e.T44856A22072380. Available from: https://doi.org/10.2305/IUCN.UK.2016-3.RLTS.T44856A22072380.en (accessed 21 July 2023)
Kazakov, D.V., Artyushin, I.V., Khabilov, T.K. & Tadzhibaeva, D.E. & Kruskop, S.V. (2020) Back to life and to taxonomy: new record and reassessment of *Myotis bucharensis* (Chiroptera: Vespertilionidae). *Zootaxa*, 4878 (1), 129–144.
https://doi.org/10.11646/zootaxa.4878.1.5
Kazakov, D.V., Kruskop, S.V., Kawai, K., Gorban, A.A. & Gorobeyko, U.V. (2025) Phylogeography, morphometry and the species distribution modelling in *Myotis longicaudatus* (Chiroptera, Vespertilionidae) in the Eastern Palaearctic. *Mammal Research*, 70, 127–140.
https://doi.org/10.1007/s13364-025-00782-5
Khandal, D., Dhar, I., Bohra, D.L. & Talmale, S.S. (2022) Natural history notes on three bat species. *Journal of Threatened Taxa*, 14 (8), 21501–21507.
https://doi.org/10.11609/jott.7995.14.8.21501-21507
Koh, H.S., Jo, J.E., Oh, J.G., Kweon, G.H., Ahn, N.H., Sin, W.H. & Sin, D.S. (2014) Little genetic divergence of the greater horseshoe bat *Rhinolophus ferrumequinum* from far-eastern Asia, with a preliminary report on genetic differentiation of *R. ferrumequinum* from Eurasia and northern Africa examined from cytochrome b sequences. *Russian Journal of Theriology*, 13, 97–103.
https://doi.org/10.15298/rusjtheriol.13.2.05

Korad, V.S. & Yardi, K.D. (2004) New records of bats from Central Western India. *Records of the Zoological Survey of India*, 103 (1–2), 171–177.
https://doi.org/10.26515/rzsi/v103/i1-2/2004/159497

Kruskop, S.V. (2005) Towards the taxonomy of the Russian *Murina* (Vespertilionidae, Chiroptera). *Russian Journal of Theriology*, 4, 91–99.
https://doi.org/10.15298/rusjtheriol.04.2.01

Kruskop, S.V. (2013) *Bats of Vietnam and Adjacent Territories. Checklist and Identification Manual*. KMK Scientific Press, Moscow, 300 pp.

Kruskop, S., Borisenko, A.V., Ivanova, N.V., Lim, B.K. & Eger, J.L. (2012) Genetic diversity of northeastern Palearctic bats as revealed by DNA barcodes. *Acta Chiropterologica*, 14 (1), 1–14.
https://doi.org/10.3161/150811012X654222

Kruskop, S.V., Kawai, K. & Tiunov, M.P. (2019) Taxonomic status of the barbastelles (Chiroptera: Vespertilionidae: *Barbastella*) from the Japanese archipelago and Kunashir Island. *Zootaxa*, 4567 (3), 461–476.
https://doi.org/10.11646/zootaxa.4567.3.3

Kumar, S., Stecher, G., Li, M., Knyaz, C. & Tamura, K. (2018) MEGA X: molecular evolutionary genetics analysis across computing platforms. *Molecular Biology and Evolution*, 35, 1547–1549.
https://doi.org/10.1093/molbev/mys096

Kusuminda, T., Mannakkara, A., Ukuwel, D.B., Kruskop, S., Amarasinghe, C.J., Saikia, U., Venugopal, P., Karunarathna, M., Gamage, R., Ruedi, M., Csorba, G., Yapa, W. & Patterson, B.D. (2022) DNA barcoding and morphological analyses reveal a cryptic species of *Miniopterus* from India and Sri Lanka. *Acta Chiropterologica*, 24 (1), 1–17.
https://doi.org/10.3161/15081109ACC2022.24.1.001

Lindsay, H.M. (1927) Report No 44: Kangra and Chamba, Bombay Natural History Society's Mammal Survey of India. *Journal of the Bombay Natural History Society*, 31, 597–607.

Liu, T., Jia, J., Liu, L., Wang, J., Chen, W., Miao, G., Niu, Y., Guo, W., Zhang, K., Sun, K., Yu, W., Zhou, J. & Feng, J. (2023) New Insights into the Taxonomy of Myotis Bats in China Based on Morphology and Multilocus Phylogeny. *Diversity*, 15 (7), 805.
https://doi.org/10.3390/d15070805

Liu, T., Sun, K., Csorba, G., Zhang, K., Zhang, L., Zhao, H., Longru, J., Thong, V., Xiao, Y. & Feng, J. (2019) Species delimitation and evolutionary reconstruction within an integrative taxonomic framework: A case study on *Rhinolophus macrotis* complex (Chiroptera: Rhinolophidae). *Molecular Phylogenetics and Evolution*, 139, 106544.
https://doi.org/10.1016/j.ympev.2019.106544

Mao, X., Tsagkogeorga, G., Bailey, S.E. & Rossiter, S.J. (2017) Genomics of introgression in the Chinese horseshoe bat (*Rhinolophus sinicus*) revealed by transcriptome sequencing. *Biological Journal of the Linnean Society*, 121, 698–710.
https://doi.org/10.1093/biolinnean/blx017

Martens, J. & Eck, S. (1995) Towards an ornithology of the Himalayas: systematics, ecology and vocalizations of Nepal birds. *Bonner Zoological Monographs*, 38, 1–445.

Mata, V.A., Amorim, F., Guillen-Servent, A. & Beja, P. (2017) First complete mitochondrial genomes of molossid bats (Chiroptera: Molossidae). *Mitochondrial DNA*, Part B, 2 (1), 152–154.
https://doi.org/10.1080/23802359.2017.1298419

McCain, C.M. (2007) Could temperature and water availability drive elevational richness patterns? A global case study for bats. *Global Ecology and Biogeography*, 16, 1–13.
https://doi.org/10.1111/j.1466-8238.2006.00263.x

McCain, C.M. & Grytnes, J.A. (2010) Elevational Gradients in Species Richness. *In*: *Encyclopedia of Life Sciences*. John Wiley & Sons, Ltd, Chichester. [unknown pagination]
https://doi.org/10.1002/9780470015902.a0022548

Meyer-Oehme, D. (1965) Die Saeugetiere Afghanistans (Teil III). Chiroptera. *Quarterly Journal of the faculty of science, Kabul University*, August 1965, 42–58.

Miehe, G., Miehe, S. & Schlütz, F. (2009) Early human impact in the forest ecotone of southern High Asia (Hindu Kush, Himalaya). *Quaternary Research*, 71 (3), 255–265.
https://doi.org/10.1016/j.yqres.2009.02.004

Mishra, N.B. & Chaudhury, G. (2014) Spatio-temporal analysis of trends in seasonal vegetation productivity across Uttarakhand, Indian Himalayas. *Applied Geography*, 15, 29–41.
https://doi.org/10.1016/j.apgeog.2014.10.007

Mittermeier, R.A., Gil, P.R., Hoffmann, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & Fonseca, G.A.B. (2004) *Hotspots revisited: Earths biologically richest and most endangered terrestrial ecoregions.* The University of Chicago Press, Chicago, Illinois, 199 pp.

Morales, A.E., Burbrink, F.T., Segall, M., Meza, M., Munegowda, C., Webala, P.W., Patterson, B.D., Thong, V.D., Ruedi, M., Hiller, M. & Simmons, N.B. (2024) Distinct genes with similar functions underlie convergent evolution in *Myotis* bat ecomorphs. *Molecular Biology and Evolution*, 41 (9), msae165.
https://doi.org/10.1093/molbev/msae165

Morales, A.E., Ruedi, M., Field, K. & Carstens, B.C. (2019) Diversification rates have no effect on the convergent evolution of foraging strategies in the most speciose genus of bats, *Myotis*. *Evolution*, 73, 2263–2280. https://doi.org/10.1111/evo.13849

Nandy, S.N., Dhyani, P.P. & Samal, P.K. (2006) *Resource Information Database of the Indian Himalaya. ENVIS Monograph*. G.B. Pant Institute of Himalayan Environment & Development, Almora, 123 pp.

Neuhauser, H.N. (1970) First positive record of *Pipistrellus savii* (Chiroptera: Vespertilionidae) from India. *Journal of the Bombay Natural History Society*, 67, 319–320.

Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D., Powell, G.V.N., Underwood, E.C., D'amico, J.A., Itoua, I., Strand, H.E., Morrison, J.C., Loucks, C.J., Allnutt, T.F., Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W., Hedao, P. & Kassem, K.R. (2001) Terrestrial Ecoregions of the World: A new map of life on earth: A new global map of terrestrial ecoregions provides an innovative tool for conserving biodiversity. *BioScience*, 51, 933–938. https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Osgood, W.K. (1932) Mammals of the Kelley-Roosevelts and Delacour Asiatic expeditions. Field Museum of Natural History. *Zoological Series*, 18, 193–339. https://doi.org/10.5962/bhl.title.2798

Perrigo, A., Hoorn, C. & Antonelli, A. (2019) Why mountains matter for biodiversity. *Journal of Biogeography*, 47 (2), 315–325. https://doi.org/10.1111/jbi.13731

Peters, W. (1872) Mittheilung über neue Flederthiere. *Monatsberichte Königliche Preussische Akademie der Wissenschaften*, 1872, 256–264.

Raman, S., Padmarajan, S., Thomas, L., Sidharthan, A. & Hughes, A.C. (2020) New geographic record of Peters's Trumpet-eared Bat *Phoniscus jagorii* (Peters, 1866) from India. *Journal of Bat Research & Conservation*, 13 (1), 66–73. https://doi.org/10.14709/BarbJ.13.1.2020.12

Ratnasingham, S. & Hebert, P.D.N. (2007) BOLD: The Barcode of Life Data System (http://www.barcodinglife.org). *Molecular Ecology Notes*, 7, 355–364. https://doi.org/10.1111/j.1471-8286.2007.01678.x

Ratnasingham, S. & Hebert, P.D.N. (2013) A DNA-based registry for all animal species: the Barcode Index Number (BIN) system. *PLoS One*, 8, e66213. https://doi.org/10.1371/journal.pone.0066213

Ruedi, M. (2020) Lesser Mouse-Eared Bat *Myotis blythii* (Tomes, 1857). *In*: Hackländer, K. & Zachos, F.E. (Eds.), *Handbook of the Mammals of Europe*. Springer Nature, Heidelberg, pp. 1–24. https://doi.org/10.1007/978-3-319-65038-8_60-1

Ruedi, M., Biswas, J., Chachula, O. & Arbenz, T. (2012) A winter survey of bats from the Jaintia Hills with a synopsis of their diversity in Meghalaya. *In*: Arbenz, T. (Ed.), *Cave pearls of Meghalaya. Vol I Pala Range and Kopili Valley*. Abode of Cloud project, Graubünden, pp. 87–105.

Ruedi, M., Csorba, G., Lin, L.K. & Chou, C.H. (2015) Molecular phylogeny and morphological revision of *Myotis* bats (Chiroptera: Vespertilionidae) from Taiwan and adjacent China. *Zootaxa*, 3920 (2), 301–342. https://doi.org/10.11646/zootaxa.3920.2.6

Ruedi, M., Eger, J.L., Lim, B.K. & Csorba, G. (2018) A new genus and species of vespertilionid bat from the Indomalayan Region. *Journal of Mammalogy*, 99, 209–222. https://doi.org/10.1093/jmammal/gyx156

Ruedi, M., Saikia, U., Thabah, A., Görföl, T., Thapa, S. & Csorba, G. (2021) Molecular and morphological revision of small Myotinae from the Himalayas shed new light on the poorly known genus *Submyotodon* (Chiroptera: Vespertilionidae). *Mammalian Biology*, 101, 468–480. https://doi.org/10.1007/s42991-020-00081-3

Ruedi, M., Stadelmann, B., Gager, Y., Douzery, E.J.P., Francis, C.M., Lin, L.K., Guillén-Servent, A. & Cibois, A. (2013) Molecular phylogenetic reconstructions identify East Asia as the cradle for the evolution of the cosmopolitan genus *Myotis* (Mammalia, Chiroptera). *Molecular Phylogenetics and Evolution*, 69, 437–449. https://doi.org/10.1016/j.ympev.2013.08.011

Russo, D. & Jones, G. (2002) Identification of twenty-two bat species (Mammalia: Chiroptera) from Italy by analysis of time-expanded recordings of echolocation calls. *Journal of Zoology*, 258, 91–103. https://doi.org/10.1017/S0952836902001231

Saikia, U. (2018) A review of Chiropterological studies and a distributional list of the bat fauna of India. *Records of the Zoological Survey of India*, 118, 242–280. https://doi.org/10.26515/rzsi/v118/i3/2018/121056

Saikia, U., Chakravarty, R., Hegde, V.D., Meetei, A.B., Csorba, G., Kruskop, S. & Ruedi, M. (2021) First record of *Eudiscopus denticulus* from India with notes on its ecology and genetics. *Revue suisse de Zoologie*, 128 (1), 187–198. https://doi.org/10.35929/RSZ.0044

Saikia, U., Csorba, G. & Ruedi, M. (2017) First records of *Hypsugo joffrei* (Thomas, 1915) and the revision of *Philetor brachypterus* (Temminck, 1840) specimens (Chiroptera: Vespertilionidae) from the Indian Subcontinent. *Revue suisse de Zoologie*, 124, 83–89. https://doi.org/10.5281/zenodo.322668

Saikia, U. & Meetei, A.B. (2022) Diversity, distribution and abundance status of small mammalian fauna (Chiroptera, Rodentia and Eulipotyphla) of Manipur, India. *Journal of Threatened Taxa*, 14 (9), 21751–21768. https://doi.org/10.11609/jott.8050.14.9.21751–21768

Saikia, U., Ruedi, M. & Csorba, G. (2022) Out of Southeast Asia: a new species of thick-thumbed bat (Chiroptera: Vespertilionidae: *Glischropus*) from Meghalaya, northeastern India. *Zootaxa*, 5154 (3), 355–364. https://doi.org/10.11646/zootaxa.5154.3.8

Saikia, U., Thakur, M.L., Bawri, M. & Bhattacherjee, P.C. (2011) An inventory of the chiropteran fauna of Himachal Pradesh, northwestern India with some ecological observations. *Journal of Threatened Taxa*, 3 (4), 1637–1635. https://doi.org/10.11609/JoTT.o2409.1637-55

Saikia, U., Thabah, A. & Ruedi, M. (2020) Taxonomic and ecological notes on some lesser known bat (Mammalia: Chiroptera) species of Meghalaya, northeastern India. *Journal of Threatened Taxa*, 12 (1), 15311–15325. https://doi.org/10.11609/jott.5264.12.3.15311-153255

Saitou, N. & Nei, M. (1987) The neighbor-joining method: A new method for reconstructing phylogenetic trees. *Molecular Biology and Evolution*, 4, 406–425.

Salick, J., Zhendong, F. & Byg, A. (2009) Eastern Himalayan alpine plant ecology, Tibetan ethnobotany, and climate change. *Global Environmental Change*, 19, 147–155. https://doi.org/10.1016/j.gloenvcha.2009.01.008

Sangster, G. & Luksenburg, J.A. (2020) The published complete mitochondrial genome of *Eptesicus serotinus* is a chimera of *Vespertilio sinensis* and *Hypsugo alaschanicus* (Mammalia: Chiroptera). *Mitochondrial DNA*, Part B, 5 (3), 2661–2664. https://doi.org/10.1080/23802359.2020.1785349

Sano, A. (2015) *Rhinolophus ferrumequinum*. *In*: Ohdachi, S.D., Ishibashi, Y., Iwasa, M.A., Fukui, D. & Saitoh, T. (Eds.), *The Wild Mammals of Japan*. *2nd Edition*. Shoukadoh Book Sellers, Kyoto, pp. 58–59.

Sati, J.P. & Tak, P.C. (2010) *Mammalia*. *In*: Director of the Zoological Survey of India. *Fauna of Uttarakhand, State Fauna Series*, 18, 1–621.

Schaller, G.B. (1977) *Mountain monarchs. Wild sheep and goats of the Himalaya.* University of Chicago Press, Chicago, Illinois, 412 pp.

Seibert, A.M., Koblitz, J.C., Denzinger, A. & Schnitzler, H.U. (2015) Bidirectional echolocation in the bat *Barbastella barbastellus*: different signals of low source level are emitted upward through the nose and downward through the mouth. *PLoS One*, 10 (9), e0135590. https://doi.org/10.1371/journal.pone.0135590

Sharma, B.R., Chakravarty, R. & Acharya, P.R. (2021) The first record of European free-tailed bat, *Tadarida teniotis* Rafinesque, 1814 and note on probable elevational movement from Nepal. *Journal of Asia-Pacific Biodiversity*, 14 (2), 248–254. https://doi.org/10.1016/j.japb.2021.02.001

Sharma, E., Tsering, K., Chettri, N. & Shrestha, U.B. (2009) Biodiversity in the Himalayas-Trends, perception and impacts of climate change. IMBC-Plenary Session 1: climate change and its implications for mountains. *Proceedings of the International Conference on Mountain Biodiversity, Kathmandu*, 2008, 40–53.

Sharma, M. & Nafees, M. (2018) Spot-bellied Eagle-Owl *Bubo nipalensis* feeding on Indian Flying Fox *Pteropus giganteus*. *Indian Birds*, 14, 59.

Shiel, R. (2006) Seasonal changes in the foraging behaviour of Leisler's bats (*Nyctalus leisleri*) in Ireland as revealed by radio-telemetry. *Journal of Zoology*, 249, 247–358. https://doi.org/10.1017/S0952836999009929

Shrestha, U.B., Gautam, S. & Bawa, K.S. (2012) Widespread climatic change in the Himalayas and associated changes in the local ecosystems. *PLoS One*, 7 (5), e36741. https://doi.org/10.1371/journal.pone.0036741

Siemers, B.M., Kalko, E.K.V. & Schnitzler, H.U. (2001) Echolocation behavior and signal plasticity in the Neotropical bat *Myotis nigricans* (Schinz, 1821) (Vespertilionidae): A convergent case with European species of *Pipistrellus*. *Behavioral Ecology and Sociobiology*, 50 (4), 317–328. https://doi.org/10.1007/s002650100379

Sikes, R.S. & Animal Care and Use Committee of the American Society of Mammalogists (2016) 2016 Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. *Journal of Mammalogy*, 97, 663–688. https://doi.org/10.1093/jmammal/gyw078

Simmons, N. (2005) *Chiroptera*. *In*: Wilson, D.E. & Reeder, D.M. (Eds.), *Mammal Species of the World: A Taxonomic and Geographic Reference. Vols. 1 & 2. 3rd Edition*. John Hopkins University Press, Baltimore, Maryland, pp. 312–529.

Singh, R.B. & Mal, S. (2012) Climate change and vegetation in Nanda Devi Biosphere Reserve, Indian Himalaya. *In*: Himiyama, Y. & Bilic, I. (Eds.), *Land Use Cover Changes in Selected Regions of World. Vol. VI. IGU Commission on Land Use Cover Change, IGU-LUCC Research Reports*. s.n., s.l. [unknown pagination]

Singh, R.B. & Mal, S. (2014) Trends and variability of Monsoon and other rainfall seasons in Western Himalaya, India. *Atmospheric Science Letters*, 15, 218–226. https://doi.org/10.1002/asl2.494

Sinha, Y.P. (1994) Occurrence of Kashmir cave bat *Myotis longipes* (Dobson, 1873) in Meghalaya, India. *Geobios New Report*, 13 (1), 68.
Sinha, Y.P. (1996) Bats of the Siju cave, South Garo Hills, Meghalaya, India: Taxonomy and Bionomics. *Records of the Zoological Survey of India*, 97 (1), 101–122.
https://doi.org/10.26515/rzsi/v97/i1/1999/160258
Soisook, P. (2019) *Hipposideros armiger*. *In*: Wilson, D.E. & Mittermeier, R.A. (Eds.), *Handbook of the Mammals of the World. Vol. 9. Bats*. Lynx Edicions, Barcelona, pp. 237–238.
Soisook, P., Karapan, S., Satasook, C., Thong, V.D., Khan, F.A.A., Maryanto, I., Csorba, G., Furey, N., Aul, B. & Bates, P.J.J. (2013) A review of the *Murina cyclotis* complex (Chiroptera: Vespertilionidae) with descriptions of a new species and subspecies. *Acta Chiropterologica*, 15, 271–292.
https://doi.org/10.3161/150811013x678928
Soisook, P., Karapan, S., Srikrachang, M., Dejtaradol, A., Nualcharoen, K., Bumrungsri, S., Oo, S.S.L., Aung, M.M., Bates, P.J.J., Harutyunyan, M., Buś, M.M. & Bogdanowicz, W. (2016) Hill forest dweller: A new cryptic species of *Rhinolophus* in the "*pusillus* group" (Chiroptera: Rhinolophidae) from Thailand and Lao PDR. *Acta Chiropterologica*, 18, 117–139.
https://doi.org/10.3161/15081109ACC2016.18.1.005
Son, N.T., Csorba, G., Tu, V.T., Thong, V.D., Wu, Y., Harada, M., Oshida, T., Endo, H. & Motokawa, M. (2015) A new species of the genus *Murina* (Chiroptera: Vespertilionidae) from the Central Highlands of Vietnam with a review of the subfamily Murininae in Vietnam. *Acta Chiropterologica*, 17, 201–232.
https://doi.org/10.3161/15081109ACC2015.17.2.001
Spada, M., Szentkuti, S., Zambelli, N., Mattei-Roesli, M., Moretti, M., Bontadina, F., Arlettaz, R., Tosi, G. & Martinoli, A. (2008) Roost selection by non-breeding Leisler's bats (*Nyctalus leisleri*) in montane woodlands: implications for habitat management. *Acta Chiropterologica*, 10 (1), 81–88.
https://doi.org/10.3161/150811008X331117
Spitzenberger, F., Strelkov, P.P., Winkler, H. & Haring, E. (2006) A preliminary revision of the genus *Plecotus* (Chiroptera, Vespertilionidae) based on genetic and morphological results. *Zoologica Scripta*, 35 (3), 187–230.
https://doi.org/10.1111/j.1463-6409.2006.00224.x
Srinivasulu, B., Kaur, H., Shah, T.A., Devender, G., Gopi, A., Raman, S. & Srinivasulu, C. (2020) A review of the bacular morphology of some Indian bats (Mammalia: Chiroptera). *Journal of Threatened Taxa*, 12 (9), 15985–16005.
https://doi.org/10.11609/jott.5650.12.9.15985-16005
Srinivasulu, B. & Srinivasulu, A. (2023) A new species of the Miniopterus australis species complex (Chiroptera: Miniopteridae) from the Western Ghats, India. *Zootaxa*, 5296 (2), 233–249.
https://doi.org/10.11646/zootaxa.5296.2.5
Srinivasulu, B. & Srinivasulu, C. (2019a) *Falsistrellus affinis*. *The IUCN Red List of Threatened Species*, 2019, e.T17324A22131594. Available from: https://doi.org/10.2305/IUCN.UK.2019-3.RLTS.T17324A22131594.en (accessed 25 July 2021)
Srinivasulu, B. & Srinivasulu, C. (2019b) *Myotis sicarius*. *The IUCN Red List of Threatened Species*, 2019, e.T14202A22063965. Available from: https://doi.org/10.2305/IUCN.UK.2019-3.RLTS.T14202A22063965.en (accessed 7 January 2025)
Srinivasulu, C. & Srinivasulu, B. (2019c) *Myotis muricola*. *The IUCN Red List of Threatened Species*, 2019, e.T85537578A22065403. Available from: https://doi.org/10.2305/IUCN.UK.2019-3.RLTS.T85537578A22065403.en (accessed 6 February 2025)
Strelkov, P.P. (1989) New data on the structure of baculum of Palaearctic bats. I. The genera *Myotis, Plecotus* and *Barbastella*. *In*: Hanak, V., Horácek, I. & Gaisler, J. (Eds,), *European bat research 1987. Proceedings of the Fourth European Bat Research Symposium*. Charles University Press, Prague, pp. 87–94.
Sun, K.P., Feng, J., Jiang, T.L., Ma, J., Zhang, Z.Z. & Jin, L.R. (2008) A new cryptic species of *Rhinolophus macrotis* (Chiroptera: Rhinolophidae) from Jiangxi Province, China. *Acta Chiropterologica*, 10, 1–10.
https://doi.org/10.3161/150811008X331045
Sun, K., Luo, L., Kimball, R.T., Wei, X., Jin, L., Jiang, T., Li, G. & Feng, J. (2013) Geographic variation in the acoustic traits of greater horseshoe bats: testing the importance of drift and ecological selection in evolutionary processes. *PLoS One*, 8 (8), e70368.
https://doi.org/10.1371/journal.pone.0070368
Surlykke, A., Miller, L.A., Møhl, B., Andersen, B.B., Christensen-Dalsgaard, J. & Jørgensen, M.B. (1993) Echolocation in two very small bats from Thailand: *Craseonycteris thonglongyai* and *Myotis siligorensis*. *Behavioural Ecology and Sociobiology*, 33, 1–12.
https://doi.org/10.1007/BF00164341
Szewczak, J.M. (2000) A tethered zip-line arrangement for reliably collecting bat echolocation reference calls. *Bat Research News*, 41, 142.
Taylor, P.J. (2019) East Asian free-tailed bat *Tadarida insignis*. *In*: Wilson, D.E. & Mittermeier, R.A. (Eds.), *Handbook of the Mammals of the World. Vol.9. Bats*. Lynx Edicions, Barcelona, pp. 666–667.
Thomas, N.M., Duckworth, J.W., Douangboubpha, B., Williams, M. & Francis, C.M. (2013) A checklist of bats (mammalian: Chiroptera) from Lao PDR. *Acta Chiropterologica*, 15 (1), 193–260.
https://doi.org/10.3161/150811013X667993

Thomas, N.M. (2000) Morphological and mitochondrial-DNA variation in *Rhinolophus rouxii* (Chiroptera). *Bonner zoologische Beiträge*, 49, 1–18.
Thomas, O. (1891) LXII.—Descriptions of three new bats in the British Museum Collection. *Journal of Natural History*, 7, 527–530.
https://doi.org/10.1080/00222939109460659
Thomas, O. (1911) New Asiatic Muridae. *Annals and Magazines of Natural History*, Series 8, 7 (38), 205–209.
https://doi.org/10.1080/00222931108692923
Thomas, O. (1915a) Scientific results from the mammal survey No. 10: The Indian bats assigned to the genus *Myotis*. *Journal Bombay Natural History Society*, 23, 607–612.
Thomas, O. (1915b) On Pipistrelles of genera *Pipistrellus* and *Scotozous*. *Journal of Bombay Natural History Society*, 24, 29–36.
Tomes, R.F. (1857) Descriptions of four undescribed species of bats. *Proceedings of the Zoological Society of London*, 1857, 50–54.
https://doi.org/10.1111/j.1096-3642.1857.tb01197.x
Tomes, R.F. (1859) Descriptions of six hitherto undescribed species of bats. *Proceedings of the Zoological Society of London*, 1859, 68–79.
Topál, G. (1958) Morphological studies on the os penis of bats in the Carpathian basin. *Annales Historico-Naturales Musei Nationalis Hungarici L*, Series Nova IX, 331–342.
Topál, G. (1971) The taxonomic position of *Myotis dobsoni* (Trouessart, 1879), and some statistical data to the subspecific examination of *Myotis blythi* (Tomes, 1857). *Annales Historico-naturales Musei Nationalis Hungarici*, 63, 383–400.
Topál, G. (1997) A new mouse-eared bat species, from Nepal, with statistical analyses of some other species of subgenus Leuconoe (Chiroptera, Vespertilionidae). *Acta Zoologica Academiae Scientiarium Hungaricae*, 43, 375–402.
Tsytsulina, K. & Strelkov, P. (2001) Taxonomy of the *Myotis frater* species group (Vespertilionidae, Chiroptera). *Bonner zoologische Beiträge*, 50, 15–26.
Uvizl, M., Kotyková, V. & Benda, P. (2024) Phylogenetic relationships among horseshoe bats within the *Rhinolophus ferrumequinum* group (Mammalia, Chiroptera). *Zoologica Scripta*, 53 (3), 249–266.
https://doi.org/10.1111/zsc.12650
Volleth, M., Loidl, J., Mayer, F., Yong, H.-S., Müller, S. & Heller, K.-G. (2015) Surprising genetic diversity in *Rhinolophus luctus* (Chiroptera: Rhinolophidae) from Peninsular Malaysia: Description of a new species based on genetic and morphological characters. *Acta Chiropterologica*, 17, 1–20.
https://doi.org/10.3161/15081109ACC2015.17.1.001
Volleth, M., Son, N.T., Li, Y., Yu, W., Lin, L.K., Arai, S., Trifonov, V., Liehr, T. & Harada, M. (2017) Comparative chromosomal studies in *Rhinolophus formosae* and *R. luctus* from China and Vietnam: elevation of *R. l. lanosus* to species rank. *Acta Chiropterologica*, 19, 41–50.
https://doi.org/10.3161/15081109ACC2017.19.1.003
Wang, X., Han, X., Csorba, G., Wu, Y., Chen, H., Zhao, X., Dong, Z., Yu, W. & Lu, Z. (2025) A new species of Tube-nosed Bat (Chiroptera: Vespertilionidae: *Murina*) from Qinghai-Tibet Plateau, China. *Journal of Mammalogy*, 106, 178–186.
https://doi.org/10.1093/jmammal/gyae104
Weyeneth, N., Goodman, S.M., Stanley, W.T. & Ruedi, M. (2008) The biogeography of *Miniopterus* bats (Chiroptera: Miniopteridae) from the Comoro Archipelago inferred from mitochondrial DNA. *Molecular Ecology*, 17, 5205–5219.
https://doi.org/10.1111/j.1365-294X.2008.03994.x
Wroughton, R.C. (1914) Report No 15: Kumaon. Bombay Natural History Society's Mammal Survey of India. *Journal Bombay Natural History Society*, 22, 282–301.
Xu, J., Badola, R., Chettri, N., Chaudhary, R.P., Zomer, R., Pokhrel, B., Hussain, S.A., Pradhan, S. & Pradhan, R. (2019) *Sustaining Biodiversity and Ecosystem Services in the Hindu Kush Himalaya*. *In*: Wester, P., Mishra, A., Mukherji, A. & Shrestha, A. (Eds.), *The Hindu Kush Himalaya Assessment*. Springer, Cham, pp. 127–165.
https://doi.org/10.1007/978-3-319-92288-1_5
Yoshiyuki, M. (1989) *A Systematic Study of the Japanese Chiroptera*. National Science Museum, Tokyo, 242 pp.
Zeng, X., Chen, J., Deng, H., Xiao, N. & Zhou, J. (2018) A new species of *Murina* from China (Chiroptera: Vespertilionidae). *Ekoloji*, 103, 9–16.

Appendix

APPENDIX A: The following comparative material was used for morphological comparisons.

Rhinolophus affinis: Himachal Pradesh, India: ZSI-HARC M28.

Rhinolophus nippon: Himachal Pradesh, India: ZSI-HARC CW12, 28; Nepal: HNHM 95.57.1., 97.57.2., 97.57.3., 95.57.10., 98.5.26.

Rhinolophus ferrumequinum: Kashmir, India: HNHM 92.80.1.

Rhinolophus perniger: Himachal Pradesh, India: ZSI-HARC CW21.

Rhinolophus sinicus: Himachal Pradesh, India: ZSI-HARC M27.

Hypsugo savii: Switzreland: MHNG 1756.088, 1868.067–080, 1956.056, 1999.056, 1999.075; Greece: MHNG 1807.061–63; Iran: MHNG 1703.092–94.

Myotis blythii: Himachal Pradesh, India: ZSI-HARC CW34, 35, M34; ZS-NERC V/M/ERS/405.

Myotis frater: China: AMNH 48039 (holotype); Taiwan: HNHM 2004.19.03., MHNG TS85, NTU FB006. NTU S51.

Myotis laniger: Vietnam: HNHM 93.57.1, 98.20.2, IEBR NH32, NTS1705, NTS1706; Meghalaya, India: 92.108.1, 92.108.2, 92.108.3; Taiwan: KMC 11855, 11866; MHNG 1988.064; THUMB B027, B028, B102, B104; Fujian, China: ZMB 4146 (lectotype).

Myotis longicaudatus: Russia: AMNH 245368; South Korea: HNHM 2003.37.44.; Japan: HNHM 2013.11.1., KKC 052, 056, TO1511, KMC 6466, 6465, 6466, 6467, 6519, 6523, 6527, 6537, 6538, 6541, 12148, 12149, 12444, 12449, 12984, 12985, MHC 251, MHNG 1325.096, NSMT 2606 (holotype of *My. l. kaguyae*), 3686 (paratype of *My. l. kaguyae*), 4584, 5683, 9573, 10538, 10539, 11846, 12375, 14802, 14810, 16673, 20141, 22524, 25635, 25644.

Myotis longipes: Kashmir, India: HNHM 92.104.45., 92.104.47., 92.104.48.

Myotis nipalensis: Himachal Pradesh, India: ZSI-HARC CW38.

Plecotus homochrous: Nepal: NHMUK 1854.9.1.1 (holotype), NHMUK 1879.11.21.98; Uttarakhand, India NHMUK 1814.7.10.31; Pakistan: NHMUK 1905.11.19.1 (holotype of *puck*).

Plecotus wardi: Jammu and Kashmir, India: BMNH 1906.10.3.1, 1906.10.3.2 (holotype) 8.7.6.3; India? 8.7.6.1, 8.7.6.2, 10.10.12.4; Pakistan: BMNH 10.7.13.1, 25.6.10.2, 77.433, 77.434, 77.435, HNHM 99.14.2., 99.14.3, 99.14.4.

Pipistrellus babu: Pakistan: BMNH 1907.11.21.2 (holotype).

Pipistrellus javanicus: Java, Indonesia: BMNH 62a (holotype of *tralatitius*), 1909.1.5.296; MHNG 1487.014.

Scotozous dormeri: Himachal Pradesh, India ZSI–HARC CW 39, 40.

Submyotodon caliginosus: "Himalayas": BMNH 75.10.27.1, 75.10.27.2 (syntypes of *blanfordi*), ZMB 4373, 4717 (syntypes of *blanfordi*); "Kashmir" BMNH 8.7.6.10, India: BMNH 7.1.1.512 (holotype), Himachal Pradesh, India: BMNH 13.1.19.18, 13.1.19.19, Uttarakhand, India: BMNH 14.7.10.55, Sikkim, India: BMNH 15.9.1.21, 91.10.7.57; Himachal Pradesh, India: BMNH 23.1.9.14, 23.9.1.13., Nepal: HNHM 98.8.7.; Pakistan: BMNH 10.1.18.17, 10.1.18.18, 71.1574, 71.1575, 71.1576, 71. 577, Himachal Pradesh, India: ZSI-HARC M50, ZSI-NERC V/M/ERS/417, 418, 421.

APPENDIX B: An updated checklist of the bat species reported from the Western Himalayas based on previous and the present studies.

Zoogeographic affinities are based on known distribution pattern of the species. UTK and HP stand for Uttarakhand and Himachal Pradesh, respectively. *Indicates species encountered during the present surveys.

No	Species	Locality records and elevation range	Affinity	References comments
1	*Rousettus leschenaultii* (Desmarest, 1820) (Fulvous Fruit Bat)	**UTK:** Dungripanth (610 m), Dalmisain (610 m), Narkota (610 m), Raitoli (610 m), Srinagar (550 m) in Pauri District; Patet (920 m), Tejam (1080 m), Thal (920 m) in Pithoragarh district; Dugada (680 m) in Naini Tal district; Sahasradhara (770 m) in Dehradun district; Tanakpur (2120 m) in Nainital District; Kapkot (1140 m), Kataithbara (770 m), Phaltaniya (770 m) in Almora District. **HP**: Ballu (c.700 m) in Bilaspur district; Bandrol (c.1190 m), Sooma (1400 m) in Kullu district; Dadh (1080 m) in Kangra district; Gambhar (680 m) in Solan district; Gutkar (710 m), Mandi (1050 m).	Oriental	Wroughton 1914; Bhat 1974; Bhat *et al.* 1983; Saikia *et al.* 2011.
2	*Pteropus medius* (Temminck, 1825) (Indian Flying Fox)	**UTK:** Throughout the state. **HP:** Chamba town (c.1000 m), Sultanpur (840 m) in Chamba district; Bilaspur (530 m) in Bilaspur district; Dharampur (630 m), Dodour near Nehr Chawk (760 m) in Mandi district; Kotla (940 m), Kullu (c. 1250 m) in Kullu district; Kunihar (960 m), Nalagarh (600 m) in Solan district; Gopalpur (c. 1250 m), Nurpur (590 m) in Kangra district.	Oriental	Ferrar 1934; Lindsay 1937; Sati & Tak 2010; Saikia *et al.* 2011; Joshi 2016; Chakravarty *et al.* 2020; R. Kapoor, *pers comm*.
3	*Cynopterus sphinx* (Vahl, 1797) (Greater Short-nosed Fruit Bat)	**UTK:** Bilaspur (1380 m), Dugada (680 m), Garjia (460 m), Ramgarh (350 m) in Naini Tal district; Dharchula (920 m), Kotera (920 m), Tejam (1080 m) in Pithoragarh district; Didoli (770 m) in Chamoli district; Bagheswar (770 m), Chalthi (770 m), Kataithbara (620 m), Arey (770 m) in Almora district, Dehradun (610 m), Sahaspur (600 m) in Dehradun district, Dalmisain (610 m) in Pauri district. **HP:** Not recorded	Oriental	Bhat 1974.
4	**Sphaerias blanfordi* Thomas, 1891 (Blanford's Fruit Bat)	**UTK:** Dogalbita (2370 m), Kanchula (2600 m) in Chamoli district; Sukhidhang (1380 m), Almora district; Dharchula (920 m), Dummer (1540 m), Khela (1540 m) and Tawaghat (1140 m) in Pithoragarh district. **HP:** Not recorded	Oriental	Bhat 1974; present study
5	*Eonycteris spelaea* (Dobson, 1871) (Dawn Bat)	**Utarakhand:** Thal (920 m) in Pithoragarh district. **HP**: Not recorded	Oriental	Bhat 1974

.....continued on the next page

APPENDIX B: (Continued)

No	Species	Locality records and elevation range	Affinity	References comments
6	*Lyroderma lyra* E. Geoffroy, 1810 (Greater False Vampire)	**UTK:** Rani Bagh (620 m) in Nainital district. **HP:** Damtal in Kangra district	Oriental	Wroughton 1914; Ghosh 2008
7	**Tadarida insignis* (Blyth, 1862) (East Asian Free-tailed Bat)	**UTK:** Dehradun (450 m) in Dehradun district; Taapu Sera (1000 m) in Tehri Garhwal district; Mandal (2000 m), Chamoli district	Oriental	Chakravarty *et al.* 2020 as *Ta. teniotis*; Present study. This is the first record of this species in India
8	**Rhinolophus nippon* (Temminck, 1835) (Greater Japanese horseshoe bat)	**UTK:** Katarmal (1380 m) in Almora district. **HP:** Barog Tunnel (1560 m), Lutru Cave near Arki (1550 m), Mount Karol (1890 m), Solan Town (1500 m) in Solan District; Chakmoh (c.760 m) in Hamirpur District; Chamba (c.1000 m) in Chamba District; Kullu Valley, Manali (1950 m) in Kullu District; Mandi (c.1050 m) in Mandi District; Ghannati (c.1640 m), Shimla (2100 m), Tottu (c.1900 m) in Shimla District	Palearctic	Allen 1908; Dodsworth 1913; Lindsay 1927; Bhat 1974; Chakraborty 1977; Bates & Harrison 1997; Ghosh 2008; Saikia *et al.* 2011 as *Rh. ferrumequinum*; present study.
9	**Rhinolophus affinis* Horsfield, 1823 (Intermediate Horseshoe Bat)	**UTK:** Kaladhungi (140 m) and Bilaspur (1380 m) near Bhim Tal in Naini Tal district; Maldevta (850 m), Landour (1800 m) and Benog WLS (1730 m) in Dehradun district; Devalsari (1600 m) and Dhanaulti (2100 m) in Tehri-Garhwal district. **HP:** Barog tunnel (1560 m), Happy valley near Solan town (1550 m), Kot Beja (1100 m) and Devthal (963 m) in Solan district	Oriental	Bhat 1974; Saikia *et al.* 2011; Chakravarty *et al.* 2020; present study.
10	**Rhinolophus sinicus* Anderson, 1905 (Chinese Horseshoe Bat)	**UTK:** Dharkuri (2700 m) in Rudraprayag district; Mussoorie (2000 m Dehradun district; Mandal (1500m) and Ansuya (2200 m) in Chamoli district. **HP:** Happy valley (1550 m), Saproon (1550 m) and Salogra (1440 m) in Solan district	Oriental	Wroughton 1914 as *R. rouxii*; Saikia *et al.* 2011; Chakravarty *et al.* 2020; present study.
11	**Rhinolophus lepidus* Blyth, 1844 (Blyth's Horseshoe Bat)	**UTK:** Khati (2300 m), Almora (1600 m) in Almora District; Ranibag (757 m) in Nainital District; Mandal (1500 m) and Ansuya (2200 m) in Chamoli district; Benog WLS (1700 m) in Dehradun district. **HP:** Baroog tunnel (1560 m); Saproon cave (1550 m) in Solan district; Drang (c.780 m) in Mandi District; Kullu (c.1200 m), Kullu District.	Oriental	Wroughton 1914 as *R. monticola*; Ghosh 2008; Chakravarty *et al.* 2020; present study.This is the first report of this species from HP.
12	*Rhinolophus pusillus* Temminck, 1834 (Least Horseshoe Bat)	**UTK:** Dehradun (600 m) and Mussoorie (2000 m) in Dehradun district; Almora (1800 m) in Almora district. **HP:** Not recorded	Oriental	Bates & Harrison 1997; Chakravarty *et al.* 2020

.....continued on the next page

APPENDIX B: (Continued)

No	Species	Locality records and elevation range	Affinity	References comments
13	**Rhinolophus macrotis* Blyth, 1844 (Big-eared Horseshoe Bat)	**UTK:** Jharipani (1400 m) and Mussorie (2000 m) in Dehradun district. **HP**: Mount Karol (1850 m) in Solan district.	Oriental	Blanford 1888 –91; Chakravarty *et al.* 2020; present study. This is first record of this species from HP
14	**Rhinolophus perniger* Hodgson, 1843 (Northern Woolly Horseshoe Bat)	**UTK:** Maldevta (850 m), Jharipani (1400 m) and Mussoorie (2000 m) in Dehradun district; Pangot (2000 m) in Nainital district. **HP:** Arki (900 m), Shalaghat (1200 m) and Barog tunnel (1560 m) in Solan district.	Oriental	Dobson 1878; Saikia *et al.* 2011; Chakravarty *et al.* 2020; present study.
15	**Rhinolophus pearsonii* Horsefield, 1851 (Pearson's Horseshoe bat)	**UTK:** Lwarkhet (1800 m) possibly Loharkhet in Bagheswar district; Narkota (c.1300 m) in Rudraprayag district; Mandal (1500 m) and Ansuya (2200 m) in Chamoli district; Benog WLS (1700 m) and Mussoorie (2000 m) in Dehradun district. **HP:** Not recorded	Oriental	Wroughton 1914; Bhat 1974; Chakravarty *et al.* 2020
16	*Hipposideros cineraceus* (Blyth, 1835) (Least Leaf-nosed Bat)	**UTK:** Mussorie (2000 m) in Dehradun district. HP**:** Not recorded	Oriental	Bates & Harrison 1997
17	*Hipposideros speoris* (Schneider, 1800) (Schneider's leaf-nosed bat)	**UTK:** Dehradun (610 m) in Dehradun district. HP**:** Not recorded	Oriental	Jerdon 1874
18	**Hipposideros armiger* Hodgson, 1835 (Great Himalayan leaf-nosed Bat)	**UTK:** Bagheswar (950 m) in Bagheswar district; Katarmal (1380 m) in Almora district; Maldevta (850 m) and Landour (1800 m) in Dehradun district; Gairsain (2000 m) in Chamoli district. **HP:** Devthal (963 m), Mount Karol (2100 m) in Solan district	Oriental	Wroughton 1914; Bhat 1974; Saikia *et al.* 2011; Chakravarty *et al.* 2020; Present study
19	**Plecotus homochrous* Hodgson, 1874 (Long-eared Bat)	**UTK:** Phurkia (3240 m) in Bagheswar district; Devalsari (1600 m) and Dhanaulti (2100 m) in Tehri-Garhwal district; Ansuya (2200 m) and Shokharakh (3065 m) in Chamoli district. HP**:** Not recorded	Palearctic	Wroughton 1914; Bhat 1974 as *Pl. auritus*; Chakravarty *et al.* 2020
20	**Plecotus wardi* Thomas, 1911 (Ward's Long-eared Bat)	**UTK:** Martoli (3575 m) and Milam (3740 m) in Pithoragarh district; Shokharakh (3065 m) in Chamoli district and Tungnath (3500 m) in Rudraprayag district. **HP:** Narkanda (2700 m) in Shimla district	Palearctic	Bates & Harrison 1997 as *Pl. austriacus*; Spitzenberger *et al.* 2006; Chakravarty *et al.* 2020; present study

.....continued on the next page

APPENDIX B: (Continued)

No	Species	Locality records and elevation range	Affinity	References comments
21	**Barbastella darjelingensis* (Hodgson, 1855) (Indian Barbastelle)	**UTK:** Kapkot (1140 m) in Almora district; Benog WLS (1700 m) and Hanifl Centre (2200 m) in Dehradun district; Khalla village (1667 m) and Chopta (2800m) in Chamoli district. **HP:** Shimla (c.2200 m), Narkanda (c.2700 m) in Shimla district.	Palearctic	Blanford 1888 –1891; Bhat 1974; Ghosh 2008; Chakravarty *et al.* 2020; present study.
22	*Nyctalus noctula* (Schreber, 1774) (Noctule)	**UTK:** UTK: Maldevta (850 m), Benog WLS (1700 m) and Hanifl Centre (2200 m) in Dehradun district; Taapu Sera (1000 m) in Tehri-Garhwal district; Gwaldam in Chamoli district. **HP**: Not recorded	Palearctic	Bhat 1974; Chakravarty *et al.* 2020;
23	**Nyctalus leisleri* (Kuhl, 1890) (Leisler's Bat)	**UTK:** Dogalbitta (2370m), Mandal (1600 –1800 m) in Chamoli district and Katarmal (1380m) in Almora district; Dehradun (600 m) and Maldevta (850m) in Dehradun district; Devalsari (1600 m) and Dhanaulti (2100 m) in Tehri-Garhwal district; Pangot (2000 m) in Nainital district. **HP:** Kothi, Kullu district and Narkanda (c.2700 m) in Shimla district	Palearctic	Bhat 1974; Bhat *et al.* 1983; Saikia *et al.* 2011; Chakravarty *et al.* 2020; present study.
24	*Nyctalus montanus* (Barrett-Hamilton, 1906) (Mountain Noctule)	**UTK:** Mussorie (c.2000 m) in Dehdradun district. **HP:** Chamba (c.1000 m) in Chamba district	Palearctic	Barret-Hamilton 1906; Bates & Harrison 1997
25	**Murina sp.*	**UTK:** Devalsari (1600 m) in Tehri-Garhwal district; Ansuya (2000 m) in Chamoli district. **HP:** Not recorded	-	Earlier records of *Mu. leucogaster* Chakravarty *et al.* 2020 possibly belongs to this undetermined taxon.
26	**Murina* cf. *aurata* Milne-Edwards, 1872 (Little Tube-nosed Bat)	**UTK:** Ansuya (2000 m); Mandal (1600 m) in Chamoli district. HP**:** Not recorded	Oriental	Chakravarty *et al.* 2020; present study
27	**Murina cyclotis* Dobson, 1872 (Round-eared Tube-nosed Bat)	**UTK:** Devalsari (1600 m) in Tehri-Garhwal district. **HP:** Kandaghat (1560 m) in Solan district (present study).	Oriental	Chakravarty *et al.* 2020; present study. This is the first mention of this species from HP.
28	**Murina huttonii* (Peters, 1872) (White bellied Tube-nosed Bat)	**UTK:** Khati (2320 m) in Bagheswar district; Lansdowne (1600 m) in Pauri-Garhwal district; Dhanaulti (2100 m) in Tehri-Garhwal district. **HP:** Kandaghat (1560 m) in Solan district	Oriental	Wroughton 1914; Chakravarty *et al.* 2020; present study
29	*Harpiola grisea* (Peters, 1872) (Peter's Tube-nosed Bat)	**UTK:** Jharipani (1500 m) in Dehradun district. HP**:** Not recorded	Oriental	Bates & Harrison 1997

.....continued on the next page

APPENDIX B: (Continued)

No	Species	Locality records and elevation range	Affinity	References comments
30	**Myotis blythii* (Tomes, 1875) (Lesser Mouse-eared Bat)	**UTK:** Katarmal (1380 m) in Almora district; Devalsari (1600 m) in Tehri-Garhwal district. **HP:** Barog Tunnel (1560 m) in Solan district; Chamba (1000 m), Dalhousie (c.1970 m) in Chmaba district; Shimla (c.2000 m) in Shimla district.	Palearctic	Dobson 1873; Dodsworth 1914; Thomas 1915; Bhat 1974 as *My. myotis*; Bates & Harrison 1997; Saikia *et al.* 2011; Chakravarty *et al.* 2020; Present study
31	*Myotis formosus* (Hodgson, 1835) (Hodgson's Bat)	**UTK:** Dehradun (450 m) and Mussoorie (2000 m) in Dehradun district. **HP:** Dharamsala (c.1250 m) in Kangra District; Drang (c.780 m) 17 km north of Mandi in Mandi District.	Oriental	Thomas 1915; Bates & Harrison 1997; Ghosh 2008
32	**Myotis nipalensis* (Dobson, 1871) (Nepal Myotis)	**UTK:** Pawalgarh (500 m) in Nainital district. **HP:** Devthal (963 m); Solan town (1500 m) in Solan district.	Oriental	Chakravarty *et al.* 2020; Present study. Previous records from HP as *My. mystacinus* in Saikia *et al.* 2011 are now ascribed to *My. longipes*.
33	**Myotis muricola* (Gray, 1864) (Nepalese Whiskered Bat*)*	UTK: Ansuya (2000 m), Chopta (2800 m) and Mandal (1600 m) in Chamoli district of UTK. HP: Not precisely known.	Oriental	Chakravarty *et al.* 2020; present study. The earlier records of this species from HP Saikia *et al.* 2011 represent *Submyotodon caliginosus*. The record from Chirot (Thirot) in Lahaul & Spiti district of HP Lindsay 1927 might actually represent this species although included as *My. mystacinus* (=*nipalensis)* in Bates & Harrison 1997.
34	*Myotis siligorensis* (Horsfield, 1855) (Himalayan Whiskered Bat)	**UTK:** Deori (1600 m) in Almora district; Dogalbita (2370 m) in Chamoli district and Phurkia (3240 m) in Bagheswar district. **HP:** Not recorded.	Oriental	Wroughton 1914 as *My. darjelingensis*; Bhat 1974. The record from Solan in Saikia *et al.* 2011 represents *My. nipalensis*

.....continued on the next page

APPENDIX B: (Continued)

No	Species	Locality records and elevation range	Affinity	References comments
35	**Myotis longipes* Dobson, 1873 (Kashmir cave Myotis)	**UTK:** Mandal (1500 m) and Ansuya (2000 m) in Chamoli district; Benog WLS (1700 m) and Landour (1800 m) in Dehradun district; Gairsain (2000 m) in Chamoli district. **HP:** Cave at Mount Karol (1980 m); Saproon (1550 m) and Salogra (1440 m) in Solan district.	Oriental	Chakravarty *et al.* 2020; present study. The present report represents the first verified record of this species from HP.
36	**Myotis himalaicus* sp. nov. (Himalayan long-tailed Myotis)	**UTK:** Mandal (1500 m) in Chamoli district; Devalsari (1600 m) in Tehri-Garhwal district. **HP**: Not recorded	Palearctic	In Chakravarty *et al.* 2020 as *My.* cf. *frater.*
37	**Myotis sicarius* Thomas, 1915 (Mandelli's Mouse-eared Bat)	**UTK:** Mandal (1600 m) in Chamoli district. Devalsari (1600 m) in Tehri-Garhwal district..**HP:** Not recorded	Oriental	In Chakravarty *et al.* 2020 as *My.* cf. *annectans.* This is the first record of this species from the Western Himalaya.
38	**Submyotodon caliginosus* (Tomes, 1859) (Himalayan Broad-muzzled Bat)	**UTK:** Ansuya (2000 m) and Shokharakh (3065 m) in Chamoli district. **HP:** Mount Karol (1950 m) in Solan district; Narkanda (c. 2700 m) in Shimla district; Sangla (2720 m) in Kinnaur district.	Oriental	Chakravarty *et al.* 2020; Ruedi *et al.* 2021; present study. The records of *My. caliginosus* from Chatri (1820 m) in Chamba district and Samayala (c.1500 m) in Kangra district Lindsay 1927 might very well belong to this species.
39	**Hypsugo savii* Bonaparte, 1837 (Savi's Pipistrelle)	**UTK:** Mandal (1600 m) in Chamoli district. **HP:** Not recorded	Palearctic	Present study. This is the first authentic report of this species from India as all previous records from India are doubtful
40	**Hypsugo* cf. *affinis* (Dobson, 1871) (Chocolate Pipistrelle)	**UTK:** Kumaon region, Mandal village, in Chamoli district (1800 m) **HP:** Not recorded	Oriental	As *Pi. afffinis* in Bates & Harrison 1997; present study.
41	**Mirostrellus joffrei* (Thomas, 1915) (Joffrei's Pipistrelle)	**UTK:** Mandal (1600 m) in Chamoli district. **HP:** Not recorded.	Oriental	Chakravarty *et al.* 2020.

.....continued on the next page

APPENDIX B: (Continued)

No	Species	Locality records and elevation range	Affinity	References comments
42	**Pipistrellus babu* Thomas, 1915 (Babu's Pipistrelle)	**UTK:** Gharial, Mussorie (2000 m) and Maldevta (850 m) in Dehradun district; Sukhidhang (1380 m) in Almora district, Srinagar (550 m) in Pauri, and Ghonti (920 m) in Tehri Pauri-Garhwal districts; Mandal (1500 m); Ansuya (2200 m) and Chopta (2800 m) in Chamoli district. **HP:** Gopalpur (2700 m), Kangra District; Shimla c.2000 m), Narkanda (c.2700 m) in Shimla district; Sangla (2700 m) in Kinnaur district.	Oriental	Lindsay 1927; Bhat 1974; Chakravarty *et al.* 2020 as *Pi.* cf. *ceylonicus*; present study. Earlier records of. *Pi. javanicus babu* now considered as *Pi. babu.*
43	*Pipistrellus coromandra* (Gray, 1838) (Coromandel Pipistrelle)	**UTK:** Dharkuri (2700 m), Rudraprayag district; Lwarkhet (1800 m) possibly Loharkhet in Bagheswar district. HP**:** Bakloh (c.1330 m) in Chamba District; Narkanda (2470 m) in Shimla District; Shaur (2400 m), Pangi Valley in Chamba District.	Oriental	Wroughton 1914**;** Ghosh 2008; Saikia *et al.* 2011.
44	*Pipistrellus tenuis* Temminck, 1840 (Indian Pygmy Bat)	**UTK:** Ramnagar (330 –450 m), Sitabani (600 m), Haldwani (430 m) in Naini Tal district and Satyanarayana (340 m) and Rajpur (900 m) in Dehradun district. **HP:** Bhunter (c.1080 m), Kullu Valley, Manikaran (c.1740 m) in Kullu District; Majothu (520 m) near Barotiwala in Solan District; Simbalbara Wildlife Sanctuary (590 m) in Sirmour District	Oriental	Wroughton 1914; Bhat 1974; Ghosh 2008; Sharma & Saikia 2009; Saikia *et al.* 2011; Chakravarty *et al.* 2020.
45	*Pipistrellus ceylonicus* (Dobson, 1878) (Kellart's Pipistrelle)	**UTK:** Lansdowne (1600 m) in Pauri-Garhwal district; Maldevta (850 m) in Dehradun district, and Devalsari (1600 m) in Tehri-Garhwal district**. HP**: Ghanatti (c.1640 m) in Shimla District	Oriental	Ghosh 2008.
46	**Arielulus circumdatus* (Temminck, 1840) (Black-gilded Pipistrelle)	**UTK:** Shokharakh (3065 m) in Chamoli district. HP**:** Not reported	Oriental	Chakravarty *et al.* 2020.
47	*Eptesicus tatei* Ellerman & Morrison-Scott, 1951 (Sombre Bat)	**UTK**: Shokharakh (3065 m) in Chamoli district. HP**:** Not reported	Palearctic	Chakravarty *et al.* 2020.

.....continued on the next page

APPENDIX B: (Continued)

No	Species	Locality records and elevation range	Affinity	References comments
48	**Eptesicus pachyomus* (Tomes, 1857*)* *(*Oriental Serotine)	**UTK**: Mussorie in Dehradun district; Mandal (1500 m) in Chamoli district; Devalsari (1600 m) in Tehri-Garhwal district. **HP**: Salogra (1440 m) in Solan district	Palearctic	Blanford 1888 –91; Chakravarty *et al*. 2020; present study. The earlier records of *Ep. serotinus* from India represent this species. *Ep. serotinus turcomanus* is extralimital to India.
49	*Scotophilus heathii* (Horsfield, 1831) (Greater yellow house bat)	**UTK:** Haldwani (430 m) and Ramnagar (350 m) in Naini Tal district; Dehradun (450 m) in Dehradun district. **HP:** Not recorded	Oriental	Bhat 1974; Chakravarty *et al.* 2020.
50	*Scotophilus kuhlii* Leach, 1821 (Lesser yellow house bat)	**UTK:** Ramnagar (330 m) in Nainital district. **HP:** Kullu valley (c.1200 –1300 m), Kullu district and Solan Town (1500 m) in Solan district	Oriental	Wroughton 1914; Saikia *et al.* 2011.
51	*Scotoecus pallidus* Dobson, 1876 (Desert Yellow Bat)	**UTK:** Not recorded. **HP**: Kullu Valley (c.1200 –1300 m) in Kullu District	Oriental	Allen 1908 as *Scoteinus pallidus*; Saikia *et al.* 2011.
52	*Scotozous dormeri* (Dobson, 1785) (Dormer's Bat)	**UTK:** Not recorded. **HP:** Majothu (520 m), near Barotiwala; Solan Town (1500 m) in Solan District	Oriental	Saikia *et al.* 2011.
53	**Miniopterus fuliginosus* (Hodgson, 1935) (Eastern Bent-winged Bat)	**UTK:** Ramnagar (330 m) in Nainital district; Mandal (1600 m) in Chamoli distri ct. **HP:** Barog Tunnel (1560 m), Brewery Tunnel (1480 m); Kandaghat (1560 m); Chambaghat (1450 m) in Solan District	Oriental	Wroughton 1914; as *Mi. schreibersii* in Saikia *et al.* 2011; Chakravarty *et al.* 2020; present study.