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NATURAL HISTORY NOTE

First record of Brown Long-eared Bat *Plecotus auritus* (Linnaeus, 1758) (Chiroptera, Vespertilionidae) from Jumla, Karnali Province, Nepal

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ABSTRACT

The brown long-eared bat *Plecotus auritus* is classified globally as a species of 'least concern' by the International Union for Conservation of Nature (IUCN) red list of threatened species, and as 'data deficient' in the National classification for Nepal. The present paper reports the first record of its occurrence in Jumla, Karnali and the third for the country, Nepal. One live male adult individual and a few faeces were observed on September 8, 2017 at 12:44PM in Jumla. We include a brief discussion of its morphological features and measurements and the habitat in which it was recorded. The paper provides discussion on the previous two records from the country, emphasizing the need for more intensive research over a prolonged period of time to improve understanding of the species' distribution, habitat and ecology in the region.

Plecotus auritus is predominantly a European species. Outside the European distribution range, this species has also been recorded in the easternmost locality of Darjeeling, West Bengal in India (Jerdon 1867) at an altitude 2000 m a.s.l. (Spitzenberger et al. 2006) and in the westernmost locality of Murree, Punjab, Pakistan, at an elevation 2500 m a.s.l. in the southern slopes of the Pir Panjal mountain chain (Bates & Harrison 1997). In Nepal, there is a confirmed report of a brown long-eared bat in the Annapurna Conservation Area (Jomsom) (Sanborn 1950, Thapa et al. 2014), and an unverified report on its presence from Makalu Barun National Park and Rara National Park (Suwal et al. 1995, Jnawali et al. 2011).

Chiropterology in Nepal dates back to 1835 with the mammalian fauna assortment by Hodgson (1835). From that point onward, up to 2000, bat studies were constrained to foreign-led expeditions in eastern, central and western Nepal (Hodgson 1835, Scully 1887, Hinton & Fry 1923, Fry 1925, Sanborn 1950, Abe 1971, Johnson et al. 1980, Mitchell 1980, Kock 1996, Bates & Harrison 1997, Csorba et al. 1999) and an unprecedented visit to mid and far-western districts (Acharya et al. 2010). From 2000, Nepalese researchers began their studies on bat species. Past research is centered around first bat species records, observations and monitoring records (Ghimire et al. 2010, Thapa 2010, 2018, Thapa & Thapa 2010, Thapa et al. 2012, 2014, Sharma et al. 2018a, Baniya et al. 2019); descriptive examinations of habitat and roosting behavior (Acharya 2006, Giri 2009, Baniya et al. 2018, Sharma 2016); diet (Malla 2000, Sharma 2016); and, human-bat interactions and conservation threats (Neupane et al. 2016, Manandhar et al. 2017, Sharma et al. 2018b, Katuwal et al. 2019).

In Nepal, despite the fact that many Nepalese bat species have not been documented and evaluated (Bates & Harrison 1997, Hutson et al. 2001, Baral & Shah 2008), a previous inventory of 53 bat species (Thapa 2010) has recently been updated with an extra 17 species (Acharya & Ruedas 2007).

Overall bat studies in Nepal are at the state of infancy compared to other nations. Chronicled records on bats, and academic and non-governmental research on bat is limited to central and western Nepal. Bat research in mid and far western Nepal seems neglected, with few advances in bat species inventories besides those mentioned by Jnawali et al. (2011). In this context, this study aims to document the first record of the brown long-eared bat *P. auritus* in Jumla, Karnali mid-western Nepal.

Jumla District is located in Karnali Province in mid-western Nepal. Chandannath Municipality is the only municipality in Jumla District and it extends between 29° 14.417' N 82° 5.267' E and 29° 21.833' N 82° 13.033' E, with Guthichaur Rural Municipality to the east, Sinja Rural Municipality to the west, Tatopani Rural Municipality to the south, and Patarasi and Kankasundari Rural Municipality to the North (Fig. 1). Chandannath is characterized by temperate, subalpine, alpine, and nival vegetation.

Following a call from a houseowner to the local authority reporting a bat that had accidentally flown into a building, we visited the site along with other local concerned authority to record the finding. The bat was identified as a *P. auritus* bat by referring to Bates & Harrison (1997), Dietz & von Helversen (2004) and through consultation with experts. The genus *Plecotus* (long-eared bats) contains many cryptic species.

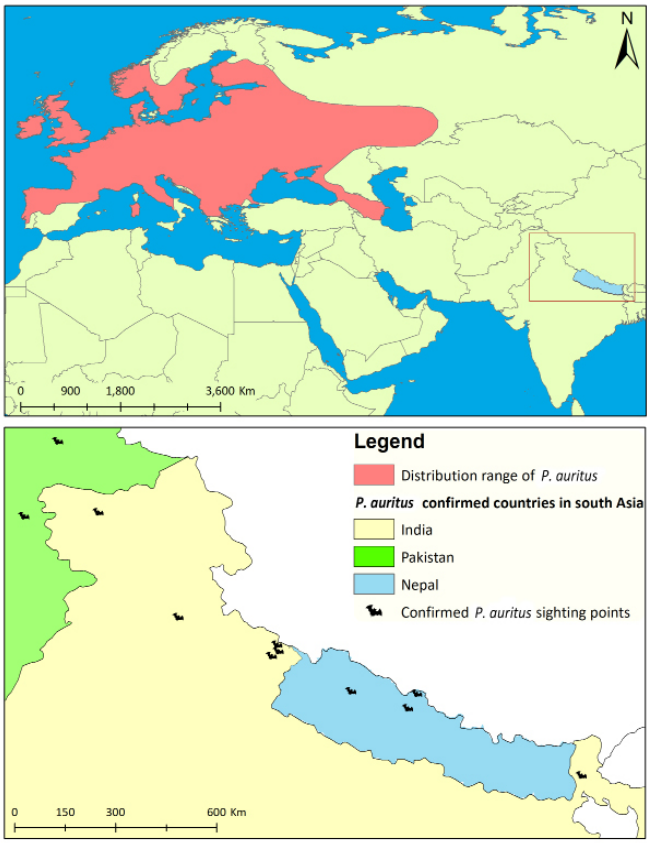

Fig. 1 - Geographic range of *P. auritus* retrieved from International Union for Conservation of Nature (IUCN) 2008 including GPS points provided for South Asia (Srinivasulu et al. 2010).

Fig. 2 - Brown Long-eared Bat (*P. auritus*) ©Keshav Paudel

To discriminate *P. auritus* from all other *Plecotus* species morphometrically, the individual was photographed, major characters were noted and morphological measurements for fifteen external features were taken for identification in accordance with Kiefer & von Helversen (2004), Tvrtkovic et al. (2005), Spitzenberger et al. (2006), Dietz et al. (2007) and Archarya et. al (2010) before release. The measurements taken include forearm length (FA), hind foot length (HF), tibia length (TIB), tragus length, tragus width, thumb length, 3rd metacarpal and phalanges length, 4th metacarpal and phalanges length and 5th metacarpal and phalanges length. The coordinates for *P. auritus* confirmed localities in south Asia (Srinivasulu et al. 2010) were overlaid with global geographic range map of *P. auritus* retrieved from IUCN 2008. A single male individual of *P. auritus* and three faeces were recorded inside a drawer of a table (Fig. 2) kept in the attic spaces of old residential building made up of woods at Khalanga (29° 16.310' N and 82°10.695' E) in Chandannath Municipality of Jumla district at an altitude of 2342 m a.s.l. on September 8, 2017 at 12:44PM. The limited number of faeces suggest the bat didn't typically roost there, and had accidentally flown inside. The temperature in the afternoon at the observation site was 18°C. The morphometric measurements taken for the bat are summarized in Table 1.

The bat's face was completely furred with brown hairs. It had dorsal and ventral pelages that are uniformly dark brown, dense, and woolly. Yellowish brown ventral fur was comprised of hair ranging between 6.8 mm and 8.1 mm. Likewise, dark brown dorsal fur was comprised of hair ranging between 11.3 mm and 11.9 mm and was found to extend to a very narrow area of the proximal part of the tail membrane. The hair roots were dark throughout. It had medium brown wing membranes, and brown toes covered densely with hairs and with brown claws. It had dark facial mask, hard triangular lip pad, and semitransparent long brown ears. The muzzle behind its nostrils was noticeably inflated. The tragus width was 4.8 mm at its widest point. The thumb of the brown long-eared bat was 7.2 mm.

The new distribution record of *P. auritus* in alpine valley at the foothill of the high mountain clearly points to a unique habitat of conservation value at Jumla. Using ArcGIS, the distance between *P. auritus* confirmed site in Jumla has been estimated to be about 3063 km east of its main easternmost distribution range in Europe (Fig. 1), 978 km east of its westernmost distribution locality in Murree, Punjab, Pakistan and 635 km west of its easternmost distribution locality in Darjeeling India in south Asia. *P. auritus* is a non-migratory species; distances of inter-colony movements measure < 1 km (Burland et al. 1999). This confirmed location of *P. auritus* in Jumla far beyond its main distribution range in Europe could be attributed to vicariant events during the Pleistocene suggesting the disruption of the formerly continuous range (Spitzenberger et al. 2006). Hence, isolated habitat in Jumla is of high conservation value for non-migratory species like *P auritus*.

Likewise, the site is located at about 160 km west of both those pervious records habitats explained by Sanborn (1950) and Thapa et al. (2014) in Jomsom, Mustang. This record was approximately 900 m away from the forests on the southern slope comprising of *Abies spectabilis*, *Betula utilis, Cedrus deodara, Drepanostachyum falcatum, Juniperus* sp., *Quercus lanata, Q. semecarpifolia, Rhododendron anthopogon, R. arboreum, R. barbatum, Tsuga dumosa*, and shrubs like *Rosa* sp. (Rosaceae) and vegetation was similar to those explained by Thapa et al. (2014). The traditional wooden residential building in which the brown long-eared bat was recorded lies next to a large orchard of apricot, walnut, peach, pear, and plum in the urban center of Chandannath Municipality. These days those traditional wooden buildings and orchards which used to act as roosting sites for bats are being gradually replaced by modern buildings as a result of urbanization.

This paper documents an incidental record of *P. auritus*. Morphometric measurements of forearm length, tragus width, thumb length, ventral and dorsal hair length and

Table 1 - Sex and Morphometric measurements of the *P. auritus* from Jumla and Mustang.

External Characters	Jumla (current study) (mm)	Mustang District, Nepal, 2003 (Thapa et al. 2010) (mm)
Sex	Male	Female
Forearm length	38.8	41
Tibia length	17.2	18
Hind foot length	7.8	8
Tragus length	14.7	15
Tragus Width	4.8	NA
Thumb length	7.2	NA
3rd metacarpal length	39.6	35
4th metacarpal length	36.3	36
5th metacarpal length	35.1	36
Length of 1st phalanx of 3rd metacarpal	16.3	16
Length of 2nd phalanx of 3rd metacarpal	19.6	20
Length of 1st phalanx of 4th metacarpal	11.5	11
Length of 2nd phalanx of 4th metacarpal	11.6	12
Length of 1st phalanx of 5th metacarpal	10.3	11
Length of 2nd phalanx of 5th metacarpal	9.4	20

morphological observations like brown furry face, hard triangular lip pad, semitransparent long brown ears, inflated muzzle and uniformly dark brown, dense, and woolly dorsal and ventral pelages of the bat recorded in Jumla are in line with the features of *P. auritus* explained by Strelkov (1988,1989), Kiefer & von Helversen (2004), Tvrtkovic et al. (2005), Spitzenberger et al. (2006), Dietz et al. (2007) and Archarya et. al (2010). Hence, *P. auritus* occupancy has been confirmed, representing the third published report in the literature for the country and first for Jumla. Its distribution was within the previously provided elevational range 2300-3600 m a.s.l (Baral & Shah 2008) and below the highest elevational record of 3938 m a.s.l by Thapa et al. (2014). This record suggests that either the species has previously been overlooked in this area or that it has extended its range.

Hodgson collected the holotype named *Plecotus homochrous* in 1847 and labelled it as a male taken in the 'central region of sub-Himalayas' (Spitzenberger et al. 2006) which does not necessarily mean Nepal and, in fact, may have been Darjeeling in India or Sikkim (Sanborn 1950, Bates & Harrison 1997). The collection of the Natural History Museum, London holds two additional bats from the 'Indian Museum, ex Coll. Hodgson' with British Museum (BM) 79.11.21.98 and 79.11.21.99. Both were assigned the name *Plecotus homochrous* Hodgson and in 79.11.21.99 the name *darjilingensis* was added. Similarly, one more specimen (1993.91) named *Plecotus auritus*, was added and labelled with the following notes: 'India, ? Darjeeling'. Jerdon's (1867) reported that *homochrous* and *darjilingensis*, both described by Hodgson, were probably conspecific with the 'European bat'. *P homochrous* is an eastern Palearctic species and its distribution in Nepal could be attributed to arboreal refugia called Nepalesian refuge (Spitzenberger et al. 2006).

Due to ambiguity of Hodgson's record we are treating Fleming's specimen as the first from Nepal. The first Nepalese Brown long-eared bat specimen was collected by R. L. Fleming at an elevation of 2804 m a.s.l from Jomsom (28°49'N, 83°42'E), Mustang District on 6 December 1949. That female specimen was retained in the collections of the Field Museum of Natural History (FMNH), Chicago, USA with FMNH catalogue number and Electronic Museum Internal Record Numbers (Emu IRN) 67304 and 2566529 respectively. The specimen collected was found frozen to a rock in the Kali Gandaki River bank (Sanborn 1950). However, the coordinates provided in FMNH catalogue were for Baglung District and not for Mustang, creating confusion of the true location from where the species was collected (Thapa et al. 2014). We plotted the same coordinates using ArcGIS and found them to be in Mustang district of Nepal (Fig. 3). So, we can confidently say that the specimen collected by Fleming was from Mustang. The specimen retained in the collections of the FMNH, Chicago, USA had been listed as *P. auritus homochrous* (Pearch 2011) based on the taxonomy of Csorba et al. (1999). Its forearm length measure was 44.5 mm (Sanborn 1950), which is within the range of *P. austriacus*, the grey long-eared bat (41.9–45.1 mm, n=10) but notably beyond the range of *P. auritus* (36.5–40.3 mm, n=4) (Bates & Harrison 1997). Thapa et al. (2014) has therefore questioned the identity of Fleming's specimen as *P. auritus* without any further explanation.

Madhu Chettri's collection of a dead adult female specimen at an altitude of 3938 m a.s.l. from Lomanthang Rural Municipality (from a place called Chhonhup at the time), Mustang (29°12.032'N; 83° 56.572'E) in June 2003, is the second record of a brown long-eared bat for the country in the literature. This specimen was retained in the collections of the Natural History Museum (NHM), Swoyambhu, Kathmandu with catalogue number NHM

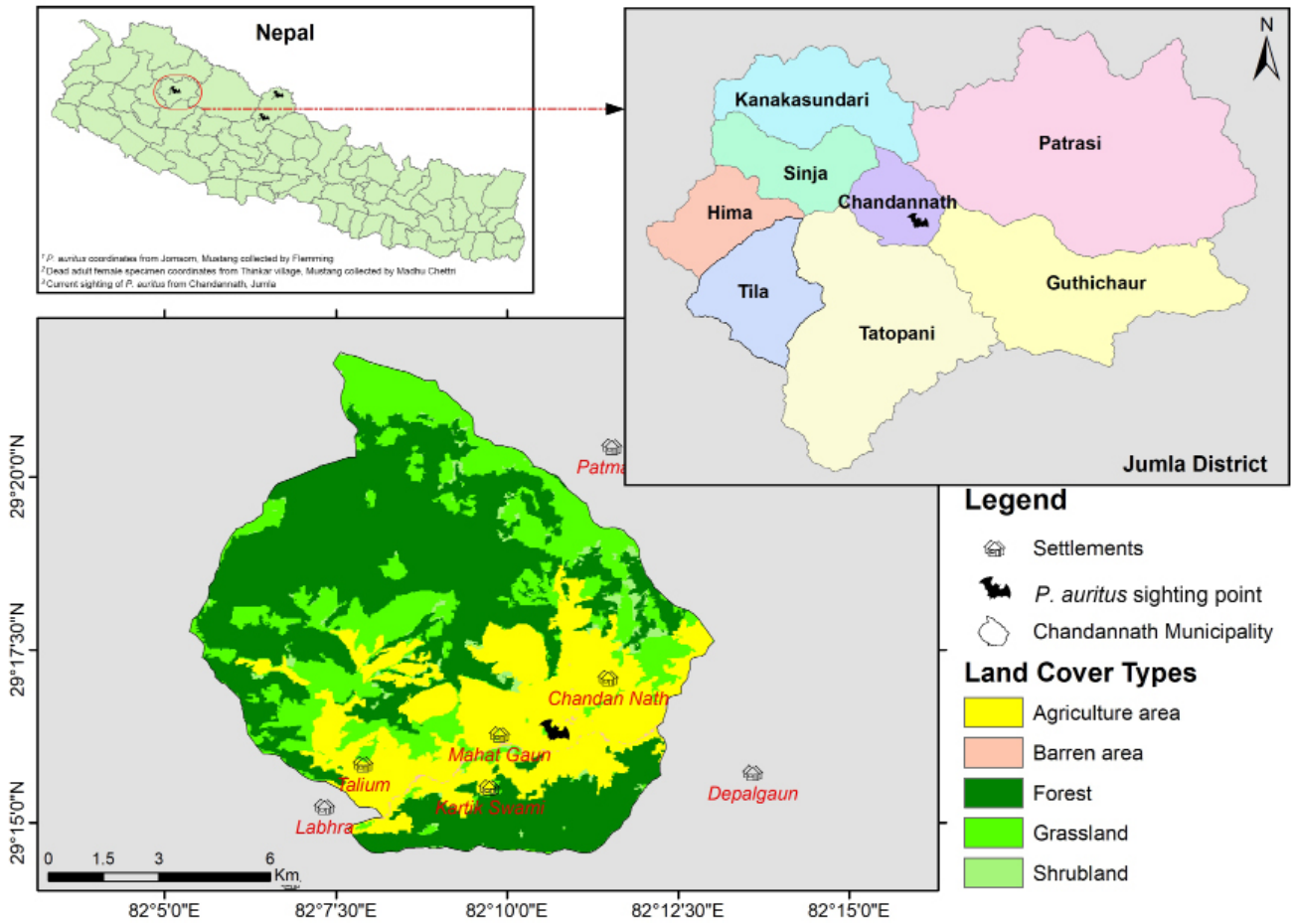

Fig. 3 - Study area depicting *P. auritus* sighting point on a land cover map retrieved from the International Centre for Integrated Mountain Development (ICIMOD) regional database system (ICIMOD 2013).

246 on 4 November 2003. Thapa et al. (2014) affirmed this specimen from Chhonhup to be the highest ever elevational record of 3938 m a.s.l for *P. auritus*. Thapa et al. (2014) also outlined thirteen morphometric measurements including forearm dimensions and morphological description of the specimen in order to confirm the specimen collected to be *P. auritus* specimen.

However, neither Sanborn (1950) nor Thapa et al. (2014) provided cranial measurements to confirm the specimen as *P. auritus* (Pearch 2011). Although this paper too lacks cranial measurement and genetic analysis of faeces to confirm the species as *P. auritus*, the forearm length of *P auritus* in Jumla was 38.8mm which is notably within the range of *P. auritus* (36.5–40.3 mm, n=4) (Bates & Harrison 1997). Likewise, it provides strong supporting evidences to confirm occurrence of *P. auritus* in Jumla from other morphometric measurements and morphological description, in accordance with a number of reference material for this species including first holotype *P. homochorus* for the country. Recent studies revealed that phenetically very similar *Plecotus* species are often separated from each other by high genetic distances (Mayer & Helversen 2001, Spitzenberger et al. 2001, 2002, 2003, Kiefer & Veith 2002, Benda et al. 2004, Juste et al. 2004) so, highly recommend for genetic analysis to avoid taxonomic confusion of such sibling (cryptic) species for this genus.

P. auritus is classified globally as a species of 'least concern' by the International Union for Conservation of Nature (IUCN) red list of threatened species, and as 'data deficient' in the National classification for Nepal. Similarly, it has been Listed in Appendix II of Conservation of Migratory Species of Wild Animals (CMS) and is also protected by National Parks and Wildlife Conservation Act 1973 in Nepal.

To date, there is a lack of information available to make an accurate assessment of its population and its extinction risk in Nepal. Therefore, this study fills an important knowledge gap in this species' distribution in mid-western Nepal and enhances the understanding of *P. auritus*'s distribution and habitat use. Hence, it provides meaningful information for better assessment of extinction risk of this species throughout its habitats. This could be the pioneer observational report on any bat species from mid-western Nepal and hereafter could encourage Nepalese bat researchers to undertake further studies of all the bat species including the brown long-eared bat not only in Jumla, but further afield in Nepal.

This first record of the *P. auritus* from Jumla emphasizes requirement for more intensive research over a period of time to improve understanding of the species' distribution, habitat and ecology in the mid and far- western region.

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