

NATURAL HISTORY NOTE

Record of Great Woolly Horseshoe Bat (*Rhinolophus luctus*, Temmick 1834) in Western Nepal

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ABSTRACT

The study of bats is generally sparse and underdeveloped in Nepal. However, recently, there has been more interest in the bat research, but despite the increase of publications, it is still in its preliminary phase. Proper species inventory and thorough research on the distribution of bats is still lacking. Previously, the Great Woolly Horseshoe Bat (*Rhinolophus luctus*) was recorded from only five different locations in Nepal. Here, we report the range extension of the species to the Western landscape in Nepal. Two independent studies have identified its presence in four new locations: Chamere Gupha (The Bat cave), Banpale forest within the Kaski District, Parbati cave, and the Pipale odaar within Parbat District. Hereby, we provide a new distribution map for *R. luctus* and recommend further research on the ecology of bats in the Mid-western and Far-western regions of Nepal in order to fill current knowledge gaps.

Research on bat ecology through Nepalese researchers began after 2000. Before, the sporadic information was mainly compiled for taxonomic collection by foreign scientists (for example [Hodgson 1835](#), [Scully 1887](#), [Hinton & Fry 1923](#), [Sanborn 1950](#), [Sinha 1970](#), [Abe 1971](#), [Johnson et al. 1980](#), [Mitchell 1980](#), [Kock 1996](#) and [Acharya et al. 2010](#)). In Nepal, although the total number of Nepalese bat species has not been fully assessed ([Bates & Harrison 1997](#), [Hutson et al. 2001](#), [Acharya & Ruedas 2007](#), [Baral & Shah 2008](#)), a checklist of 53 bat species has been recently updated ([Thapa 2010](#)) with the possibility of an additional 17 species ([Acharya & Ruedas 2007](#)). Nepal comprises over 40% of South Asian and approximately 5% of global bat species richness. Previous studies have been focused on first bat species records and monitoring ([Thapa & Thapa 2010](#), [Thapa 2012](#), [Thapa et al. 2014](#)), descriptive studies such as diet ([Sharma 2016](#)), diurnal behavior ([Manandhar et al. 2017](#)) and human disturbance to Pteropid colonies ([Sharma et al. 2018](#)). All the above listed studies were carried out mainly on the Indian Flying fox (*Pteropus giganteus*). Additionally, an acoustic data compilation of bats in Kathmandu was carried out in 2017 ([Thapa 2018](#)) to build a call reference library which revealed the presence of Frateral Myotis (*Myotis frater*), Birdlike Noctule (*Nyctalus aviator*) and Lesser Short-nosed Fruit Bat (*Cynopterus brachyotis*), raising the number of extant bat species in Nepal to 56. However, more comprehensive studies on the ecology and behavior are needed.

The Family Rhinolophidae is characterized by a roughly triangular nose leaf, a lack of cartilage on the ribs from the fusion of presternum, first and second rib, seventh cervical and first thoracic vertebrae, thus forming a solid thoracic ring of bone ([Csorba et al. 2003](#)). Rhinolophidae are distributed throughout the Old World at altitudes of up to 3400 m, and have been found roosting in a variety of sites such as old houses, tree cavities, mines, holes, tunnels, but mostly in caves ([Csorba et al. 2003](#)). The Great Woolly Horseshoe Bat (*Rhinolophus luctus*) is listed as "Least concern" both in the IUCN red list of threatened taxa ([Walston et al. 2008](#)) as well as in the National status ([Jnawali et al. 2011](#)). Its foraging flight is low at only 6-9 m above the ground ([Medway 1969](#)). It has a wide distribution ranging from South to South East Asian countries. In Nepal, *R. luctus* is mentioned to occur from the East to Centre of the country ([Molur et al. 2002](#)). It has been recorded in the forest of Hattiban ([Hinton & Fry 1923](#)), Bansbahari (on the way to Dakshinkali) ([Fry 1925](#)) in Kathmandu, Num VDC of Sankhuwasabha district ([Bates & Harrison 1997](#)), Chitwan National Park ([Hodgson 1843](#), [Suwal et al. 1995](#)) and at Patal Dawar, 3 km East of Bimalnagar, Tanahun district ([Ghimire et al. 2010](#)). Since those studies, two new locations within Kathmandu valley have been added from Nagarkot (N27° 42' 6.876", E85° 31' 37.488") and Sundarijal in the tunnel below the Scout building (N27° 46' 13.512", E85° 25' 33.456") ([Thapa et al. 2018](#)).

This paper reports the first record of *R. luctus* from the Western landscape in Nepal. The findings include two case records from Kaski and Parbat districts of Western Nepal (Fig. 1). In Parbat district, bats were captured using mist nets (4 m, 6 m and 9 m) and a 3-bank harp trap 4 m². Morphometric measurements were recorded using a vernier caliper (0.1 mm accuracy) and pesola balance (0.1 g accuracy). In Kaski, photographic methods were used for surveying cave dwelling bats, cave microclimate was evaluated using temperature and humidity data logger of 0.1°C accuracy. Cave measurements were taken using linear tape and included height of the ceiling from the cave floor, distance from the cave entrance, and height and width of the cave entrance. Height was measured using a bamboo stick; laying it upright until it touches the ceiling and then measuring the bamboo.

R. luctus is characterized by pronounced circular basal lappets (Fig. 2), tip of the sella pointed and angled forwards, reduced and rounded off connecting process, well-developed lancet with rounded off tip (Fig. 3) and large horseshoe that covers the lips on all sides (Csorba et al. 2003). For both new reports, genetic samples and vouchers were not collected due to bureaucratic limitations, but we consider the identifications reliable due to unique defining physical features (Acharya et al. 2010). The morphometric measurements of the captured specimens are provided in Table 1.

Rhinolophus pearsonii, a species of bat with similar size to juvenile *R. luctus*, is also found in Nepal. However, the latter could easily be distinguished from the *Pearsonii* group by the presence of basal circular lappets (Acharya et al. 2010) (Fig. 4).

All the species of the *Trifoliatus* group are characterized by the presence of lateral projecting lappets at the base of its sella (Csorba et al. 2003). Although *R. luctus* could be confused with larger specimens of the group such as

Rhinolophus beddomei (they overlap in forearm length, which range between 54.5 mm to 64.5 mm in *R. beddomei* and 58.0 and 80.50 mm in *R. luctus*), the two species are separated geographically (Csorba et al. 2003). *R. beddomei* is distributed only in Southern India and Sri Lanka (Csorba et al. 2003). In *Trifoliatus* group, *R. luctus* can be distinguished from *Rhinolophus sedulus* (FA 38 mm to 44 mm) by its large size. It can further be separated from *R. trifoliatus* by non-yellowish color of the noseleaf and ears, and from *Rhinolophus formose* by larger skull and teeth measurements (Csorba et al. 2003).

On March 12, 2018, *R. luctus* was first observed in Chamere cave (N28° 15'48", E83° 59'32") of Pokhara valley (Kaski district) at an altitude of 965m above sea level. The entire cave has two compartments - the entrance compartment with daily microclimate fluctuations between 16-22°C and > 80% relative humidity and inner compartment with stable microclimate ranging between 17.5°C and 18.4°C and > 90% relative humidity. The inner compartment is the hibernation roost of *Hipposideros armiger* with estimated counts of 5000±145 individuals during winter months (Baniya et al. 2018). The vicinity of the cave site is characterized by bamboo aggregations and cropland. A bituminous road and man-made structures exist at the East side of the cave entrance while a community protected forest patch is located at a hilly terrain behind the cave. *R. luctus* was seen roosting 10 m inside of the entrance of the cave. No other bats roosted in this compartment during the given period. While surveying the cave crevices for any signs of *H. armiger*, a solitary *R. luctus* was seen roosting at a height of approximately 3.5 m from the cave floor. The species remained in torpor even with heavy inflow of visitors (>70) and excess of noise. It showed no response to disturbance.

On March 20, 2018, this species was detected in the same cave roosting 7m from entrance and 9.5 m above the ground floor. The entrance compartment hosted no other species of bats. On April 18, 2018, *R. luctus* was not observed

Table 1- Morphometric measurements (mm) of *R. luctus* captured in Parbat District and Kaski District (mt-meta tarsal and ph- phalange).

External Characters	Measurements in Parbat District	Measurements in Kaski District
Forearm	74.5	66.5
Body length	73.4	108.2
Ear	31.1	33.9
Tibia	39.7	34.6
Hind foot	10.7	15.6
Tail	45.2	38.6
3mt	48.5	48.5
1ph 3mt	30.4	27.4
2ph 3mt	38.4	40.3
4mt	53.5	55.9
1ph 4mt	15.8	15.9
2ph 4mt	24.8	25.4
5mt	54.3	56.2
1ph 5mt	18.4	17.5
2ph 5mt	26.4	29.4
Sex	Male	Male

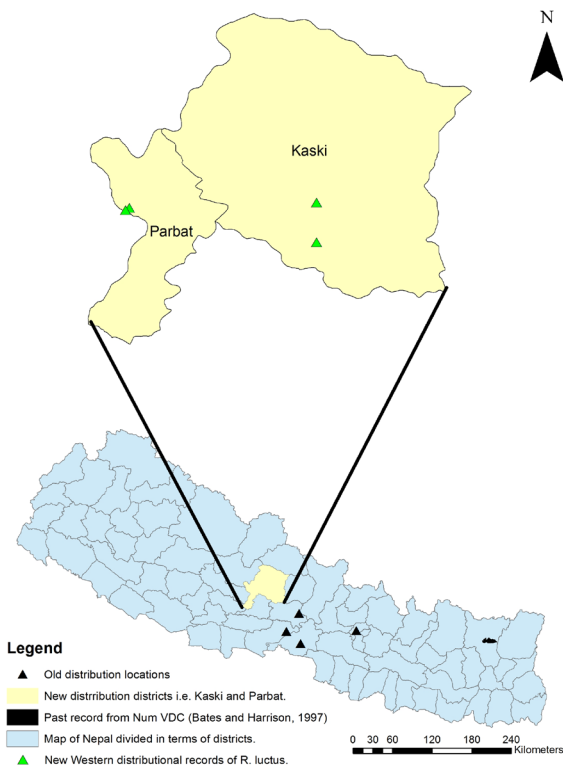


Fig. 1 - Map of Nepal divided in District administrative units showing the present and past distributional record of *R.luctus*. New locations include Kaski and Parbat districts of Western Development Region.

in the cave. Similarly, while following up the research on May 25, 2018 the entrance compartment was occupied by 83 individuals of *H. armiger* and still no trace of *R. luctus*.

On September 20, 2018, an individual of *R. luctus* was caught in a mist net in Banpale forest (N28° 11' 17.28", E83° 59' 23.58" at 831.8m above sea level) located at Institute of Forestry, Pokhara. The sub-tropical forest is approximately 10.6km from the Chamere cave. Two mist nets of 6m and 9m were placed across a known flyway dominated by *Schima wallichii* and *Castanopsis indica* from 19:00 hours till 21:00 hours with frequent inspection of the nets in 20 minutes interval (Serra-Gonçalves et al. 2017). Nine *C. sphinx* and a single *R. luctus* were caught during the period.

In Parbat district, a single individual of *R. luctus* was observed roosting inside Parbati cave (N28° 15'10.8", E83° 38'36.5" at 846 m above sea level) on October 12, 2017. The cave consisted of two chambers, one accessible and another inaccessible. It had four entrances with an estimated 25 m height, 10 m and 17 m width in two openings and 85 m length in the accessible flank. The length of inaccessible chamber could not be estimated. The surrounding vegetation consisted of *Bambusa spp*, *Ficus spp*, *Diploknema butyracea* (Roxb.) H.J. Lam and *Pinus roxburghii* Sarg. Mist nets were installed at the cave openings of both sides and *R. luctus* was captured in the mist net set up at the Southern opening at a height of two meters from ground level. Harp traps were not used in this site because of the large height and width of the entrance. *C. sphinx*, *Rhinolophus pussilus*, *Rhinolophus affinis*, *Miniopterus schreibersii*, *H. armiger* and



Fig. 2 - Frontal view of *R. luctus* captured in Parbati cave of Paang, Parbat on October 2017.



Fig. 3 - *R. luctus* with a well-developed lancet photographed in Bat Cave, Kaski on March, 2018.



Fig. 4 - Differentiating characteristics between *Rhinolophus pearsonii* and *Rhinolophus luctus*. Figure 'A' is a *R. pearsonii* with smaller noseleaf devoid of any basal circular lappets on either side of sella (Photo credit: Hari Basnet). Figure 'B' is a *R. luctus* with clear basal circular lappets."

an unidentified *Myotis* were also captured in harp traps and mist nests placed at the opening of the cave. In April 2017, while conducting a follow up research in Parbat District, another individual was observed roosting solitarily in Pipale oodar cave (N28° 14'56.49", E83° 38'10" at 826m above sea level), about 2 km from Parbati cave.

R. luctus is described as a forest dweller bat, recorded roosting on its own or in pairs from large caves, rocky outcrops, overhanging ledges and large hollow trees (Molur et al. 2002). Our findings confirm the above stated assertion i.e. forest dweller and solitary cave rooster. The record of *R. luctus* for the first time since 1997 (Bates & Harrison 1997, Csorba et al. 1999, Phuyal 2005, Acharya 2006, Phuyal & Dhoubhadel 2006, Adhikari & Mohan 2008, Giri 2009, Adhikari 2010) suggests the need to improve bat research and acoustic monitoring of bats in Pokhara. Contrary to Ghimire et al. (2010) that noted a single *R. luctus* resting at high places inside the cave, the individuals observed during this study were roosting at about 3.5 m from the cave floor despite 12 m height at the entrance. This indicates *R. luctus* might be flexible in terms of microhabitat roost selection. The ecological aspects of the species remains to be explored. Although the species is classified as "Least Concern" (Walston et al. 2008), information on its roosting, breeding, hibernation and feeding ecology is lacking. Current records of *R. luctus* from Pokhara and Parbat highlight the need of revision of previous literature such as the species list for bats in Pokhara (Adhikari 2008). We expect that further bat surveys at Mid-western and Far-western Nepal would generate additional records of the species. Dietary studies of *R. luctus* using faecal samples after capturing will be useful to understand its role in hilly ecosystems such as broad-leaved forest in Nepal. It is also fundamental to understand how this species uses the habitat available, and identify the major threats to this species. Baseline information of its range, habitat and population status is, therefore, pivotal to the conservation of the species.

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REFERENCES

- ABE, H. (1971). Small mammals of Central Nepal. *Journal of the faculty of agriculture, Hokkaido University*, 56(4): 367-423.
- ACHARYA, P. R. (2006). Distribution of roosting and survival threats of bat in Pokhara valley with reference to species and population survey at Chamere Gupha. A dissertation submitted to the Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal.
- ACHARYA, P. R. & RUEDAS, L. A. (2007). The Bat fauna of Nepal: a current conspectus. *BAT NET-CCINSA newsletter*, 8(1-2): 16-19.
- ACHARYA, P. R., ADHIKARI, H., DAHAL, S., THAPA, A. & THAPA, S. (2010). Bats of Nepal: a field guide. Small mammals conservation and research foundation, New Baneshwor, Kathmandu, Nepal, 116 pp.
- ADHIKARI, H. (2008). From radio Annapurna to Nepal. *BAT NET-CCINSA newsletter*, 9(1): 23.
- ADHIKARI, H. & MOHAN, K. C. (2008). One day training program on bats, organized at Bat Cave, Pokhara. *BAT NET-CCINSA newsletter*, 9(1): 21-22.
- ADHIKARI, H. (2010). Species richness, distribution, and threats of bats in (Palpa and Kaski districts) of western Nepal. *Small mammal mail*, 1-15.
- BANIYA, S., ACHARYA, P. R. & RAUT, N. (2018). Roost preference and colony monitoring of the Great Himalayan leaf-nosed bat (*Hipposideros armiger* Hodgson, 1835: family *Hipposideridae*)- A case study in Bat cave and Mahendra cave, Pokhara, Nepal. <https://doi.org/10.13140/RG.2.2.21564.08325>
- BARAL, H. S. & SHAH, K. (2008). Wild mammals of Nepal. Himalayan Nature, Kathmandu, Nepal, 158 pp.
- BATES, P. J. J. & HARRISON, D. L. (1997). Bats of Indian subcontinent. Harrison zoological museum publication, Sevenoaks, Kent, United Kingdom, 250 pp.
- CSORBA, G., KRUSKOP, S. V. & BORISSENKO, A. V. (1999). Recent records of bats (Chiroptera) from Nepal, with remarks on their natural history. *Mammalia*, 63(1): 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, Berkshire, United Kingdom, 160 pp.
- FRY, T. B. (1925). Bombay natural history society's mammal survey of India, Burma, and Ceylon. Report No. 37a: Nepal. *Journal of the Bombay natural history society*, 30: 525-530.

- GHIMIRE, R., ACHARYA, S. & THAPA, S. B. (2010). Monitoring of Chiropteran status in Tanahun district. Small mammals conservation club, Central department of environmental science, Tribhuvan University, Kirtipur, Kathmandu and Small mammals conservation and research foundation, New Baneshwor, Kathmandu, Nepal, 35 pp.
- GIRI, B. K. (2009). Habitat suitability mapping and species identification of Chiroptera: a case study from Kaski district, Nepal. Institute of Forestry (IOF), Tribhuvan University, Pokhara, Nepal. <https://doi.org/10.13140/RG.2.2.32760.55044/1>
- HINTON, M. A. G. & FRY, T. B. (1923). Bombay natural history society's mammal survey of India, Burma, and Ceylon. Report No. 37: Nepal. *Journal of the Bombay natural history society*, 29: 399-428.
- HODGSON, B. H. (1835). Synopsis of the Vespertilionidae of Nepal. *Journal of Asiatic society of Bengal*, 4: 699-701.
- HODGSON, B. H. (1843). Notice of two marmots inhabiting respectively the plains of Tibet and the Himalayan slopes near the snows, and also of a *Rhinolophus* of the central region of Nepal. *Journal of the Asiatic society of Bengal*, 12: 409-414.
- HUTSON, A. M., MICKLEBURGH, S. P. & RACEY, P. A. (comp.). (2001). Microchiropteran bats: global status survey and conservation action plan. IUCN/SSC Chiroptera specialist group, IUCN: Gland, Switzerland and Cambridge, United Kingdom, 258 pp. <https://doi.org/10.2305/IUCN.CH.2001.SSC-AP.1.en>
- JNAWALI, S. R., BARAL, H. S., LEE, S., ACHARYA, K. P., UPADHYAY, G. P., PANDEY, M., SHRESTHA, R., JOSHI, D., LAMINCHHANE, B. R., GRIFFITHS, J., KHATIWADA, A. P., SUBEDI, N. & AMIN, R. (comp.). (2011). The status of Nepal mammals: the national red list series, 4. Department of national parks and wildlife conservation Kathmandu, Nepal. Preface by Simon M. Stuart Chair IUCN species survival commission. <https://doi.org/10.13140/RG.2.1.2561.7448>
- JOHNSON, D. H., RIPLEY, S. D. & THONGLONGYA, K. (1980). Mammals from Nepal. *Journal of Bombay natural history society*, 77: 56-63.
- KOCK, D. (1996). Fledermause aus Nepal (Mammalia: Chiroptera). *Senckenbergiana Biologica*, 75: 15-21.
- MANANDHAR, S., THAPA, S., SHRESTHA, T. K., JYAKHWO, R., WRIGHT, W. & ARYAL, A. (2017). Population status and diurnal behaviour of the Indian Flying Fox *Pteropus giganteus* (Brünnich, 1782) in Kathmandu Valley, Nepal. *Proceedings of the zoological society*, 71(4): 363-375. <https://doi.org/10.1007/s12595-017-0219-x>
- MEDWAY, L. (1969). The wild mammals of Malaya and offshore islands including Singapore. Kuala Lumpur: Oxford University Press, Kuala Lumpur, Malaysia, 127 pp.
- MITCHELL, R.M. (1980). New records of bats (Chiroptera) from Nepal. *Mammalia*, 44 (3): 339-342. <https://doi.org/10.1515/mamm.1980.44.3.339>
- MOLUR, S., MARIMUTHU, G., SRINIVASULU, C., MISTRY, S., HUTSON, A. M., BATES, P. J. J., WALKER, S., PRIYA, P. P. & PRIYA, A. R. B. (2002). Status of south asian Chiroptera: conservation assessment and management plan (C.A.M.P.) workshop report, 317 pp.
- PHUYAL, S. P. (2005). Survey of bats of Pokhara Valley, Nepal. Report submitted to Bat Conservation International, Austin, Texas, USA.
- PHUYAL, S. P. & DHOUBHADEL, S. P. (2006). Status and threats of bats of Pokhara Valley. *BAT NET-CCINSA newsletter*, 7(1-2): 34-36
- SANBORN, C.C. (1950). A Nepal record of the Long-eared bat (*Plecotus homochrous* Hodgson). *Natural history miscellanea*, 69: 1- 2.
- SCULLY, J. (1887). On the Chiroptera of Nepal. *Journal of Asiatic society Bengal*, 56: 233-259.
- SERRA-GONÇALVES, C., LÓPEZ-BAUCELLS, A. & ROCHA, R. (2017). Opportunistic predation of a silky short-tailed bat (*Carollia brevicauda*) by a tawny-bellied screech-owl (*Megascops watsonii*), with a compilation of predation events upon bats entangled in mist-nets. *Journal of bat research & conservation*, 10(1): 7. <https://doi.org/10.14709/Barbj.10.1.2017.07>
- SHARMA, B. (2016). Diet analysis of Indian Flying Fox in subtropical mid hill of Nepal. Institute of Forestry (IOF), Tribhuvan University, Pokhara, Nepal.
- SHARMA, B., SUBEDI, A., GYAWALI, K., GHIMIRE, P., BIST, B. S. & BANIIYA, S. (2018). Can *Pteropus giganteus* Brünnich, 1782 co-exist in a human dominated landscape? A case study in Pokhara valley, western Nepal. *Journal of bat research & conservation*, 11(1): 6. <https://doi.org/10.14709/Barbj.11.1.2018.06>
- SINHA, Y. P. (1970). Taxonomic notes on some Indian bats. *Mammalia*, 34: 81-92.
- SUWAL, R., VERHEUGT, W. J. M. & YONZAN, P. (1995). Enumeration of the mammals of Nepal. Department of national parks and wildlife conservation, Kathmandu, Nepal. 119 pp.
- THAPA, S. (2010). An updated checklist of valid bat species of Nepal. *Small mammal mail-bi- annual newsletter of CCINSA & RISCINSA*, 2(1): 16-17.
- THAPA, A. & THAPA, S. (2010). A short note on chiropteran status from Kailash cave, Syangja district, Western Nepal. *Lifescience Journo-Magazine*, 2(1): 1-7.
- THAPA, S., SHRESTHA, S., DAHAL, S., DANIEL, B. A., & SINGH, N. B. (2012). Monitoring and conservation of bats in the Kathmandu valley, Nepal. *Asian journal of conservation biology*, 1(1): 1-4.

- THAPA, S., SHAH, K. B. & CHETRI, M. (2014). The highest elevation record of the brown Long-eared bat (*Plecotus auritus*). *The journal of Asian biodiversity*, 6(1): 63-65. <https://doi.org/10.4038/tapro.v6i1.7093>
- THAPA, S. (2018). Habitat and acoustic survey and an action plan for bats conservation in the Kathmandu valley, Nepal. The Rufford small grants foundation, 34 pp.
- WALSTON, J., KINGSTON, T. & HUTSON, A. M. (2008). *Rhinolophus luctus*. The IUCN red list of threatened species 2008: e.T. <http://doi.org/10.2305/IUCN.UK.2008.RLTS.T19548A8972416.en>