

OPEN ACCESS



The Journal of Threatened Taxa is dedicated to building evidence for conservation globally by publishing peer-reviewed articles online every month at a reasonably rapid rate at www.threatenedtaxa.org. All articles published in JoTT are registered under [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/) unless otherwise mentioned. JoTT allows unrestricted use of articles in any medium, reproduction, and distribution by providing adequate credit to the authors and the source of publication.



Journal of Threatened Taxa

Building evidence for conservation globally

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

SHORT COMMUNICATION

**FIRST RECORD OF A WRINKLE-LIPPED FREE-TAILED BAT
CHAEREPHON PLICATUS BUCHANNAN, 1800 (MAMMALIA:
CHIROPTERA: MOLOSSIDAE) COLONY IN SRI LANKA, WITH
NOTES ON ECHOLOCATION CALLS AND TAXONOMY**

Tharaka Kusuminda & Wipula B. Yapa

26 April 2017 | Vol. 9 | No. 4 | Pp. 10115–10120
10.11609/jott.3279.9.4.10115-10120



For Focus, Scope, Aims, Policies and Guidelines visit http://threatenedtaxa.org/About_JoTT
For Article Submission Guidelines visit http://threatenedtaxa.org/Submission_Guidelines
For Policies against Scientific Misconduct visit http://threatenedtaxa.org/JoTT_Policy_against_Scientific_Misconduct
For reprints contact <info@threatenedtaxa.org>

Partner



Publisher/Host





ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

FIRST RECORD OF A WRINKLE-LIPPED FREE-TAILED BAT *CHAEREPHON PLICATUS* BUCHANNAN, 1800 (MAMMALIA: CHIROPTERA: MOLOSSIDAE) COLONY IN SRI LANKA, WITH NOTES ON ECHOLOCATION CALLS AND TAXONOMY

Tharaka Kusuminda¹ & Wipula B. Yapa²

¹Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

²Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, Colombo, Sri Lanka

¹t.kusuminda@gmail.com (corresponding author), ²wipula@gmail.com

OPEN ACCESS



Abstract: In this paper we report the discovery of a colony of Wrinkle-lipped Free-tailed Bat *Chaerephon plicatus* for the first time in Sri Lanka, and a record of this species after a lapse of 20 years. *C. plicatus* has been recorded twice previously, in 1935 and 1997, but a roosting colony has not been recorded before. In May 2016, a colony containing about 300 *C. plicatus* was observed in a vertical cleft of the rock supporting Sigiriya fortress, a popular historical tourist destination. Four bats were captured during their evening emergence using mist nets. Recording of echolocation calls showed them to be similar to those previously documented for this species in being narrow bandwidth with shallow frequency modulation and low peak frequency (24.9–30.3 kHz), with average call duration of 7.7 milliseconds (ms). The forearm length range (45.2–49.1 mm) of captured specimens corresponds to the specimen recorded in 1997 in Sri Lanka and with those recorded in Vietnam and Myanmar. The discovery of a colony of *C. plicatus* in Sri Lanka provides a basis for future studies of the biology and taxonomy of this species.

Keywords: *Chaerephon plicatus*, Molossidae, roosting site, Sigiriya, Sri Lanka.

Free-tailed bats of the family Molossidae are thought to be the swiftest of all bats, and their tendency to fly well above the canopy keeps them out of human reach (Freeman 1981). Members of this widely-distributed family are found in Africa, southern Europe, southern Asia, Australia and North, Central and South America (Bates & Harrison 1997). The number of species in the family continues to grow with current estimates totaling 111 species (Ammerman et al. 2012; Ralph et al. 2015; Tsang et al. 2016). Four species of free-tail bats belonging to three genera are reported from southern Asia (Bates & Harrison 1997; Srinivasulu et al. 2010). In Sri Lanka only two species of free-tail bats have been recorded: Egyptian Free-tailed Bat *Tadarida aegyptiaca* and the Wrinkle-lipped Free-tail Bat *Chaerephon plicatus* Buchannan 1800 (Phillips 1980; Bates & Harrison 1997).

C. plicatus is a geographically widespread species ranging from India and Sri Lanka to Myanmar, Thailand, Cambodia, Vietnam, southern China, Hong Kong, and

DOI: <http://doi.org/10.11609/jott.3279.9.4.10115-10120> | **ZooBank:** urn:lsid:zoobank.org:pub:639DB651-5E25-43DB-A637-4CB539614937

Editor: Anonymity requested.

Date of publication: 26 April 2017 (online & print)

Manuscript details: Ms # 3279 | Received 08 January 2017 | Final received 30 March 2017 | Finally accepted 02 April 2017

Citation: Kusuminda, T. & W.B. Yapa (2017). First record of a Wrinkle-lipped Free-tailed Bat *Chaerephon plicatus* Buchannan, 1800 (Mammalia: Chiroptera: Molossidae) colony in Sri Lanka, with notes on echolocation calls and taxonomy. *Journal of Threatened Taxa* 9(4): 10115–10120; <http://doi.org/10.11609/jott.3279.9.4.10115-10120>

Copyright: © Kusuminda & Yapa 2017. Creative Commons Attribution 4.0 International License. JoTT allows unrestricted use of this article in any medium, reproduction and distribution by providing adequate credit to the authors and the source of publication.

Funding: None.

Competing interests: The authors declare no competing interests.



Acknowledgements: We are extending thanks to Ms. Madumi Kariyawasam, Ms. Sumudu Jayakody and Mr. Malith Wijeratne of University of Colombo for giving their assistance during field works. We thank Director Generals of the Central Cultural Fund (CCF), Archeological Department of Sri Lanka and Department of Wildlife Conservation in Sri Lanka for providing their permission to work in the study site and capture bats (Permit No. WL/3/2/02/2016). We thank Mr. Kusumsiri Kodituwakku (CCF), Mr. Senaka Jayasuriya and Mr. Ranjith Bandara (Archeological Department) for their support given during field works. We acknowledge to Dr. Paul Bates, Dr. Vu Dinh Thong, Dr. Bruce Patterson, Dr. Tamás Görföl, Mr. Timothy Hornby and Mr. Duminda Dissanayake for providing necessary literature on the focal species and photographs of museum specimen to confirm the species identifications. We thank Dr. Jon Flanders for his helpful comments on the manuscript. Finally encouragements received from Mr. Bernard Geeganage, Dr. Amani Mannakkara, Mr. Sameera Suranjan Karunaratna and Mrs. Niroshi Madushani are highly appreciated.

southeast to Philippines, Malaysia, Lao PDR and Indonesia (Csorba et al. 2014). The current literature gives very little information on the population status and roosting ecology of this species in the Indian subcontinent (Bates & Harrison 1997). *C. plicatus* was first recorded in Sri Lanka in 1931 from Kumbalgamuwa in the Central Province (Phillips 1932) (Fig. 1). It was described as a subspecies, *Chaerephon plicatus insularis*, based on the three specimens collected by shooting free flying bats (Phillips 1932). After 65 years a single specimen was captured in a mist net in Bulathsinhala of the Western Province of Sri Lanka in 1996 (Bates & Harrison 1997) (Fig. 1). Bates & Harrison (1997) speculated that this species probably roosted in a crevice in the sheer rock face above the Pahiyangala temple. *Chaerephon plicatus* has therefore only been recorded twice in Sri Lanka despite several extensive field studies on Sri Lankan bats being carried out in the recent past (Digana et al. 2001; Yapa et al. 2002). At present, *C. plicatus* is listed as a Critically Endangered species in Sri Lanka and presumably Least Concern worldwide due to its wide distribution (Ministry of Environment 2012; Csorba et al. 2014). In this paper we report the discovery of a roosting colony of *C. plicatus* in Sri Lanka for the first time.

MATERIALS AND METHODS

Study site

Field studies were conducted in the Sigiriya rock fortress (7°57'N & 80°45'E) in the Matale District near Dambulla City, Central Province, Sri Lanka in May 2016 (Fig. 1). Sigiriya rock fortress is a UNESCO World Heritage Site and one of Sri Lanka's most well-known and popular tourist destinations, visited by thousands of people every year. The gigantic granite rock rises 200 m above the surrounding plain (377 m above sea level), which lies within the Sigiriya sanctuary and surrounded to the west by 40ha of parkland and ornamental gardens, situated in the dry zone. The study area receives a mean annual rainfall of 1,750mm with a distinct dry season from May to September. The mean annual daytime temperature is approximately 30°C, although the maximum temperature may exceed 37°C (Pavey et al. 2001; Perera 2012; Dissanayake et al. 2014).

Field sampling

There is a man-made observation platform at a feature known as the Mirror Wall at the bottom of the western rock face. A network of staircases leads from the base of the rock to this platform, from which during the initial survey on 14 December 2015 a colony of bats was recorded and observations of the roosting

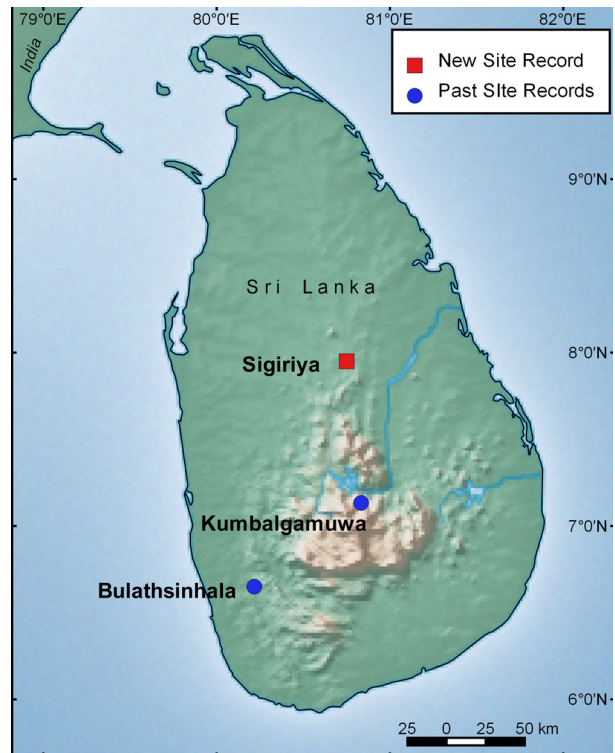


Figure 1. Location of Sigiriya Rock Fortress, the newly discovered colony of *Chaerephon plicatus* and previously reported locations for the species in Sri Lanka.

site were made using a 10x26 binocular (Bushnell Outdoor Products, USA). GPS coordinates were taken using a Garmin eTrex 20 hand-held GPS receiver (Garmin International, Inc., USA). Roosting bats were counted using photos of the site (Thomas & LaVal 1988; Sutherland 2006), and during a subsequent visit on 08 May 2016 a mist net was set near to the Mirror Wall in front of the entrance of the roosting site from 17:45–18:30 hr. Dimensions of the mist net were 2.5x6 m, and mesh size was 38mm. Captured bats were immediately removed from the net and kept in clean cotton bags for identification. A wing punch from the left wing of each specimen was taken using 3mm Miltex biopsy punch (Integra Lifescience Corporation, USA) after sterilizing the cutting edge. Tissue samples were stored in 99% ethanol for future molecular analysis.

Morphological measurements

Measurements of captured individuals were recorded using a digital vernier caliper (Mitutoyo, Japan): forearm length (FA), head and body length (H&B), tail length (T), tibia length (Tib), hind foot length (HF), length of third metacarpal (3mt), length of first phalange of 3mt (1ph 3mt), length of second phalange of 3mt (2ph 3mt),

length of fourth metacarpal (4mt) and length of fifth metacarpal (5mt). Weights were measured using a 100g spring balance (Pesola AG, Switzerland). Photographs of bats were taken using Fujifilm finepix S4000 digital camera (Fujifilm Holding Corporation, Japan). Species identification was done using the original description of the species (Buchanan 1800) and other local and regional bat guides (Phillips 1980; Bates & Harrison 1997).

Acoustic measurement

After recording morphological and morphometric data, bats were released at the capture site and their echolocation calls were recorded during release using a Pettersson M500 microphone (Pettersson Elektronik AB, Sweden) and BatSound Touch software (Pettersson Elektronik AB, Sweden) on a Dell Core i5 laptop (Dell Inc., USA) as sound files (.wav) (Audio 1). A total of 10 individuals, unambiguous echolocation calls with high signal to noise ratio of four free flying individuals of *C. plicatus* were selected for further analyses. Bat echolocation calls were analysed using BatSound Pro v.3.32 (Pettersson Elektronik AB, Sweden) with software settings at FFT size = 1024 samples, with 95% overlap in a Hanning Window. From spectrograms, standard acoustic parameters of the fundamental calls were measured manually in kilohertz (kHz): Start Frequency (SF), End Frequency (EF) and Frequency with maximum Energy (FmaxE) or Peak Frequency. Call duration (t), and Inter-Pulse Interval (IPI) of selected calls were measured in milliseconds (ms) from the Oscillograms (Brigham et al. 2004; Hughes et al. 2011).

RESULTS

Four bats were captured during evening emergence: three males and a female (weight 15–28 g). Morphometric data for these specimens were compared with published data (Tables 1 & 2). Forearm measurements obtained from this study (45.2–49.1 mm) are within the forearm measurements (43.1–50.2 mm) compared in Table 1 except for measurements published by Phillips (1932). External morphological features confirm that this species is a member of the Family Molossidae, and it can clearly be distinguished from all other bats so far recorded in Sri Lanka (Image 1A). Ears are large and irregular in shape with their anterior borders connected with a skin fold. A strip of fur is visible dorsally, just below the anterior edge of ears, starting from inner base of ear. Antitragus well developed and prominent. Tragus very small, truncated (Image 1B), and concealed entirely by the antitragus. Muzzle almost naked, but has several long, erect bristles and more short bristles, muzzle broad and blunt with very thick, fluted lips, the upper lip overhanging the lower. Eyes relatively large. Wings long (Wingspan: 30–33 cm) and narrow with the membranes arising from tibia. Interfemoral membrane poorly developed. Tail relatively shorter (47–63 %) than the head and body length, stout, naked and major portion free and protruding from the outer edge of the interfemoral membrane; Thumb small with a well-developed pad at the base. Feet rather short, the toes and their small claws are partially concealed by longish hair; outer toes relatively thickened and the spatulate hairs densely on ventral surface of the first and fifth digits. Pelage short, very dense and soft, somewhat velvet, dark brown on upper side, slightly paler on ventral surface. Another

Table 1. Key measurements of *C. plicatus* (this study) compared with three other published measurements from Sri Lanka, Myanmar and Vietnam (Definitions for all the abbreviations below are given in the materials and methods section).

| Character/ Measurement (mm) | <i>C. plicatus</i> Present study (n=4) | <i>C. plicatus insularis</i> (Phillips 1932) from Sri Lanka | <i>C. plicatus</i> (Bates & Harrison 1997) from Sri Lanka and Myanmar | <i>C. plicatus</i> (Thong 2014) from Vietnam |
|--------------------------------|---|--|---|---|
| FA | 45.2–49.1 | 34–44 | 43.1–50.2 | 46.2–49.3 |
| H&B | 59.9–67.2 | 64–66 | 66–71 | – |
| Tail | 31.9–41.2 | 36–40 | 30–44 | 35.1–39.4 |
| Tib | 15.5–16.2 | – | – | 16.2–16.5 |
| HF | 10.0–11.1 | 9.5–10.5 | 9.0–11.3 | 8.1–11.4 |
| 3mt | 45.9–48.6 | – | 43.9–49.4 | – |
| 1ph of 3mt | 19.1–20.7 | – | – | – |
| 2ph of 3mt | 17.2–19.9 | – | – | – |
| 4mt | 41.3–48.0 | – | 41.8–47.0 | – |
| 5mt | 27.6–29.4 | – | 26.1–28.6 | – |

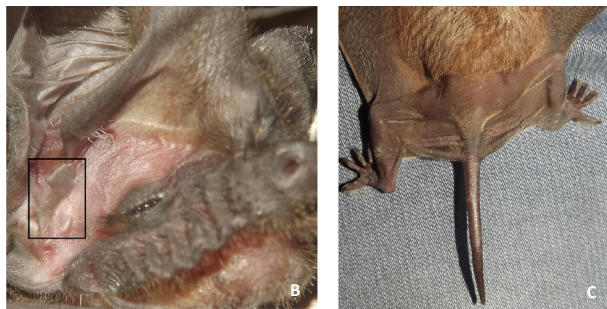


Image 1. *Chaerephon plicatus* at Sigiriya Rock Fortress, Sri Lanka. A - Face; B - Tragus; C - Naked rump.



Image 2. Western face of Sigiriya Rock Fortress, Sri Lanka.

Table 2. Individual measurements of *C. plicatus* (present study)

| Character/Measurement (mm) | Specimen 1 | Specimen 2 | Specimen 3 | Specimen 4 |
|----------------------------|------------|------------|------------|------------|
| Gender | Male | Male | Female | Male |
| FA | 49.1 | 45.2 | 48.5 | 46.7 |
| H&B | 65.6 | 67.2 | 59.9 | 67.0 |
| Tail | 41.2 | 33.4 | 37.9 | 31.9 |
| Tib | 16.1 | 16.2 | 16.2 | 15.5 |
| HF | 11.1 | 10.1 | 10.0 | 10.7 |
| 3mt | 48.5 | 45.9 | 48.6 | 47.6 |
| lph 3mt | 20.7 | 19.1 | 20.1 | 20.1 |
| 2ph 3mt | 18.9 | 17.2 | 19.6 | 19.9 |
| 4mt | 48.0 | 45.2 | 41.3 | 47.1 |
| 5mt | 29.2 | 27.6 | 29.4 | 28.3 |

distinct feature of the captured bats is that the rump on the dorsal surface is characteristically naked (Image 1C). The dorsal fur coat never extends to the lateral margins of the wing membranes. In contrast, fur extends to the ventral surface of wing-membrane including the interfemoral membrane.

The focal colony of *C. plicatus* was roosting inside vertical crevices in the west face of Sigiriya Rock (Image 2). The crevice runs vertically about 3m and the width is rather narrow, not more than 10cm. The colony size appeared to be about 300 individuals. Bats were clinging on to the rock surface using their hind feet and thumbs while keeping heads downward. Loud social calls were very distinct even at a distance of 10–15 m from the roost, but as Little Swifts *Apus affinis* are also occupying nearby crevices of the rock surface it can be hard to detect the colonies of the bats for an inexperienced observer. Emergence occurred at 3 minutes before sunset (18:18) on 08 May 2016 with one or two individuals leaving at a time. The returning bats first landed on the vertical rock face closer to the crevice and then crawled in to the crevice forward.

Analysis of the echolocation calls of each of the four released bats (n=10 calls) were distinctly narrow band, shallower frequency modulation calls with low peak frequency (24.9–30.3 kHz) with an average call duration

of 7.7ms (Table 3). For each call the spectrogram clearly shows one fundamental signal, one harmonic and a partial echo of the fundamental signal (Image 3). The calls are characterized with the presence of a distinct small hook at the beginning of the call (Image 3).

DISCUSSION

This is the first confirmed record of a roosting site of *C. plicatus* in Sri Lanka, and the first report of this species on the island in almost 20 years. *C. plicatus* has never been captured in several island-wide surveys conducted previously (Digana et al. 2001; Yapa et al. 2002). Free-tailed bats are fast flying bats and tend to fly well above the canopy and out of human reach (Freeman 1981). They use a wide variety of roosts in caves, rock crevices, tree cavities and manmade structures (Altringham 2011). Shek (2006) reported that nothing is known about the roosting sites of this species in Hong Kong. According to Thong (2014), *C. plicatus* roosts in a cave of limestone karst and crevices of rocks in Vietnam. Colonies range between thousands and millions of

Table 3. Echolocation call parameters of free flying *Chaerephon plicatus* from Sri Lanka, Thailand, India and Vietnam. Data are given as mean (min–max). (Definitions for all abbreviations are given in the materials and methods section).

| Data source; number of calls (n) | Frequency (KHz) | | | Duration (ms) | IPI (ms) |
|----------------------------------|------------------|------------------|------------------|---------------|------------------|
| | FmaxE | SF | EF | | |
| This study; n=10 | 27.6 (24.9–30.3) | 39.7 (37.1–41.7) | 17.8 (17.0–19.3) | 7.7 (6.0–9.0) | 85.2 (75.0–95.0) |
| Utthammachai (2009) | 27.4 | 36.8 | 26 | 7.2 | – |
| Deshpande & Kelkar (2015); n=54 | 23.65 | 35.88 | 19.76 | 12.31 | 147.2 |
| Borissenko & Kruskop (2003) | ~30 | – | – | – | – |

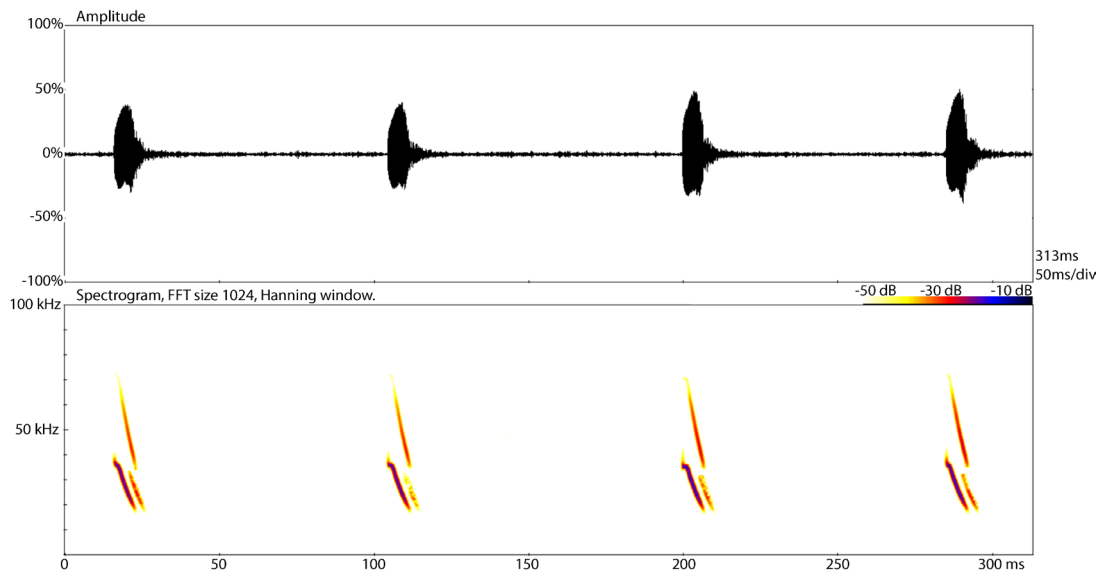


Image 3. Oscillogram (above) and spectrogram (below) of echolocation calls emitted by a free-flying *Chaerephon plicatus* from Sigiriya Rock Fortress, Sri Lanka. Prepared by: Jon Flanders.

individuals. Aye (2006) reported that the larger roosts of focal species are mainly recorded in spacious dome-shaped caves with large entrances in Myanmar. In Thailand, there are 18 known caves with large colonies of *C. plicatus* (Boonkird & Wanghongsa 2001). In South Asia this species is widely distributed in range but found only in a few localities within each country (Molur et al. 2002). Knowledge of a roosting site is vitally important in studying life history traits such as breeding biology, social behavior, diet, and activity patterns (Altringham 2011). It is our belief that the discovery of a natural roost of *C. plicatus* for the first time in Sri Lanka will pave the way for a number of future studies to understand the biology of this species and to adopt necessary conservation measures.

Echolocation calls recorded as part of this study are similar to those previously documented for this species (Borissenko & Kruskop 2003; Utthammachai 2009; Deshpande & Kelkar 2015), although there is some variation as shown in Table 3. Geographical variation

is common in the echolocation calls of bat species (Altringham 2011; Chattopadhyay et al. 2012).

Measurements of the specimens captured in the present study, corresponds to the published and available measurements by Bates & Harrison (1997) in Sri Lanka and Thong (2014) in Vietnam but different from the *C. p. insularis* recorded by Phillips (1932) from Sri Lanka. Moreover, there are few prominent morphological differences found between original description of *Chaerephon plicatus* by Buchannan (1800) and original description of *Chaerephon plicatus insularis* by Phillips (1932), such as naked rump area and fur spreading into the wing membrane of *C. plicatus*: however in *C. p. insularis* rump area is not naked and fur not spread into the wing membrane. Hill (1961) reviewed the genus *Tadarida* (including *Chaerephon*) in Indo-Australian region but had not elaborated on these prominent variations and Sri Lankan specimens are classified as subspecies of *C. plicatus* (*C. plicatus insularis*) based on darker colour and slightly smaller size. Bates

& Harrison (1997) who reviewed the taxonomy of the bats of Indian Subcontinent had also documented the Sri Lankan species as *C. plicata insularis* based on Hill's (1961) classification.

It is clear that there are significant morphological variations between the specimens recorded by Phillips (1932), with the subsequent records of *C. plicatus* by Bates & Harrison (1997) and by us in the present study, as well as with the type specimens by Buchannan (1800). Therefore, the taxonomic status of the *Chaerephon plicatus insularis* described by Phillips (1932) needs to be studied in detail to resolve this taxonomic ambiguity.

CONCLUSION

The taxonomic status of the *Chaerephon plicatus insularis* described by W.W.A. Phillips in 1932 needs to be studied in detail to resolve this taxonomic ambiguity between these two specimens. The discovery of a natural roost of *C. plicatus* for the first time in Sri Lanka will pave the way for a number of future studies to understand the biology and taxonomy of this species.

REFERENCES

- Altringham, J.D. (2011). *Bats from Evolution to Conservation*. Oxford University Press, New York, 324pp.
- Ammerman, L.K., D.N. Lee & T.M. Tipps (2012). First molecular phylogenetic insights into the evolution of free-tailed bats in the subfamily Molossinae (Molossidae, Chiroptera). *Journal of Mammalogy* 93(1): 12–28; <http://doi.org/10.1644/11-MAMM-A-103.1>
- Aye, N.N. (2006). Ecology and economic importance of *Tadarida plicata* (Buchannan, 1800), free tailed bat in some areas of Myanmar. PhD Thesis. Department of Zoology, University of Yangon, iii+116pp.
- Bates, P.J.J. & D.L. Harrison (1997). *Bats of the Indian Subcontinent*. Harrison Zoological Museum Publication, Sevenoaks, 258pp.
- Boonkird, K. & S. Wanghongsa (2001). Management of bat caves, pp. 33–45. In: National Parks and Wildlife Research Division. Annual Report. Royal Forest Department, Bangkok. (In Thai).
- Borissenko, A.V. & S.V. Kruskop (2003). *Bats of Vietnam and Adjacent Territories: an identification manual*. Joint Russian-Vietnamese Science and Technological Tropical Centre, Moscow and Hanoi, 211pp.
- Brigham, R.M., E.K.V. Kalko, G. Jones, S. Parsons & H.J.G.A. Limpens (2004). *Bat Echolocation Research: Tools, Techniques and Analysis*. Bat Conservation International, Texas, 167pp.
- Buchannan, F. (1800). Description of the *Vespertilio plicatus*. *Transactions of the Linnean Society of London* 5: 261–263.
- Chattopadhyay, B., K.M. Garg, K.A.K. Vinoth, D.P.S. Doss, U. Ramakrishnan & S. Kandula (2012). Sibling species in South Indian populations of the Rufous Horse-shoe Bat *Rhinolophus rouxii*. *Conservation Genetics* 13: 1435–1445; <http://doi.org/10.1007/s10592-012-0361-y>
- Csorba, G., S. Bumrungsri, C. Francis, P. Bates, P. Ong, M. Gumal, T. Kingston, L. Heaney, D. Balete, S. Molur & C. Srinivasulu (2014). *Chaerephon plicatus*. In IUCN Red List of Threatened Species 2014: Downloaded on 21 May 2016.
- Deshpande, K. & N. Kelkar (2015). Acoustic identification of *Otomops wroughtoni* and other free-tailed bat species (Chiroptera: Molossidae) from India. *Acta Chiropterologica* 17(2): 419–428; <http://doi.org/10.3161/15081109ACC2015.17.2.018>
- Digana, P.M.C.B., W.B. Yapa, P.V. Randeniya & W.D. Ratnasooriya (2001). Present status of Sri Lankan bats. *Proceedings of Institute of Biology* 21: 21.
- Dissanayake, D.S.B., S.M. Wellappuliarachi, J.A.H.U. Jayakody, S.K. Bandara, S.J. Gamagae, D.A.C.I. Deerasingha & S. Wickramasingha (2014). The avifaunal diversity of Sigiriya Sanctuary and adjacent areas, North Central province, Sri Lanka. *BirdingASIA* 21: 86–93.
- Freeman, P.W. (1981). A multivariate study of the family Molossidae (Mammalia: Chiroptera): morphology, ecology, evolution. *Fieldiana: Zoology (New Series)* 7: 1–173.
- Hill, J.E. (1961). Indo-Australian bats of the genus *Tadarida*. *Mammalia* 25: 29–56.
- Hughes, A.C., C. Satasook, P.J.J. Bates, P. Soisook, T. Sritongchuay, G. Jones & S. Bumrungsri (2011). Using echolocation calls to identify Thai bat species: Vespertilionidae, Emballonuridae, Nycteridae and Megadermatidae. *Acta Chiropterologica* 13: 447–455.
- Molur, S., G. Marimuthu, C. Srinivasulu, S. Mistry, A.M. Hutson, P.J.J. Bates, S. Walker, K.P. Priya & A.R.B. Priya (Eds.) (2002). Status of South Asian Chiroptera: Conservation Assessment and Management Plan (C.A.M.P.) Workshop Report, 2002. Zoo Outreach Organisation, CBSG South Asia and WILD, Coimbatore, India.
- Ministry of Environment (2012). The National Red List 2012 of Sri Lanka; Conservation Status of the Fauna and Flora. Ministry of Environment Sri Lanka, Colombo, 452pp.
- Pavey, C.R., C.J. Burwell, J. Grunwald, C.J. Marshal & G. Neuweiler (2001). Dietary Benefits of Twilight Foraging by the Insectivorous Bat *Hipposideros speoris*. *BIOTROPICA* 33(4): 670–681; <http://doi.org/10.1111/j.1744-7429.2001.tb00224.x>
- Perera, A. (2012). Present status of dry-zone flora in Sri Lanka, pp. 165–174. In: Weerakoon, D.K. & S. Wijesundara (eds.). The National Red List 2012 of Sri Lanka; conservation status of the fauna and flora. Ministry of Environment, Colombo, 452pp.
- Phillips, W.W.A. (1932). Additions to the fauna of Ceylon. No. 2. Some new and interesting bats from the hills of the Central province. *Spolia Zeylanica* 16: 329–335.
- Phillips, W.W.A. (1980). *Manual of the Mammals of Sri Lanka. Part I*. Wildlife & Nature Protection Society of Sri Lanka, Colombo, 116pp.
- Ralph, T.M.C., L.R. Richards, P.J. Taylor, M.C. Napier & J.M. Lamb (2015). Revision of Afro-Malagasy Otomops (Chiroptera: Molossidae) with the description of a new Afro-Arabian species. *Zootaxa* 4057(1): 001–049; <http://doi.org/10.11646/zootaxa.4057.1.1>
- Shek, C. (2006). Wrinkle-lipped Free-tailed Bat (*Chaerephon plicata*) in Hong Kong. *Hong Kong Biodiversity* 11: 11.
- Srinivasulu, C., P.A. Racey & S. Mistry (2010). A key to the bats (Mammalia: Chiroptera) of South Asia. *Journal of Threatened Taxa* 2(7): 1001–1076; <http://dx.doi.org/10.11609/JoTT.o2352.1001-76>
- Sutherland, W.J. (Eds.) (2006). *Ecological Census Techniques - A Handbook*. Cambridge University Press, UK, 432pp.
- Thomas, D.W. & R.K. LaVal (1988). Survey and census methods, pp. 77–90. In: Kunz, T.H. (ed.). *Ecological and Behavioral Methods for the Study of Bats*. Smithsonian Institution Press, Washington D.C., United States, 533pp.
- Thong, V.D. (2014). Taxonomic and distributional assessments of *Chaerephon plicatus* (Chiroptera: Molossidae) from Vietnam. *Tap Chi Sinh Hoc* 36(4): 479–486; <http://doi.org/10.15625/0866-7160/v36n4.5980>
- Tsang, S.M., A.L. Cirranello, P.J.J. Bates & N.B. Simmons (2016). The Roles of Taxonomy and Systematics in Bat Conservation, pp. 503–538. In: Voigt, C.C. & T. Kingston (eds.). *Bats in the Anthropocene: Conservation of Bats in a Changing World*. Springer International Publishing AG, Switzerland, 606pp.
- Utthamachai, K. (2009). Foraging habitat use by acoustic monitoring of *Tadarida plicata* (Buchannan, 1800) in an agricultural landscape, Ratchaburi Province, Thailand. MSc Thesis. Kastesart University.
- Yapa, W.B., P.V. Randeniya & W.D. Ratnasooriya (2002). *Ecology and Biology of Bats in Sri Lanka: A Survey on the Distribution of Bats in Sri Lanka*. National Science Foundation, Colombo, Sri Lanka.



**OPEN ACCESS**

The Journal of Threatened Taxa is dedicated to building evidence for conservation globally by publishing peer-reviewed articles online every month at a reasonably rapid rate at www.threatenedtaxa.org. All articles published in JoTT are registered under [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/) unless otherwise mentioned. JoTT allows unrestricted use of articles in any medium, reproduction, and distribution by providing adequate credit to the authors and the source of publication.

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

April 2017 | Vol. 9 | No. 4 | Pages: 10021–10140

Date of Publication: 26 April 2017 (Online & Print)

DOI: 10.11609/jott.2017.9.4.10021-10140

www.threatenedtaxa.org

Articles

Distribution and population status assessment of the endemic grass-like palm *Butia marmorii* (Arecaceae) in Paraguay

-- Irene Gauto, Fernando Palacios, Pamela Marchi, Nelson Silva & Gloria Céspedes, Pp. 10021–10034

Conservation of the Southern River Terrapin *Batagur affinis* (Reptilia: Testudines: Geoemydidae) in Malaysia: a case study involving local community participation

-- Pelf Nyok Chen, Pp. 10035–10046

Butterflies associated with major forest types in Arunachal Pradesh (eastern Himalaya), India: implications for ecotourism and conservation planning

-- Arun P. Singh, Pp. 10047–10075

Communication

Traditional home garden agroforestry systems: habitat for conservation of Baya Weaver *Ploceus philippinus* (Passeriformes: Ploceidae) in Assam, India

-- Yashmita-Ulman, Awadhesh Kumar & Madhubala Sharma, Pp. 10076–10083

Peer Commentary

Livestock and wild herbivores in the western Himalaya: competition or co-existence?

-- Zarreen Syed & Mohd Shahnawaz Khan, Pp. 10084–10088

Short Communications

Conservation status assessment and new population record of the threatened Golden Himalayan Spike

***Phlomoides superba* (Royle ex Benth.) Kamelin & Makhm. from Jammu & Kashmir, India**

-- Amber Srivastava, Yash Pal Sharma, O.P. Sharma Vidyarthi & Sunil Kumar Srivastava, Pp. 10089–10095

Host specificity of some wood-decaying fungi in moist deciduous forests of Kerala, India

-- A. Muhammed Iqbal, Kattany Vidyasagaran & Narayan Ganesh, Pp. 10096–10101

New records of social wasps (Hymenoptera: Vespinae: *Vespa* and *Provespa*) from Bhutan

-- Phurpa Dorji, Thinley Gyeltshen, Wim Klein & Tshering Nidup, Pp. 10102–10108

Butterfly diversity (Lepidoptera: Rhopalocera) associated with nectar feeding on *Ziziphus mauritiana* Lamarck (Rosales: Rhamnaceae) flowers in Chuadanga, Bangladesh

-- Tahsinur Rahman Shihan, Pp. 10109–10114

First record of a Wrinkle-lipped Free-tailed Bat

***Chaerephon plicatus* Buchannan, 1800 (Mammalia:**

Chiroptera: Molossidae) colony in Sri Lanka, with notes on echolocation calls and taxonomy

-- Tharaka Kusuminda & Wipula B. Yapa, Pp. 10115–10120

Density and obligatory feeding habits of an isolated Golden Jackal *Canis aureus* L. (Mammalia: Carnivora: Canidae) population in Pirotan Island, Gulf of Kachchh, India

-- Kamaraj Ramkumaran, Rethnaraj Chandran, Chowdula Satyanarayana, Kailash Chandra & Tikadar Shyamal, Pp. 10121–10124

Notes

The seasonal occurrence of the Whale Shark *Rhincodon typus* (Smith, 1828) (Orectolobiformes: Rhincodontidae) along the Odisha coast, India

-- Shesdev Patro, Biraja Kumar Sahu, Chandanlal Parida, Madhusmita Dash & K.C. Sahu, Pp. 10125–10129

A new record of Gunther's Waspfish *Snyderina guentheri* (Boulenger, 1889) (Scorpaeniformes: Tetrarogidae) from Visakhapatnam, India

-- Muddula Krishna Naranji & Sujatha Kandula, Pp. 10130–10132

First record of *Neojurtina typica* from India (Hemiptera: Heteroptera: Pentatomidae)

-- S. Salini, Pp. 10133–10137

***Xenomerus orientalis* Walker (Hymenoptera:**

Platygastridae): a new distribution record for India

-- Kalmesh Managanvi, A.K. Karnatak & M.A. Khan, Pp. 10138–10140