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First record of Bourret's Horseshoe Bat *Rhinolophus paradoxolophus* (Mammalia: Chiroptera: Rhinolophidae) from Myanmar with a review of the taxonomy, distribution and ecology of the species

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Abstract: Two specimens of Bourret's Horseshoe Bat, *Rhinolophus paradoxolophus*, were recently collected from near Kalaw, western Shan State, Myanmar. They represent the first country record of the species as well as a considerable western range extension. A brief discussion of the taxonomic history of *R. paradoxolophus* is included along with a summary of its known ecology. The distribution is mapped and shows a correlation with areas of limestone karst.

Keywords: Chiroptera, range extension, Rhinolophidae, Southeast Asia.

During a survey for bats in Shan State in September 2016 two specimens of *Rhinolophus paradoxolophus* (Bourret, 1951) were collected. Since this is a relatively little known bat species with some ambiguity in its taxonomy (Wu & Thong 2011) and since the new location, near Kalaw, represents the first record from Myanmar and a westward expansion of its known range by 280km, this material is described herein.

Rhinolophus paradoxolophus, with a type locality of Chapa (= Sa Pa) in northern Vietnam (Loc. 29, Image 1), is a medium-sized rhinolophid bat with a distinctive noseleaf, which is characterised by a broad sella, low connecting process and almost hidden posterior lancet (Image 2). Bourret (1951) described the external characters; Dorst (1954) provided a description of the cranial and dental characters.

Despite its unusual external morphology, however, the taxonomic status of *R. paradoxolophus* in comparison to *R. rex* G.M. Allen, 1923, which was described from

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Sichuan Province, China has not been clearly resolved. Hill (1972) and Corbet & Hill (1992) differentiated the two taxa on the basis of the larger size of *R. rex,* a view followed by Hendrichsen et al. (2001). Thonglongya (1973) also noted that *R. paradoxolophus* differs chiefly in size but suggested that in addition there were slight differences in the shape of the nasal swellings and postorbital zygomatic process. This view was followed by Eger & Fenton (2003) who listed some minor differences in the shape of the antitragus and sella. Simmons (2005) treated the two taxa as separate species but commented that they might be conspecific. Zhang et al. (2009) suggested that *R. paradoxolophus* and *R. rex* are 'probably the same taxon' and are 'probably best recognised as geographical races'. This view however was not followed by Wu & Thong (2011) who, whilst describing a new, apparently closely-related species, *R. schnitzleri*, from Yunnan Province, China, provisionally treated *R. paradoxolophus* and *R. rex* as separate species primarily on the basis of morphology but with some supporting comments based on acoustic data.

Here, following Wu & Thong (2011) and Vuong et al. (2017), *R. paradoxolophus, R. rex* and *R. schnitzleri* are all included in the *Rhinolophus philippinensis* group together with *R. huananus* Wu et al., 2008, *R. marshalli* Thonlongya, 1973, *R. montanus* Goodwin, 1979, *R. philippenensis* Waterhouse, 1843, *R. siamensis* Gyldenstolpe, 1917, *R. macrotis* Blyth, 1844 and a number of as yet undescribed cryptic species of *R. macrotis.*

Material and Methods

New Material: Two specimens of *R. paradoxolophus*, one female (SO 160927.1) and one male (SO 160927.2) were collected by SSLO, DSN and LNS in a mist net on 27 September 2016 at Phar Gu (Phar cave), approximately 2km north-west of Kalaw, Shan State (20.63611111 N, 96.55194444 E) (Loc. 1, Image 1) at an elevation of 1,320m.

The following external, cranial and dental measurements were taken using a digital caliper to the nearest 0.1 mm (definitions follow Wu & Thong 2011): FA, forearm length - from the extremity of the elbow to the extremity of the carpus with the wings folded; EH, ear height - length of ear conch; TIB, tibia length - from the knee joint to the ankle; HF, hind-foot length - from the extremity of the heel behind the os calcis to the extremity of the longest digit, excluding the hairs or claws; T, tail length - from the anal opening to the tip of the tail; 3rdF, total length of the third digit; 4thF, total length of the fourth digit; 5thF, total length of the fifth digit; SL, skull total length - from the occiput to the most anterior part of the canine; CCL, condylocanine length - from the exoccipital condyle to the most anterior part of the canine; IOW, interorbital width - the least width of the interorbital constriction; ZW, zygomatic width - the greatest width of the skull across the zygomatic arches; MW, mastoid width - the greatest distance across the mastoid region; C^1–C^1, upper canine width - greatest width, taken across the outer borders of upper canines; M^3–M^3, upper molar width - greatest width, taken across the outer crowns of the last upper molars; C–M^3, maxillary tooth row length - from the front of the upper canine to the back of the crown of the third molar; ML, mandible length - from the anterior rim of the alveolus of the first lower incisor to the most posterior part of the condyle; C-M_3, mandibular tooth row length - from the front of the lower canine to the back of the crown of the third lower molar.

The distribution map is based primarily on the literature and includes references to the following collections: EBD: Estació Biológica de Doñana, Sevilla, Spain; HNHM: Hungarian Natural History Museum, Budapest; IEBR: Institute of Ecology and Biological Resources, Hanoi, Vietnam; ROM: Royal Ontario Museum, Canada; SMF: Senckenberg Museum, Frankfurt Am Main, Germany. It also includes CMF field records, which refer to those of Charles M Francis.

Morphometrics

With a forearm length of 56.0mm and 54.3mm (female and male, respectively), the two new Myanmar specimens of *R. paradoxolophus* are comparable in size to specimens of *R. rex* and *R. paradoxolophus* included in Wu & Thong (2011) (Table 1). The lengths of the third, fourth and fifth digits, however, are much shorter than those of *R. rex* (and *R. schnitzleri*) and are comparable only to those of *R. paradoxolophus.* The tibiae are also noticeably shorter than those of *R. schnitzleri.* The ears are massive (Image 2) and the noseleaf, in general form, is comparable to those of *R. rex, R. schnitzleri* and *R. paradoxolophus* as described in Wu & Thong (2011). The anterior emargination of the horseshoe is well defined and relatively broad, not very narrow, deep and parallel sided as in *R. schnitzleri*; the sella tip is also clearly rounded and curved forwards in the Myanmar specimens, whereas in *R. schnitzleri* the tip is broadly blunt. Although skulls of both Myanmar specimens are relatively large compared to *R. paradoxolophus* from Vietnam, they are still smaller than those of *R. rex* and *R. schnitzleri* from China (Table 2). Upper toothrow length (C-M^3) is also shorter. It is, therefore, considered

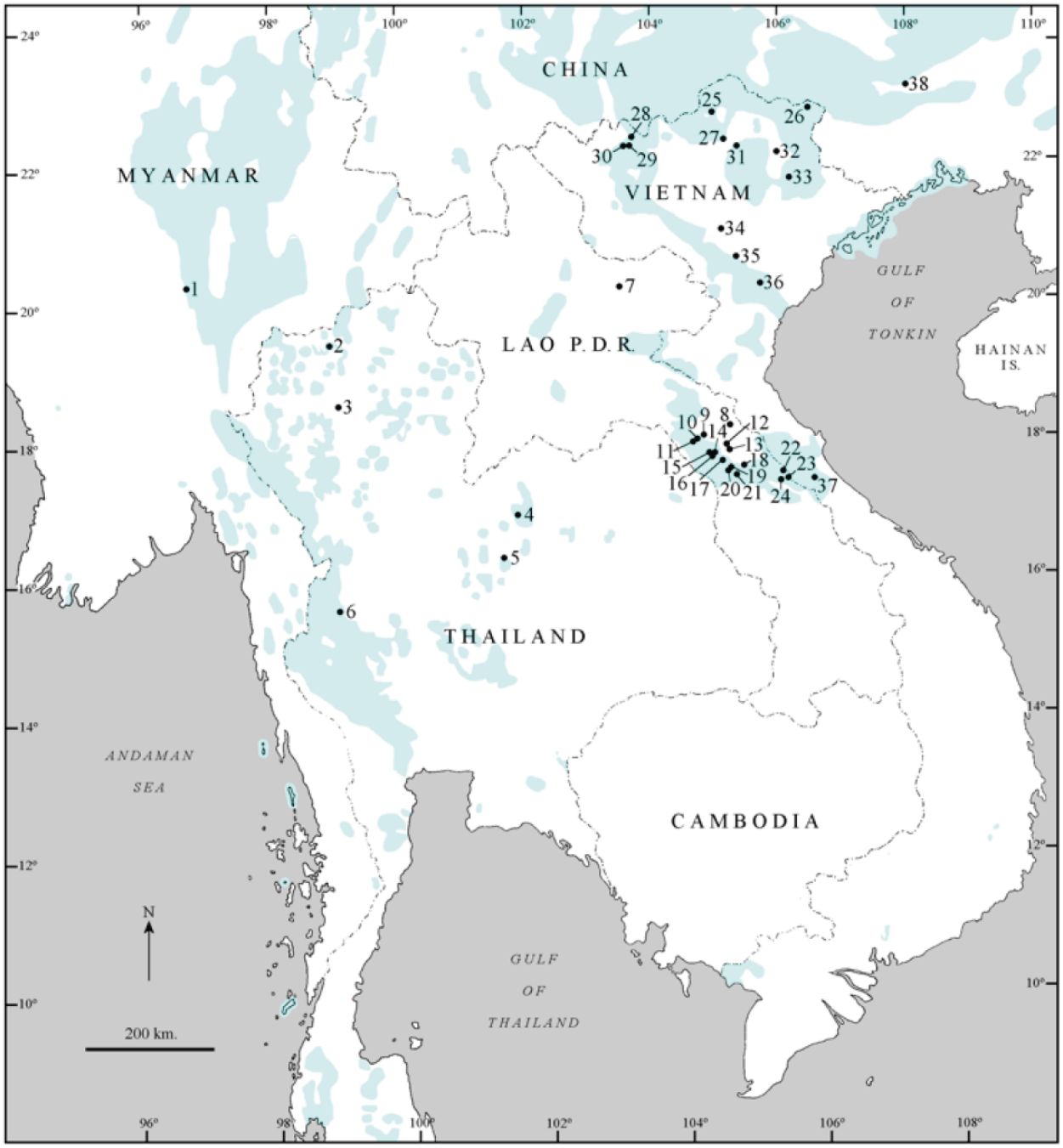

Image 1. Map showing the 34 known localities of *Rhinolophus paradoxolophus* (for locality names, see Appendix 1). Areas of limestone karst are represented approximately by the sections shaded blue and are based on information provided in Bates & Tin Nwe (2001), Clements et al. (2006), Furey et al. (2010) and Nowak (2015).

that the two specimens from Myanmar can be referred with confidence to the taxon *paradoxolophus*. This is irrespective of whether subsequent genetic studies maintain *paradoxolophus* as a discrete cryptic species or as a smaller geographical race of *R. rex.*

Acoustics

No data were collected on the acoustic characters of the two Myanmar *R. paradoxolophus* specimens. In Lao PDR echolocation frequencies of 22–25 kHz were recorded from handheld individuals (Francis 2008); in Vietnam, the frequency of maximum energy was reported as 27.5 to 29.5 kHz (Furey et al. 2009) and as

Image 2. ***Rhinolophus paradoxolophus*** **from near Kalaw, western Shan State, Myanmar (not to scale).**

Image 3. Pine woods near Kalaw, western Shan State: habitat of ***Rhinolophus paradoxolophus*****.**

28.0 to 28.6 (Vuong et al. 2017). In contrast, Eger & Fenton (2003) report that in China echolocation calls were 40–50 ms long and dominated by a 43kHz constant frequency component; terminal portions of calls swept from 43 to 37 kHz.

Distribution

(based on current taxonomic understanding which treats *Rhinolophus paradoxolophus* and *R. rex* as separate species): *Rhinolophus paradoxolophus* is widely distributed in the Indo-Chinese subregion of South-east Asia, where it is currently known from Myanmar, Thailand, Lao PDR, and Vietnam; it is also recorded from one locality in China (Appendix 1).

Ecology

According to Francis (2008), *Rhinolophus paradoxolophus* appears to be closely associated with limestone areas, a view that is borne out when species range is mapped against karst distribution (Image 1). Francis (2008) also notes that it is found in a variety of forest types, including dry deciduous, pine, moist evergreen and disturbed riverine forests. The two recent specimens from Myanmar were collected in a mist net in Phar Gu (gu = cave), approximately 2km north-west of Kalaw, in September 2016. This limestone cave is at an altitude of 1,320m and surrounded by secondary pine forest and sesame cultivation (*Sesamum indicum*) (Image 3); it is approximately 300m away from human habitation. The cave has one entrance and one large chamber, which is approximately 50m long and 7m wide. The two individuals were collected from a small inner chamber. The cave was wet since it was the monsoon season and the floor was muddy. There were signs of human disturbance, including a fire-pit.

In Thailand, *R. paradoxolophus* was collected on 24 August 1971 at 850m on the Kam Mang Plateau (Thonglongya 1973). The single individual was captured in a mistnet left overnight in rather dry pine forest (*Pinus merkusii*), mixed with *Shorea* sp., *Pentacme* sp., *Xylia* sp., and *Ficus* sp., near to the plains. Meanwhile, the specimen from southwestern China was found torpid in a limestone cave in late November 1999 (Eger & Fenton 2003).

Table 1. External measurements of *Rhinolophus paradoxolophus, R. rex* and *R. schnitzleri* (including mean, standard deviation, and range)

n	sex	FA	EH	TIB	HF	T	3rd F	4th F	5thF
***Rhinolophus paradoxolophus* (Myanmar)**									
1	M	54.3	29.9	21.0	7.3	19.6	76.7	64.5	65.1
1	F	56.0	32.3	21.4	8.8	23.8	79.5	65.7	63.8
***Rhinolophus paradoxolophus* (Thailand) after Thonglongya (1973)**									
1	F	54.0	27.0	22.0	*	23.0	*	*	*
***Rhinolophus paradoxolophus* (Vietnam) after Wu & Thong (2011)**									
7	M, M	51.4 ± 2.1	29.4 ± 1.5	21.6 ± 0.9	8.6 ± 0.9	25.8 ± 2.0	77.1 ± 2.2	61.9 ± 2.2	64.0 ± 1.3
		48.0-54.1	27.7-32.0	20.4-22.8	7.4-9.5	23.4-28.4	74.0-80.2	58.8-65.2	62.5-66.5
7	F, F	54.4 ± 2.6	30.6 ± 1.4	21.9 ± 0.6	9.6 ± 0.2	26.8 ± 1.5	78.0 ± 1.5	62.4 ± 2.7	64.8 ± 2.2
		50.2-57.6	28.3-32.5	21.1-22.5 (4)	9.4-10.0 (4)	25.2-28.4 (4)	76.1-79.7 (4)	59.5-64.8 (4)	61.6-66.6
***Rhinolophus* rex (China) after Wu & Thong (2011)**									
8	M, M	56.5 ± 1.1	32.0 ± 1.2	24.1 ± 1.1	10.1 ± 1.0	26.4 ± 2.9	*	68.8 ± 1.3	71.3 ± 1.5
		54.8-57.8	29.9-33.2	21.5-25.6 (7)	8.5-11.4	23.3-32.8	81.2-85.2	68.0-70.8	70.4-73.5
8	F, F	56.5 ± 1.8	31.4 ± 2.9	22.9 ± 1.0	9.7 ± 0.8	25.8 ± 2.2	*	*	*
		54.9-60.3	26.6-36.0	20.8-23.9 (7)	8.9-11.0	22.4-28.8	83.9, 85.8	69.1, 73.6	70.5, 73.7
***Rhinolophus schnitzleri* (China) after Wu & Thong (2011)**									
1	M	57.7	30.1	24.4	10	26.9	86.5	70.1	76.5

Based on its wing morphology, which is characterised by a short wingspan, low aspect ratio and wing loading and high tip shape values, it can be predicted that *R. paradoxolophus* primarily forages in forest interiors (Furey & Racey 2016). Data from Kim Hy Nature Reserve, Vietnam suggests it especially favours primary forest over disturbed forest or degraded forest and agricultural land (Furey et al. 2010). Elsewhere in Vietnam, specimens were collected at various altitudes ranging from 370m in Tuyên Quang Province to 780m in Son La Province and 1,329m in Lào Cai Province (Wu & Thong 2011). In Cúc Phuong National Park, an extensive area of limestone karst, it was found in May 1997 and in May, June and August 1998. Collecting localities included a limestone hill, the Cave of Early Man, and a site adjacent to a small seasonal stream. All three localities were subject to human disturbance (Hendrichsen et al. 2001). In August 1998, a single male individual was found in the small Pu Ru cave in the Ke Bang forest. According to Timmins et al. (1999), there were substantial sections of well-preserved lowland forest in this area, but while the cave itself was located on a wooded valley slope, the valley also had extensive areas of grassland (Borissenko & Kruskop 2003).

In Vietnam, a pregnant female was collected in April in Ke Bang in thick primary forest (Borissenko & Kruskop 2003) and lactating females were observed from May to July (Furey et al. 2011).

Conservation status: in 1996 it was assessed as 'Vulnerable' but in 2008 it was downgraded to 'Least Concern' on account of it being a widespread species, with a presumed large population, occurring in protected areas, and with populations that are unlikely to be declining fast enough for listing in a more threatened category (Bates et al. 2008). The latest discovery in Myanmar indicates that it is even more widespread than previously thought. Its population density, however, is probably low and disturbance of its cave roosting sites and its reliance on forest, especially primary forest, may be a threat throughout its range. As such, its current

Table 2. Cranial and dental measurements of *Rhinolophus paradoxolophus, R. rex* and *R. schnitzleri* (including mean, standard deviation, and range)

n	sex	SL	CCL	IOW	ZW	MW	C^1-C^1	M^3-M^3	C-M^3	ML	C-M_3
***Rhinolophus paradoxolophus* (Myanmar)**											
1	M	20.70	18.25	2.20	9.24	10.00	3.95	6.20	7.30	13.54	7.40
1	F	20.80	18.61	2.40	9.26	10.50	4.15	6.00	7.34	14.01	7.50
***Rhinolophus paradoxolophus* (Thailand) after Thonglongya (1973)**											
1	F	*	18.2	2.6	9.7	10.5	4.5	6.4	7.1	13.2	7.4
***Rhinolophus paradoxolophus* (Vietnam) after Wu & Thong (2011)**											
5	M, M	20.2 ± 0.3	18.1 ± 0.4	2.8 ± 0.1	9.1 ± 0.3	10.3 ± 0.1	4.3 ± 0.1	6.3 ± 0.2	7.2 ± 0.2	13.0 ± 0.3	8.1 ± 0.2
		19.7-20.4	17.4-18.5	2.7-2.9	8.8-9.4	10.2-10.4	4.2-4.4	6.1-6.5	6.9-7.5	12.5-13.4	7.6-8.4
0	F	*	*	*	*	*	*	*	*	*	*
***Rhinolophus rex* (China) after Wu and Thong (2011)**											
5	M, M	21.9 ± 0.4	19.5 ± 0.4	2.9 ± 0.1	9.7 ± 0.3	10.6 ± 0.2	4.6 ± 0.2	6.5 ± 0.2	7.7 ± 0.2	14.0 ± 0.5	7.9 ± 0.2
		21.3-22.3	18.8-19.8	2.7-3.0	9.3-9.9	10.4-10.7	4.3-4.9	6.2-6.8	7.5-8.0	13.6-14.4	7.6-8.0
8	F, F	22.1 ± 0.4	19.5 ± 0.2	2.9 ± 0.1	9.6 ± 0.2	10.5 ± 0.2	4.5 ± 0.1	6.5 ± 0.2	7.8 ± 0.1	14.0 ± 0.3	7.8 ± 0.2
		21.6-22.7	19.1-19.7	2.9-3.0	9.2-10.0	10.3-10.8	4.3-4.7	6.1-6.7	7.6-8.0	13.6-14.3	7.6-8.1
***Rhinolophus schnitzleri* (China) after Wu & Thong (2011)**											
1	M	21.8	19.7	2.7	9.7	10.9	4.9	6.6	7.9	14.5	8.8

status should be reviewed regularly in the light of additional information about cave roosting sites and deforestation throughout its known range.

References

Allen, G.M. (1923). New Chinese bats. *American Museum Novitates* 85: 1–8.

Bates, P.J.J. & Tin Nwe (2001). Myanmar: an atlas of karst conservation. *The International Caver* (2001): 36–39.

Bates, P., S. Bumrungsri & G. Csorba (2008). *Rhinolophus paradoxolophus*. The IUCN Red List of Threatened Species 2008: e.T19558A8976934. Downloaded on 13 November 2017; http://doi.org/10.2305/IUCN.UK.2008.RLTS.T19558A8976934.en

Blyth, E. (1844). Notices of various Mammalia. *Journal of the Asiatic Society Bengal* 13: 463–494.

Borissenko, A.V. & S.V. Kruskop (2003). *Bats of Vietnam and Adjacent Territories, an Identification Manual*. Zoological Museum of Moscow, Russia. 209pp.

Bourret, R. (1951). Une nouvelle chauve-souris du Tonkin, *Rhinomegalophus paradoxolophus*. *Bulletin du Museum National d'Histoire Naturelle, Paris* 2(33): 607–609.

Clements, R., N.S. Sodhi, M. Schilthuizen & P.K.L. Ng (2006). Limestone karsts of Southeast Asia: imperiled arks of biodiversity. *BioScience* 56(9): 733–742. Downloaded on 07 August 2017; https://doi.org/10.1641/0006-3568(2006)56[733:LKOSAI]2.0.CO;2

Corbet, G.B. & J.E. Hill (1992). *The mammals of the Indomalayan Region*. Oxford University Press, Oxford, 488pp.

Csorba, G., P. Ujhelyi & N. Thomas (2003). *Horseshoe Bats of the World (Chiroptera: Rhinolophidae).* Alana Books, Shropshire, UK, 160pp.

Dang Huy Huynh (Ed.), Dao Van Tien, Cao Van Sung, Pham Trong Anh & Hoang Minh Khien (1994). *Danh Luc Các Loài Thú (Mammalia) Viêt Nam [Checklist of mammals in Vietnam].* Science and Technics, Vietnam National Centre for Natural Science and Technology, Hà Nôi, 168pp. [In Vietnamese].

Dorst, J. (1954). Precisions sur un rhinolophide rare du Tonkin. *Mammalia* 18: 212–215.

Eger, J.L. & M.B. Fenton (2003). *Rhinolophus paradoxolophus*. *Mammalian Species* 731: 1–4; https://doi.org/10.1644/731

Eger, J.L. & M.M. Theberge (1999). *Thainycteris aureocollaris* (Chiroptera, Vespertilionidae) in Vietnam. *Mammalia* 63(2): 237–240.

Francis, C.M. (2008). *A field guide to the Mammals of South-East Asia.* New Holland Publishers (UK) Ltd, Garfield House, London, 392pp.

Furey, N.M., I.J. Mackie & P.A. Racey (2009). The role of ultrasonic bat detectors in improving inventory and monitoring surveys in Vietnamese karst bat assemblages. *Current Zoology* 55: 327–341.

Furey, N.M., I.J. Mackie & P.A. Racey (2010). Bat diversity in Vietnamese limestone karst areas and the implications of forest degradation. *Biodiversity and Conservation* 19: 1821–1838. https://doi.org/10.1007/s10531-010-9806-0

Furey, N.M., I.J. Mackie & P.A. Racey (2011). Reproductive

phenology of bat assemblages in Vietnamese Karst and its conservation implications. *Acta Chiropterologica* 13(2): 341–354. https://doi.org/10.3161/150811011X624811

Furey, N.M. & P.A. Racey (2016). Can wing morphology inform conservation priorities for Southeast Asian cave bats? *Biotropica* 48(4): 545–556.

Gyldenstolpe, N. (1917). Zoological results of the Swedish zoological expeditions to Siam 1911–1912 and 1914–1915. *Kungliga Svenska Vetenskapsakademiens Handlingare* 57: 1–59.

Goodwin, R.E. (1979). The bats of Timor: systematics and ecology. *Bulletin American Museum Natural History* 163: 73–122.

Hendrichsen, D.K., P.J.J. Bates, J.L. Walston & B.D. Hayes (2001). Recent records of bats (Mammalia: Chiroptera) from Vietnam with seven species new to the country. *Myotis* 39: 35–122.

Hill, J.E. (1972). A note on *Rhinolophus rex* Allen, 1923 and *Rhinomegalophus paradoxolophus* Bourret, 1951 (Chiroptera: Rhinolophidae). *Mammalia* 36: 428–434; https://doi.org/10.1515/mamm.1972.36.3.428

Kruskop, S.V. (2000). New bat records from central Vietnam. *Plecotus* 3: 121–128. [In Russian]

Nowak, K. (2015). A race to save ancient human secrets in Borneo. National Geographic. http://news.nationalgeographic.com/2015/11/151110-borneo-indonesia-karst-archaeology-caves-rock-art/ Downloaded on 08 August 2017.

Robinson, M.F. & A.L. Smith (1997). Chiroptera from Loei Province, north-east Thailand. *Natural History Bulletin of the Siam Society* 43: 27–54.

Robinson, M.F. & M. Webber (2000). Survey of bats (Mammalia: Chiroptera) in the Khammouan Limestone National Biodiversity Area, Lao P.D.R. *Natural History Bulletin of the Siam Society* 48: 21–45.

Simmons, N.B. (2005). Order Chiroptera, pp. 312–529. In: Wilson, D.E. & D.M. Reeder (eds.). *'Mammals Species of the World: A Taxonomic and Geographic Reference'* 3rd Edition. The John Hopkins University Press, Baltimore.

Timmins, R.J., D. Tuoc, T.V. Coung & D.K. Hendrichsen (1999). *A preliminary assessment of the conservation importance and conservation priorities of the Phong Nha-Ke Bang proposed National Park, Quang Binh Province, Vietnam*. Fauna & Flora International, Indochina Programme, Hà Nôi. An unpublished report, 79pp.

Thomas, N.M., J.W. Duckworth, B. Douangboubpha, M. Williams & C.M. Francis (2013). A checklist of bats (Mammalia: Chiroptera) from Lao PDR. *Acta Chiropterologica* 15(1): 193–260; https://doi.org/10.3161/150811013X667993

Thonglongya, K. (1973). First record of *Rhinolophus paradoxolophus* (Bourret, 1951) from Thailand, with the description of new species of the *Rhinolophus philippinesis* group (Chiroptera, Rhinolophidae). *Mammalia* 37: 587–597.

Vuong, T.T., A. Hassanin, T. Görföl, S. Arai, D. Fukui, T.T. Hoang, T.S. Nguyen, N.M. Furey & G. Csorba (2017). Integrative taxonomy of the *Rhinolophus macrotis* complex (Chiroptera, Rhinolophidae) in Vietnam and nearby regions. *Journal of Zoological Systematics and Evolutionary Research* 2017: 1–22; https://doi.org/10.1111/jzs.12169

Waterhouse, G.R. (1843). On various species of bats collected by H. Cuming, Esq. in the Philippine Is. *Proceedings of the Zoological Society London* 1843: 66–69.

Wu Y., M. Harada & M. Motokawa (2008). A new species of horseshoe bat of the genus *Rhinolophus* from China (Chiroptera: Rhinolophidae). *Zoological Science* 25(4): 438–443; https://doi.org/10.2108/zsj.25.438

Wu, Y. & V.D. Thong (2011). A new species of *Rhinolophus* (Chiroptera: Rhinolophidae) from China. *Zoological Science* 28: 235–241; https://doi.org/10.2108/zsj.28.235

Yenbutra, S. & H. Felten (1986). Bats species and their distribution in Thailand according to the collections in TISTR and SMF, pp. 9–45. In: H. Felten, H. (ed.). *Contributions to The Knowledge of the Bats of Thailand*. Courier Forschungsinstitut Senckenberg, 112pp.

Zhao, H., S. Zhang, J. Zhou & Z. Liu (2002). A new record of bats from China: *Rhinolophus paradoxolophus*. *Acta Theriologica Sinica* 22(1): 74–76.

Zhang L., G. Jones, J. Zhang, G. Zhu, S. Parsons, S.J. Rossiter & S. Zhang (2009). Recent surveys of bats (Mammalia: Chiroptera) from China. I. Rhinolophidae and Hipposideridae. *Acta Chiropterologica* 11: 71–88; https://doi.org/10.3161/150811009X465703

Appendix 1. List of locality records of *Rhinolophus paradoxolophus* from throughout its range.

Myanmar: Shan State: 2 km north-west of Kalaw (20.63N, 96.55E) (Loc. 1, Image 1) (this paper); **Thailand**: Chiang Mai Province: Chiangdao (19.40N, 98.88E) (Loc. 2) (unpublished record, Pipat Soisook pers. comm.); Chiang Mai (18.66N, 99.00E) (Loc. 3) (Yenbutra and Felten, 1986); Loei Province: Wat Tam Pha Bing (17.23N, 101.70E) (Loc. 4) (Robinson and Smith, 1997); Chaiyaphum Province: Thung Kam Mang (Kam Mang Plateau) (16.38N, 101.57E) (Loc. 5) (Thonglongya, 1973); Tak Province: Umphang (15.73N 98.98E) (Loc. 6) (unpublished record, Pipat Soisook pers. comm.). **Lao PDR** (all localities abstracted from Thomas et al., 2013): Houaphan Province: Nam Chong (20.33N, 103.38E) (Loc. 7) (EBD collection); Bolikhamxai Province: Lak Sao (18.20N, 104.96E) (Loc. 8) (ROM/SMF collections); Khammouan Province: Ban Kengkhot (18.07N, 104.48E) (Loc. 9) (Robinson and Webber, 2000); Nam Hinboun Camp (18.05N, 104.43E) (Loc. 10) (Robinson and Webber, 2000); Tam Pha Tok Cam (Tham Phatok) (18.03N, 104.40E) (Loc. 11) (Robinson and Webber, 2000); Ban Khankeo (17.97N, 104.82E) (Loc. 12) (ROM/SMF collections); Nakai Plateau (17.88N, 104.83E) (Loc. 13) (SMF collection); Ban Houana (17.83N, 104.67E) (Loc. 14) (CMF field record); Ban Houayphipeng (17.83N, 104.60E) (Loc. 15) (ROM collection); Ban Nathan (17.77N, 104.67E) (Loc. 16) (CMF field record); Khammouan Limestone NBCA (17.75N, 104.80E) (Loc. 17) (ROM/SMF collections); Ban Gnommalat (17.60N, 105.17E) (Loc. 18) (CMF field record); Tam Dan Jar (Tham Dancha) (17.57N, 104.95E) (Loc. 19) (Robinson and Webber, 2000); Tam Houay Si (Tham Houaysy) (17.55N, 104.93E) (Loc. 20) (Robinson and Webber, 2000); Ban Mouangkhai (17.55N, 105.07E) (Loc. 21) (CMF field record); Ban Xam-Kang (ROM collection) (17.55N, 105.83E) (Loc. 22); Ban Vang Manua (Ban Vangma-Nua), Hin Namno NBCA (17.45N, 105.93E) (Loc. 23) (CMF field record); Ban Gnavang (Nan Gnavay) (17.40N, 105.77E) (Loc. 24) (CMF field record). **Vietnam**: Khau Ca Nature Reserve, Ha Giang Province (22.85N, 105.12E) (Loc. 25) (Vuong et al., 2017); Trung Khanh, Cao Bang Province (22.82N, 106.57E) (Loc. 26) (Vuong et al., 2017); Na Hang Nature Reserve, Tuyen Quang Province (22.42N, 105.32E) (Loc. 27) (Vuong et al., 2017); Ta Phin Commune, Sa Pa District (22.40N, 103.83E) (Loc. 28) (Wu and Thong, 2011); Lào Cai Province: Chapa (= Sa Pa, type locality of *paradoxolophus*) (22.33N, 103.85E) (Loc. 29) (Bourret, 1951; Dorst, 1954; Dang Huy Huyn et al., 1994); Hoang Lien Nature Reserve (IEBR) (22.33N, 103.83E) (Loc. 30) (Csorba et al., 2003); Tuyên Quang Province: Na Hang Nature Reserve (22.33N, 105.43E) (Loc. 31) (HNHM, Eger and Theberge, 1999; Wu and Thong, 2011); Kim Hy Nature Reserve, Bac Kan Province (22.25N, 106.02E) (Loc. 32) (Furey et al., 2010); Thai Nguyen Province: Phuong Hoang Tourism Area (21.78N, 106.12E) (Loc. 33) (Wu and Thong, 2011); Son La Province: Muong Do Commune (21.20N, 104.87E) (Loc. 34) (Wu and Thong, 2011); Hoa Binh Province: Mai Hich Commune (20.68N, 105.02E) (Loc. 35) (Wu and Thong, 2011); Ninh Binh Province: Cúc Phuong National Park (20.37N, 105.58E) (Loc. 36) (IEBR and Hendrichsen et al., 2001); Quang Bình Province: Ke Bang-Phong Nha (17.43N, 106.30E) (Loc. 37) (Timmins et al., 1999, Kruskop, 2000, Hendrichsen et al., 2001). **China:** Guangxi Province (Zhao *et al*. 2002) (23.22 N, 107.83 E) (Loc. 38) (estimated from Eger and Fenton, 2003).

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