

New remarkable bat records in Hoang Lien Son mountain range, northern Vietnam

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ABSTRACT. During a short-term survey, fifteen bat species were recorded in the north-east part of Hoang Lien Son mountain range, Tonkin, Vietnam; some of these findings are of particular zoogeographic interest. The first confirmed record of *Barbastella* from Vietnam was made; the specimens morphologically resemble *B. darjelingensis*, differing slightly in coloration from Indian and Central Asian forms. The specimen tentatively identified as *Hypsugo* cf. *joffrei* may represent the first record of the species outside its *terra typica*. *Harpiola isodon* is reported for the second time from Vietnam; its new capture site is situated half-way the between previous known location in Ngoc Linh and *terra typica* in Taiwan. Records of *Murina* cf. *harpioloides*, *Hypsugo cadornae* and *Thainycteris aureocollaris* represent Vietnamese range extensions for these species; among them, the collecting site of *M. cf. harpioloides* is very remote from previously known location. The local bat community seems to be a rich mix of Malayan, Indo-Himalayan and even Palaearctic faunal elements.

KEY WORDS: bats, *Barbastella*, *Hypsugo*, *Harpiola*, South-East Asia, Indochina.

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Новые примечательные находки рукокрылых на горном хребте Хоанг Лиен Шон, северный Вьетнам

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РЕЗЮМЕ. Во время краткого полевого исследования пятнадцать видов летучих мышей были обнаружены в северо-восточной части хребта Хоанг Лиен Шон, Тонкин, Вьетнам. Поимка широкоушки (*Barbastella*) представляет собой первую документированную находку этого рода во Вьетнаме. Пойманные широкоушки наиболее сходны с *B. darjelingensis*, хотя и отличаются по окраске от экземпляров из Индии и Средней Азии. Экземпляры, предварительно определенные как *Hypsugo* cf. *joffrei*, вероятно, представляет собой первую находку вида за пределами типового локалитета. *Harpiola isodon* обнаружена во Вьетнаме второй раз, и новая точка находки лежит между ранее известной точкой в Нгоклинне и типовым местонахождением на Тайване. Находки *Murina* cf. *harpioloides*, *Hypsugo cadornae* и *Thainycteris aureocollaris* представляют собой новые места обитания этих видов во Вьетнаме; в случае *M. cf. harpioloides* новая точка поимки весьма значительно удалена от известной прежде. В целом, локальное сообщество рукокрылых представляется смесью малайских, индо-гималайских и даже палеарктических элементов.

КЛЮЧЕВЫЕ СЛОВА: рукокрылые, широкоушка, кожановидные нетопыри, гарпиола, Юго-Восточная Азия, Индокитай.

Introduction

Hoang Lien Son mountain range is situated on the very north of Tonkin (Northern Vietnam). Situating relatively far from the supposed border between Palaearctic and Indomalayan zoogeographical regions, it actually represents an extension of the mountainous ranges, which form this border westward from Indochina (Corbet & Hill, 1992; Hoffmann, 2001) and thus could serve as 'bridges' for Palaearctic faunal elements. This, together with the high altitudinal variation, suggests a diverse fauna containing a mix of Malayan, Indo-Himalayan and even Palaearctic species.

Zoological investigation of this area started in the early 1900-th (Rozhnov, 1998), and the first complete review of local mammalian fauna was produced by Osgood (Osgood, 1932). Later one bat species was described as new on the basis of same collections, namely *Rhinolophus paradoxolophus* (originally in separate genus *Rhinomegaphyllus*) (Bouret, 1951). Recent unpublished report prepared by "Frontier" environmental exploration company lists 17 bat species including such remarkable record as *Myotis chinensis* (Tordoff *et al.*, 1999). In the recent checklist of Vietnamese mammalian fauna (Dang Ngoc Can *et al.*, 2008), 26 bat species from five families are recognized for Hoang

Table 1. List of bat species reported for Hoang Lien Son. 1 — this survey; 2 — Dang Ngoc Can et al., 2008; 3 — Tordoff et al., 1999; 4 — Rozhnov et al., 2008; * — only visual/aural record.

	Species	source	comments
Pteropodidae			
1.	<i>Rousettus leschenaulti</i> (Desmarest, 1820)	1*, 2, 3	
2.	<i>Cynopterus sphinx</i> (Vahl, 1797)	2, 3, 4	
3.	<i>Cynopterus brachyotis</i> (Müller, 1838)	2	
4.	<i>Sphaerias blanfordi</i> (Thomas, 1891)	4	
5.	<i>Megaerops niphanae</i> Yenburta, Felten, 1983	2, 3	
Hipposideridae			
6.	<i>Aselliscus stoliczkanus</i> (Dobson, 1871)	1, 2, 3	
7.	<i>Coelops frithii</i> Blyth, 1848	2	
8.	<i>Hipposideros armiger</i> (Hodgson, 1835)	2	
9.	<i>Hipposideros larvatus</i> (Horsfield, 1823)	2	
10.	<i>Hipposideros pomona</i> Andersen, 1918	2, 3	
11.	<i>Hipposideros pratti</i> Thomas, 1891	2	
Rhinolophidae			
12.	<i>Rhinolophus affinis</i> Horsfield, 1823	1, 2, 3	
13.	<i>Rhinolophus lepidus</i> Blyth, 1844	2, 4	Could be misidentified with <i>R. pusillus</i> .
14.	<i>Rhinolophus macrotis</i> Blyth, 1844	1, 2, 3	
15.	<i>Rhinolophus marshalli</i> Thonglongya, 1973	2	
16.	<i>Rhinolophus paradoxolophus</i> (Bourret, 1951)	2, 3	
17.	<i>Rhinolophus pearsonii</i> Horsfield, 1851	2, 3	
18.	<i>Rhinolophus thomasi</i> Andersen, 1905	2	
19.	<i>Rhinolophus sinicus</i> Andersen, 1905	2, 3	Often mentioned as <i>R. rouxii</i> s. l.
Vespertilionidae			
20.	<i>Harpiocephalus harpia</i> (Temminck, 1840)	4	
21.	<i>Kerivoula hardwickii</i> (Horsfield, 1824)	4	
22.	<i>Harpioa isodon</i> Kuo, Fang, Csorba, Lee, 2006	1	
23.	<i>Murina cyclotis</i> Dobson, 1872	4	
24.	<i>Murina huttoni</i> (Peters, 1872)	1, 4	
25.	<i>Murina cf. harpioloides</i> Kruskop, Eger, 2008	1	
26.	<i>Myotis chinensis</i> (Tomes, 1857)	3	
27.	<i>Myotis laniger</i> (Peters, 1871)	1, 2, 3	Also mentioned erroneously as <i>M. daubentonii</i> .
28.	<i>Myotis montivagus</i> (Dobson, 1874)	1	
29.	<i>Myotis ?adversus</i> (Horsfield, 1824)	2	Doubtful record, probably result of misidentification.
30.	<i>Myotis siligorensis</i> (Horsfield, 1855)	1, 2, 3	
31.	<i>Barbastella cf. darjelingensis</i> (Hodgson, 1855)	1	
32.	<i>Pipistrellus coromandra</i> (Gray, 1838)	1, 2	
33.	<i>Hypsugo cadornae</i> (Thomas, 1916)	1	
34.	<i>Hypsugo cf. joffrei</i> (Thomas, 1915)	1	
35.	<i>Scotomanes ornatus</i> (Blyth, 1851)	2, 3	
36.	<i>Thainycteris aureocollaris</i> Kock, Storch, 1996	1	
37.	<i>Tylonycteris pachypus</i> (Temminck, 1840)	4	
Miniopteridae			
38.	<i>Miniopterus fuliginosus</i> (Hodgson, 1835)	1	Previously was erroneously mentioned as <i>M. schreibersi</i> .
Molossidae			
39.	<i>Tadarida</i> sp.	1*	

Lien Son. Kuznetsov and Rozhnov (Kuznetsov & Rozhnov, 1998) mentioned four additional species on the basis of unconfirmed published data. Two of them, *Harpiocephalus harpia* and *Kerivoula picta*, were previously reported for Lao Cai province but not exactly for Hoang Lien Son (Dang Huy Huynh *et al.*, 1994). Records of *Rhinolophus cornutus* in Vietnam are doubtful and very probably are based on misidentified *Rh.*

pusillus or other similar species. Finally, the report of *Rh. luctus* from Hoang Lien Son is not supported by any material and absent in the latest checklists.

Investigations in Van Ban district, in the southern part of Hoang Lien Son, held by Vietnam-Russian Tropical Centre, produced several new records and, amongst other findings, documented the presence of two *Murina* species, *Kerivoula hardwickei* and *Sphaerias blanfordi*

and confirmed occurrence of the *Harpiocephalus* in Hoang Lien Son (Rozhnov *et al.*, 2008). Thus, even excluding unconfirmed records, its local bat faunal list contains over 30 species (Tab. 1). Despite this, the survey of the bat communities of Hoang Lien Son is far from completion. Its mosaic landscapes and significant elevation gradients lead to expect the occurrence of additional species.

During our survey in the vicinity of Sa Pa in 2009–2010, we confirmed and clarified several earlier bat records and found at least six bat species not previously known to Hoang Lien Son area.

Material and methods

Special short field survey focused on bats was conducted from 5 to 20 of May in 2010. Also some bats were captured and recorded in the ranks of general small mammal assessment during summer, 2009. Most of bat records were made in the vicinity of Tram Ton forest station, 6 km NW from town of Sa Pa (Chapa), Lao Cai Province (22°21'N, 103°46'E), at the elevation range of 1850–2000 m a.s.l. Also some bat records were made south from Sa Pa, in Cat Cat village, at the elevation of about 1250 m ASL.

Observations were conducted visually with the help of electric head lamps and spotlights, and acoustically by the use of narrow-band heterodyne ultrasound detector D100 (Pettersson Elektronik AB, Sweden). Taking into account local weather conditions resulted into bat activity pattern, observations were held in the thirst half of night time, from the sunset till approximately 22⁰⁰ PM, and in the early morning, from 4⁰⁰ AM to sunrise. Bats were captured alive by hand net or flap-trap (Borissenko, 1999) and by the standard technique of crossing supposed flying paths by mist-nets (size 10×4 m) (Kunz & Kurta, 1990; Borissenko & Kruskop, 2003).

A standard set of external measurements (head and body length, tail length, hind foot length (with and without claws), ear length, tragus/antitragus length, tibia length and forearm length) was taken using vernier calipers. Weight recorded using Pesola spring balances to the nearest 0.1 g. Selected specimens (from one to four) of each species were taken as vouchers for further comparison with museum material to ensure the proper identification as most species are notoriously impossible to identify in the field. Voucher specimens transferred to the Zoological Museum, Moscow State University (ZMMU, Moscow), and are preserved in 70% ethanol. Tissue samples for genetic studies were taken from fresh specimens and stored in 96% ethanol.

Results

During our brief survey presence of fifteen bat species were revealed and supported by vouchers, including some remarkable records in the content of the whole Indochinese fauna. Actual richness of the local bat community should be higher since some observed taxa

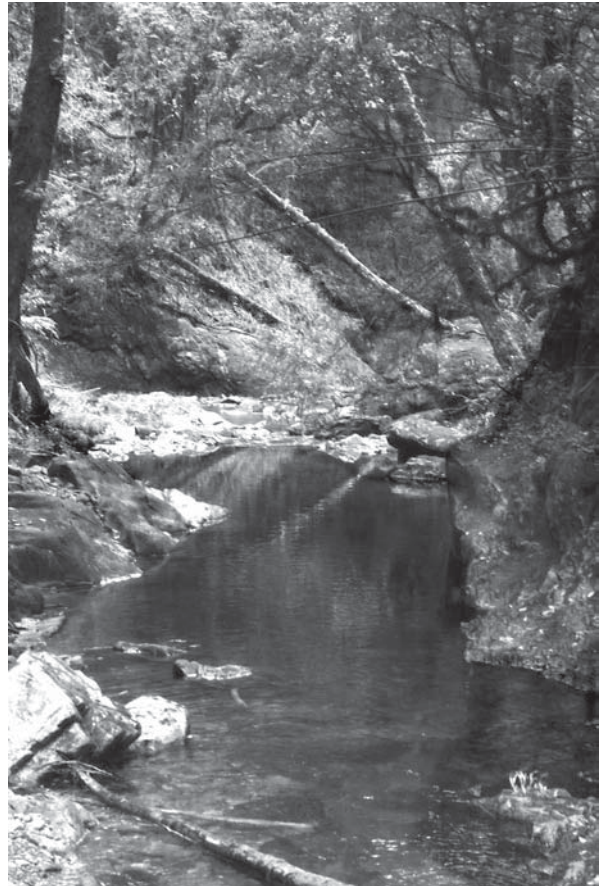


Figure 1. Backwater on the Suoi Vang Stream — foraging biotope for *Barbastella cf. darjelingensis*, *Harpiocephalus isodon*, *Murina* sp. and *Rhinolophus affinis*.

were not confirmed by captured individuals. These data suggest that the bat diversity and density comparable to that of lowland forested areas of Southern Vietnam known by their rich bat faunas (Hendrichsen *et al.*, 2001; Borissenko & Kruskop, 2003; Pollet & Ling, 2004; Nguyen Truong Son *et al.*, 2009).

The most remarkable results of the survey are the finding of three species: *Barbastella cf. darjelingensis*, *Harpiocephalus isodon* and *Hypsugo cf. joffrei* in Northern Vietnam.

An adult non-breeding female of barbastelle was captured by flap trap over the Suoi Vang stream at the elevation of about 2000 m a.s.l. on 6 May. The animal was foraging over a small backwater area (Fig. 1), moving in a highly maneuverable manner at about 0.5 to 2 meters above the water surface. A male (full-grown but probably young, Fig. 2) was captured about thirty meters from the previous place, over the same stream, on 14 May. The Suoi Vang stream in the capture site has from one and half to six meters in width and consists of alternating backwaters and stony shallows; it goes through the relatively deep ravine with slopes covered with variably disturbed evergreen forest. Both animals were captured in late evening hours in the high



Figure 2. Full-growth male of *Barbastella* cf. *darjelingensis*.

darkness, enforced by ravine slopes and forest cover. Aside from captured individuals we did not observe barbastelles in the survey area. *Barbastella* (tentatively, *B. darjelingensis*) was reported from Laos and south China and it was supposed that it is also inhabits northern Vietnam (Francis, 2008). Our record is the first confirmed occurrence of the genus in Hoang Lien Son area and in Vietnam on the whole.

One subadult male of *Harpiola isodon* was captured by a mist-net set across the stream, at the same site as *Barbastella* on May, 6 in the late evening (Fig. 3). On 8 May an adult female was caught at the same place and on 10 and 13 May two more subadult males were captured. Animal foraged over the stream backwaters and shallows, flying at about 0.2–2 meters above the water or ground. Observed flight pattern was variably fast, dodged and very maneuverable. Several times throughout the survey period animals of similar size and with same flight pattern were observed over the Suoi Vang both upstream and downstream the waterfall; however *Harpiola* seems to be almost indistinguishable in flight from the similar sized *Murina* species. The only captured female was lactating. Simultaneous presence of recently weaned individuals suggests that *Harpiola* in Hoang Lien Son may have a bi- or even polymodal breeding cycle (Happold & Happold, 1990).

The first *Hypsugo* cf. *joffrei* (adult male, Fig. 4) was captured in the early morning hours (about an hour



Figure 3. Subadult male of *Harpiola isodon*. Characteristic dental pattern is well seen.



Figure 4. Adult male of *Hypsugo* cf. *joffrei*.

before sunrise) over the backwater of Suoi Vang stream below the waterfalls, at the elevation of ca. 1900 m a.s.l. on 11 May. Later, on 13 and 15 May, two other males of this species were captured in the same place. An adult female was captured on 17 May in the vicinity of Cat Cat village. Individuals supposedly of the same

species were observed several times foraging and drinking in the valley of Suoi Vang Stream. In the vicinity of Cat Cat these bats were common, observed in the evening hours while foraging in a *Nyctalus*-like manner over the gorges and river valley, from several to tens of meters above the ground.

Eleven other bat species were captured in association with the above three. Single specimen of *Thainycteris aureocollaris*, *Hypsugo cadornae* and a small *Murina* sp., closely related or conspecific to *Murina harpioloides* from Dalat plateau, were captured at the same site above the waterfalls as *Barbastella* and *Harpioala*. *Thainycteris aureocollaris* and *H. cadornae* represent the only fifth and third records of the species from Vietnam, respectively. *Rhinolophus affinis*, *Miniopterus fuliginosus*, *Myotis siligorensis*, *Myotis montivagus* and *Pipistrellus coromandra* were captured and commonly observed in riverine habitats both upstream and downstream of the waterfalls. *Aselliscus stoliczkanus*, *Rhinolophus macrotis* and *Murina huttoni* were also captured over the small forest tributary of Suoi Vang. One additional species, *Myotis laniger*, was captured in the latter site in 2009 by the AVS, but was not observed in 2010.

At least two other bat species were observed in the same area but not confirmed by captured individuals. Relatively large fast-flying insectivorous bats with low frequency FM echolocation calls at about 12–15 kHz were observed twice near the Tram Ton forest station. The flight pattern and echolocation calls resembled that of Molossidae and the large body size suggests that the observed bats could be *Tadarida latochei* or *T. insignis*. These two species are known from south China and Laos close to Vietnamese border, but not recorded yet from Vietnam (Corbet & Hill, 1992; Francis, 2008). Another observation was of a pteropodid bat flying between trees over the Suoi Vang Stream at early dusk on May 14. In general appearance and size the observed individual resembled *Rousettus leschenaulti*, a species known to inhabit relatively high elevations in other regions of Southeast Asia (Csorba *et al.*, 1999). If confirmed, this may be the highest latitude where a fruit bat has been observed in Vietnam.

Discussion

The systematic position of some of the newly recorded species is not absolutely clear and pending further confirmation from molecular data.

Specifically, the identity of bats mentioned above as *Hypsugo* cf. *joffrei* is quite problematic. *Hypsugo joffrei* has been known from only the small type series collected in Northern Burma (Corbet & Hill, 1992). This species is supposed to be closely related (and morphologically very similar) to *H. anthonyi*, also from Burma which known by the type specimen only with damaged skull (Tate, 1942; Corbet & Hill, 1992). Both species are of the same size with a forearm length of ca. 39 mm. Their general body and wing shape resemble

genus *Nyctalus*, to which they were sometimes allocated (Koopman, 1994), and also "*Pipistrellus*" *stenopterus* and *Philetor brachypterus* (Hill, 1966). Both *P. joffrei* and *P. anthonyi* are characterized by broad and short muzzle, broad *tragi*, narrow and pointed wing, short velvety fur, short and robust rostrum, very distinct and massive supraorbital projections, presence of small upper premolar though minute and displaced from tooth row, and supposedly by distinct secondary cusps on the posterior blades of the upper canines (Corbet & Hill, 1992; Koopman, 1994; Francis, 2008). Two other "pipistrelles" of similar size presumably occurring in the region are *Pipistrellus ceylonicus* and *Falsistrellus affinis*. The former is a typical *Pipistrellus* in general proportions as well as in tooth structure and baculum shape. The latter differs from the *joffrei/anthonyi* complex by longer fur, wider wing, elongated braincase and less reduced upper small premolar (Francis, 2008). Finally, it is supposed that baculum of *H. joffrei* should be minute and delicate (Hill, 1966); baculum of *H. anthonyi* is not known.

Our specimens conform to all the described features of the *joffrei/anthonyi* group despite their slightly smaller size (forearm length is 35.7–38.6). They also have myotodont lower molars which put them apart from tribe Pipistrellini (including "*Pipistrellus*" *stenopterus* and *Philetor brachypterus* which are both nyctalodonts). The two species of the complex differ mainly by pelage coloration (Corbet & Hill, 1992); based on this feature our specimens might be referred to as *H. anthonyi* which is more dark-colored of the two. However, we prefer to use the name of better known and better described species of this complex, *H. joffrei*, which is the type for the species group. External genitalia well conform that of *H. joffrei* as they were described by Hill (1966). Baculum of one dissected male is minute and delicate, about 1.1 mm in length. It has a narrow main shaft with slightly concave ventral surface and bluntly rounded tip, and widely expanding basal lateral projections, somewhat turned downward at their ends (Fig. 5). Thus this baculum shape obviously differs from the structure of those of "*Pipistrellus*" *stenopterus* or *Philetor*, and even more so from the penis bones of either *Pipistrellus* s.str. or *Hypsugo* (Hill & Harrison, 1987) but bares some resemblance with those of some plecotines and *Arielulus*. Although presence of a reduced

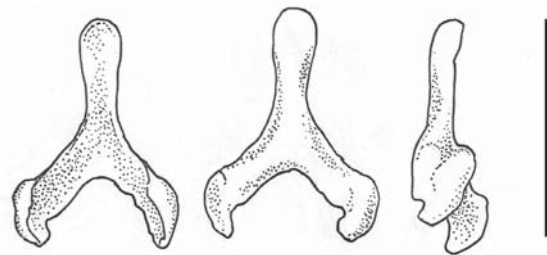


Figure 5. Baculum of *Hypsugo* cf. *joffrei* from Sa Pa: ventral, dorsal and lateral view. Scale bar = 1 mm.

small upper premolar and myotodont lower molars in combination with some external features support the allocation of *joffrei/anthonyi* to *Hypsugo*, the baculum shape contradicts this view, calling for an in-depth taxonomic reassessment.

Barbastelles were not previously known from Vietnam. The taxonomic position of our specimens needs further examination, particularly in view of the recent notion that the genus *Barbastella* has a complex species structure. The forearm length in our individuals is 41.7 and 40.0, which corresponds well to both *B. beijingensis* and *B. darjelingensis* size limits (Zhang *et al.*, 2007; Benda *et al.*, 2008). According to cranial size estimated from canine width (3.75 and 3.94) Hoang Lien Son specimens are also more or less similar to *B. darjelingensis* and smaller than species from Central China. Our barbastelles possess very dark, almost black fur, tipped with brown and almost similar on back and ventral surface. Such coloration is much darker than that of *B. darjelingensis* from Central Asia and in one specimen from Nepalese Himalayas (S-164496 in collection of ZMMU), but similar to that of *B. beijingensis* (Zhang *et al.*, 2007). Indian specimens of *B. darjelingensis*, according to their description (Bates & Harrison, 1997; Chakraborty, 1983) also have blackish coloration, but with grayish tinges and with fur tipped with white, not brown. As in typical *B. darjelingensis*, individuals from Hoang Lien Son have straight posterior ear edges without any lobes. Until additional (e.g. from molecular genetics) data become available we tentatively refer barbastelles from Vietnam to *B. darjelingensis*, accepting that the northern Vietnamese highlands could be inhabited by a distinct subspecies.

The bat fauna of Hoang Lien Son contains a rich mix of species of different zoogeographic origin. Malayan faunal elements represented by *Cynopterus sphinx*, *C. brachyotis*, *Harpiocephalus harpia* and *Tylonycteris pachypus* are probably restricted in Hoang Lien Son to low elevations. The same is true for *Hipposideros armiger*, *H. pomona* and *Coelops frithii* though their distribution extends further northward into south China (Smith & Xie, 2008) and, in the case of *H. armiger*, westward along the Himalayas mountain range (Bates & Harrison, 1997). *Kerivoula hardwickei*, while predominantly Malayan in distribution, represents a complex of several genetically diverse lineages (Francis, 2008; Francis *et al.*, 2007) and the proper affinities of Hoang Lien Son woolly bats need further clarification on the base of molecular data. Contrarily, *Rousettus leschenaulti*, *Sphaeris blanfordi*, *Rhinolophus sinicus*, *Myotis montivagus*, *M. siligorensis*, *Scotomanes ornatus*, *Hypsugo* cf. *joffrei*, *Pipistrellus coromandra* and possibly some other species have Indo-Himalayan origin and supposedly penetrate into Indochina from the north along mountain ranges. *Barbastella darjelingensis* is also an Indo-Himalayan species (Corbet & Hill, 1992); however, the genus *Barbastella* on the whole is predominantly a Palaearctic taxon (Corbet, 1978; Koopman, 1994). Also *Myotis chinensis* could

also be regarded as a Palaearctic faunal element. Despite the fact that most of its distribution is within the formal boundaries of South-East Asia (Corbet & Hill, 1992), all related species (Zhang *et al.*, 2009) obviously have Palaearctic distribution. *Rhinolophus paradoxolophus*, the closely related *R. marshalli* and probably *Myotis laniger* are specific to the mountainous regions of the northern Indochina and southern China. The distribution of *Aselliscus stoliczkanus* and *Thainycteris aureocollaris* is also confined mainly to mountainous areas of the northern Indochina (Dang Ngoc Can *et al.*, 2008; Francis, 2008).

The distribution of *Harpicola isodon* represents an exceptional case. The new record in Hoang Lien Son is situated in-between two previously known localities, at about 1800 km from the species *terra typica* on Taiwan (Kuo *et al.*, 2006), and about 930 km north from previously known Vietnamese record (Kruskop *et al.*, 2006). Thus it can be supposed that present distribution represents remnants of a much wider former range and that there is a possibility to find further *Harpicola* localities. Somewhat similarly, *Murina* cf. *harpioloides* was previously known only from the Dalat Plateau (Abramov *et al.*, 2010), whereas its closest plausible congener occurs in China (J. Eger, pers. comm.).

Summarizing we can consider that our recent results demonstrate that there is a considerable scope for bat research in Hoang Lien Son and in North Vietnam on the whole. Although the present field survey was restricted in time and space two species were added to the fauna of the country and two another were recorded for second time and represent large extensions in distribution. Aside from providing information on local bat assemblages critical for conservation planning, possible further investigation of this area will have important ramifications in our understanding of the history and origin of bat faunas in the northern and central Indochina.

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