

A new big-footed mouse-eared bat *Myotis annamiticus* sp. nov. (Vespertilionidae, Chiroptera) from Vietnam

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Summary. — A very small of species *Myotis* in the *Myotis daubentoni* group was found in a valley of the foothills of the Annamit Mountains, Quan Binh Province, Vietnam. Thirteen specimens of this bat were compared with other Eurasian big-footed bats. Analysis of external and skull morphology indicate this Vietnamese form should be described as a new species. Compared to other species of *Myotis* the new taxon is most closely related morphologically to the recently described Himalayan *M. csorbai* Topal, 1997.

Resume. — Un tres petit *Myotis* du groupe *daubentoni* a ete decouvert dans les contreforts de la province de Quan Binh au Vietnam. Treize exemplaires ont ete compares aux autres *Myotis* de meme groupe qui habitent en Europe et Asie. La morphologie generale et celle du crane permettent de presenter la forme vietnamienne comme une espee nouvelle. Parmi les *Myotis* le nouveau taxon est plus proche de l'espee himalayienne *M. csorbai* Topal, 1997.

KEY WORDS : systematics, *Myotis*, new species, Vietnam, Chiroptera.

INTRODUCTION

The uncertainty of the systematics of *Myotis* on the whole and of the *daubentoni* species group has been dicussed at length in many works, from Tate (1941) to the present time (e. g., Corbet and Hill 1992).

Tate (1941) put most of the typical small Eurasian species of the subgenus *Leuconoe* into two sections : *daubentoni* and *capaccinii*, differentiated mainly by the attachment of wing membrane to the foot. *Myotis longipes* was tentatively included into the *capaccinii* section but with comments on it's uncertain systematic affinities. Findley (1972), on the basis of fenetic data combined *M. daubentoni* and *M. capaccinii* with their relatives, including *M. longipes*, into one species group. In the last checklist (Koopman, 1994) the *daubentoni* group includes six species. An additional species,

M. csorbai, closely related to *M. longipes*, was recently described from Nepal (Topal 1997). The latter author treated *M. laniger* as a full species.

Thus, *Myotis longipes sensu lato* (i. e. including *M. csorbai*) seems to be an Afghanistan! and Himalayan endemic. The only record, extralimital to this range is from Tonkin, Vietnam (Osgood 1932; Dang Huy Huynh *et al.* 1994), however it is thought to be misidentified *M. laniger* (Topal 1997).

During the first authors' fieldwork with the biological expedition of the Joint Russian and Vietnamese Tropical centre scientific voucher specimens of bats were collected in Minh Hoa district, Quan Binh province (Central Vietnam) in March and April 1999. The collection includes among other several specimens of small mouse-eared bats (genus *Myotis*) of uncertain taxonomic position.

An analysis and the comparison of external and cranial morphology of these *Myotis* specimens has shown them to possess certain morphological peculiarities that set them apart from other South Asian representatives of the genus *Myotis*. In our opinion, these mouse-eared bats, captured in Yen Hop valley (Minh Hoa distr.) represent a distinct taxon, which deserves to be given specific rank. The description of this form is presented herewith.

MATERIAL AND METHODS

Thirteen specimens of both sexes of the new species were studied of those, 10 are specimens, preserved in fluid (5 with extracted skulls), and 2 are dry skins with skulls. All individuals were captured while flying over a stream, from March, 17 to April, 21, 1999, by using traditional nylon mist-nets (7 x 1.8 m) and Borissenko's mobile « flap-trap » (Borissenko 1999). Captured bats were weighed to the nearest 0.1 g, and a set of 23 external measurements were taken for each specimen. The external measurements were taken to the nearest 0.1 mm with an ordinary dial calipers. A set of 22 cranial measurements were taken in the laboratory to the nearest 0.01 mm with an electronic calipers in combination with a binocular microscope.

The following external measurements were taken : head and body length, tail length, length of free tail tip, ear length, tragus length, tibia length, foot length (without claws and including claws, measured to the most remote part of claw), forearm length, length of the first digit (without claw and including claw), length of the metacarpal of the second digit, and lengths of the metacarpals and phalanges of the third through fifth digits. All wing measurements were taken on the right wing.

The following cranial measurements, followed by abbreviations in parentheses, were taken : condylobasal length (CBL), condylocanine length (CCL), width of the skull at the level of the auditory bullae (W), width of braincase (BCW); height of braincase posteriorly to the auditory bullae (BCH), least interorbital width (IOW), rostral width at the level of the preorbital foramina (WR), rostral length from preorbital foramina to the alveolus of the inner incisor (LR), C-M³ length (CM3), length of the upper canine cingulum base (C), length of interval between cingula of upper canine and large premolar (« pseudodiastema », PD), molariform row length (P4M3), width of M² (WM3), length of M² (LM3), crown measured width between outer margins of upper canines (CC), crown measured width between outer margins of M³ (M3M3), lower jaw length from alveolus of i1 to the articulated process (LMD), lower jaw height to the tip of coronoid process (HMD), crown length of maxillary tooth row (MCM3).

78 specimens (including both dry and alcohol preserved once) of 8 *Myotis* species were studied as comparative material. All specimens, used in this work as comparative material, are deposited in the collections of Zoological museum of Moscow state university (ZMMU) and Zoological institute of Russian academy of sciences (ZIN).

Myotis daubentonii ussuriensis — Russian Far East: Khassan peninsula (ZMMU-86494-96, 86498, 86503-06, 86508, 104343, 104344, 104358, 104359, 104362) ; Japan (ZIN-59102, 59103).

Myotis daubentonii petax - Russia, Altai mnts. (ZMMU-33154, 33156, 61858, 103861, 103862, 154255).

Myotis daubentonii loukashkini - China, Manjuria (ZMMU-84014, 84015).

Myotis daubentonii subsp. - Russia, Tyva (ZIN-64466, 64473, 64474, 64477).

Myotis longipes - Afghanistan (ZIN-58447, 58448).

Myotis csorbai - Nepal, Annapurna Himal (ZMMU-164481, 164483, 164484, 164487, 164490 - paratypes ; 164475-480, 164482, 164485, 164486, 164488, 164489).

Myotis macrodactylus - Russian Far East (ZMMU-86359, 104370-375, ZIN-18958, 41734), Japan (ZIN- 59100, 59101).

Myotis capaccinii - Bulgaria (ZIN-48035, 48036), former Yugoslavia (ZIN-35045-048), Czech republic (ZMMU-74670).

Myotis horsfieldi - Vietnam (ZMMU-61302, 165039, 165041), Thailand (ZMMU-150320).

Myotis hasseiti - Cambodia (ZMMU-164468).

Myotis siligorensis - Vietnam, Hatien Prov. (ZMMU-164986, 165043, 165046, 165054).

***Myotis annamiticus* sp.nov.**

Holotype : Adult male, ZMMU S-167123, Yen Hop valley, near Yen Hop, ca. 35 km S Minh Hoa (Qui Dat), Minh Hoa district, Quau Binh prov., Vietnam ; 17 March, 1999. Collected by S. V. Kruskop. Alcoholic specimen, skull extracted.

Paratypes : Two adult males, ZMMU S-167126, 167133, and eleven females, S-167124, 164125, 164127-132, 1164134, 164135, collected at the type locality between 20 March and 21 April, 1999, by S. V. Kruskop.

Diagnosis

A species of *Myotis* of fairly small size : forearm length 30,6 - 34,3 (mean 32,35 ; n = 13), condylobasal length of skull 11,99 - 12,42 (mean 12,163 ; n = 7), average body weight 4,07 gr. Margin of plagiopatagium attached to the middle of the metatarsus. Frontal part of skull distinctly elevated from low rostrum (as in *M. csorbai* and *M. siligorensis*). Both small upper premolars in tooth row and similar in shape unlike most of other species of *Myotis* (*Leuconoe*); pseudodiastem enlarged, P³ sometimes not in contact with posterior large premolar (P⁴).

Measurements of the holotype (in mm). External: body length - 36, tail length - 33, length of free tail tip - 1,7, ear length - 13,7, tragus length - 7,4, tibia length - 14,6,

foot length (without claws/with claws) - 6,9/8,0, FA - 31, D1 (without claws/with claws) - 3,6/4,1, Mc2 - 26,8, Mc3 - 28,7, Ph3.1 - 10,2, Ph3.2 - 7,8, Ph3.3 - 5,0, Mc4 - 27,6, Ph4.1 - 7,5, Ph4.2 - 8,0, Mc5 - 25,6, Ph5.1 - 7,3, Ph5.2 - 7,5. Skull: CBL - 12,04, CCL - 11,29, W - 6,62, BCW - 6,24, BCH - 5,13, IOW - 3,32, WR - 3,59, LR - 2,95, CM3 - 4,89, N - 0,65, PD - 0,81, P4M3 - 3,36, WM3 - 1,19, LM3 - 0,62, CC - 3,16, M3M3 - 4,94, LMD - 8,87, HMD - 2,11, MCM3 - 5,1.

Description

Myotis annamiticus sp. nov. is a typical example of *Myotis* (*Leuconoe*). Diagnostic features of the given subgenus, namely - distinctive protoconule and protocrista on M^{12} , supplementary cusps on the inner incisors, slightly elongated cingulum of the upper canine and high attachment of the wing membrane on the metatarsus - are present and well separate this species from *Myotis siligorensis*, which is similar in size and skull shape, but typical «*Selysius*». The size of this new species is smaller than found in all known members of the *daubentonii* group, except for the Japanese species *M. pruinus*, even the very small *M. csorbai* is a little larger on the average than *M. annamiticus*.

External characters : Ear narrow and relatively long, extending to the tip of muzzle when laid forward. Tragus about one half of ear length. Third metacarpal is the longest, about 2 mm shorter than forearm, fifth metacarpal the shortest. Hind foot, measured with claws, not very large, but slightly larger than in *M. csorbai* (60,98 and 57,51 % of tibia length respectively). Margin of plagiopatagium inserted on the middle of the metatarsus. Calcar long and slender, longer than half of uropatagium margin, lacking calcar lobe. Tail relatively long, 88 % of head and body length on the average ; it's tip about 1,6 - 2,4 mm free from the membrane. Pelage relatively short (about 3,5 - 4 mm) and medium dense, dark greyish-brown on the dorsum and frosted with white tips on the venter.

Cranial and dental characters : Skull with relatively long and low rostrum, distinct fronto-nasal flexure and high brain case (Fig. 1). Brain case height ca. 78% of skull width. Upper surface of rostrum with a visible middle groove ; lateral grooves are

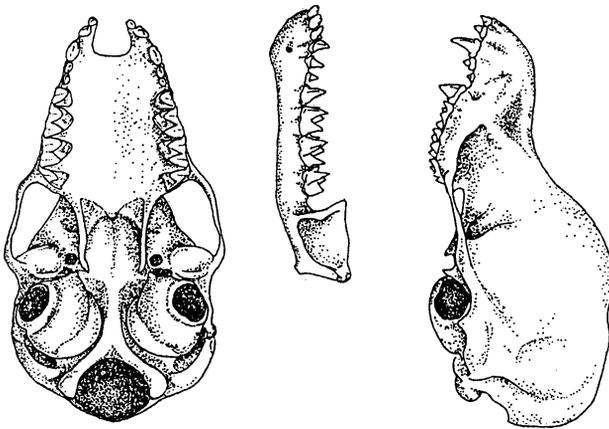


Fig. 1. - Lateral and ventral view on the cranium and mandible of *Myotis annamiticus* (holotype). Scale = 2 mm.

rather distinctive. Interorbital constriction remarkably narrow ; interorbital width about 48% of skull width. Posterior border of naris extending to the frontal margin of the upper canine. Anterorbital foramen large. Sagittal crest and supraorbital crests not developed, lambdoid crest visible laterally, but lacking at the central portion. Coronoid process of mandible vertical, but not very high, almost on the same level with the articular process. Inner upper incisor trifold, slightly smaller, than the outer one. Canine small, subequal in height with P⁴. Canine cingulum has gap on the lateral side of the tooth, where there is no distinct border between cingulum surface and cusp. The canine cusp has one distinct groove, located postero-lingually and extending forward to the middle of cusp base length ; postero-buccal groove is small or absent, can be distinguished readily only in old individuals. Distance between \bar{N} and P⁴ longer than canine cingulum base. Both small upper premolars located in the tooth row, subequal in crown area, but P³ height one half that of P². P⁴ much narrower than molars, without distinct cusplet on cingulum.

Baculum : General form Y-shaped, similar to that of other *Leuconoe* species. Baculum narrow, abruptly enlarged at the distal end ; without « wings » on the lateral sides, but with a small flexure in the central portion and a bulge at the base (in profile). The ventral surface of the baculum is almost straight, not concave. There is no notch on its proximal border (Fig. 2). Greatest length 0,75 mm, greatest width 0,35 mm (N = 2, adults).

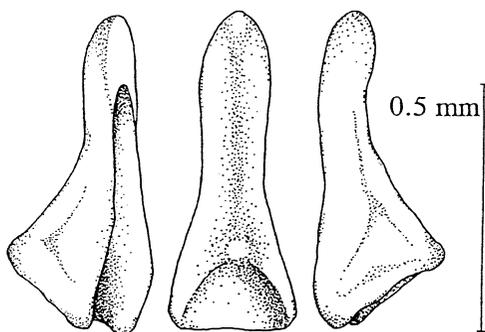


Fig. 2. - Baculum of *Myotis annamiticus*. Views : fronto-lateral, dorsal and lateral (left side).

Comparison with similar species

Individuals of the new species were compared with following members of the *M. daubentonii* group: *M. daubentonii* (Asian forms), *M. macrodactylus*, *M. capaccinii*, *M. longipes* and *M. csorbai*. Unfortunately, we were unable to examine specimens of *M. pruinus* and were obliged to use the detailed descriptions given by Yoshiyuki (1971, 1989). According to these descriptions, the latter species is rather similar to *M. annamiticus* in size, but differs by having smaller ears, larger hind feet and different dorsal pelage coloration.

Projection of the first two principal components (Fig. 3), based on 22 metric characters, shows a good segregation of the newly described species of big-footed bat from other species in the subgenus. The first principal component is most influenced

by the measurements related to overall size and emphasize the relatively small dimensions of *M. annamiticus*. The second principal component relates to the length of the gap between C and P⁴, which is longer in the new species, then in most of the other species examined.

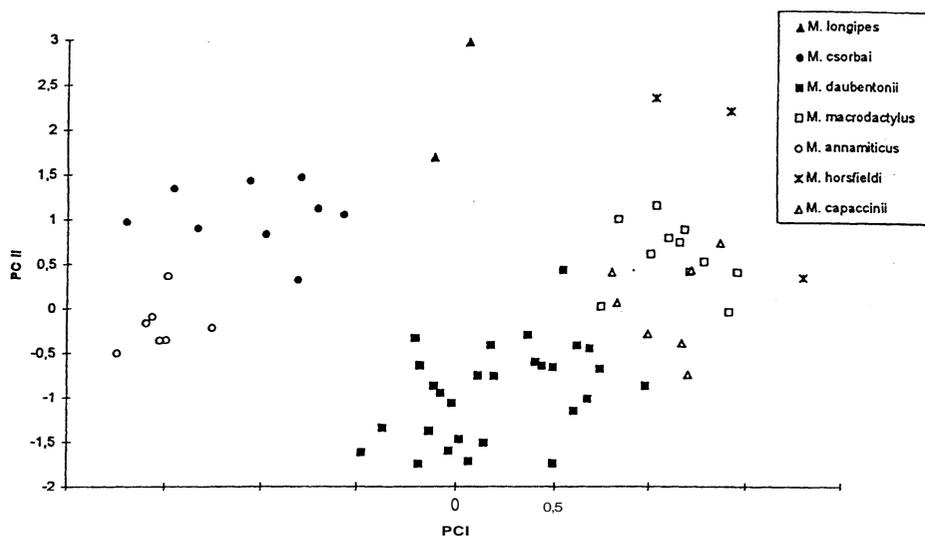


Fig. 3. -- Two-dimensional projection of principal components I and II for seven species of *Myotis* (*Leuconoe*), based on 19 cranial measurements. Eigenvalues - 13,92381 and 1,764164 % of total variance - 73,28323 and 9,285075, respectively. Missing data casewise deleted.

The stepwise discriminant function analysis revealed a high level of discrimination among all examined species. Firstly, all 22 cranial measurements were used and a set of the 10 most powerful features were used for the final comparison. In both cases 100% of the individuals were associated correctly. Squared Mahalanobis distances for each individual from the centroid of its own group and other groups differ significantly (Tab. 1.)

Table 1. — Squared Mahalanobis distances from group centroids for *Myotis* sp. nov. specimens.

New species, mus. ?	<i>Myotis csorbai</i>	<i>Myotis daubentonii</i>	<i>Myotis macrodactylus</i>	<i>Myotis</i> sp. nov.	<i>Myotis capaccinii</i>
s-167134	41.43539	136,3842	115.7634	4,367927	136.6006
s-167127	35,44716	109.7194	110.4414	1.421625	125.0267
s-167132	39.31582	134.8483	116.0611	4,26119	138,1833
s-167135	31.57809	89.43184	110.573	3.227752	123,3281
s-167128	41,43896	109,1612	112.7116	5,655962	122,5905
s-167123	42,35147	129.5	129,0817	7.247987	158.897
s-167126	54.39014	142.5969	146.1968	9,389492	147,1634

From other species *M. annamiticus* differs first of all by a combination of very small canine and well developed pseudodiastema. The ratio between these two features is less in the new species than in any other of species in the *daubentonii* group (Fig. 4). These ratios also distinguish *M. annamiticus* from species in the *adversus* group that are also widely distributed in the Indochina region, namely *M. hasseiti* and *M. horsfieldi*.

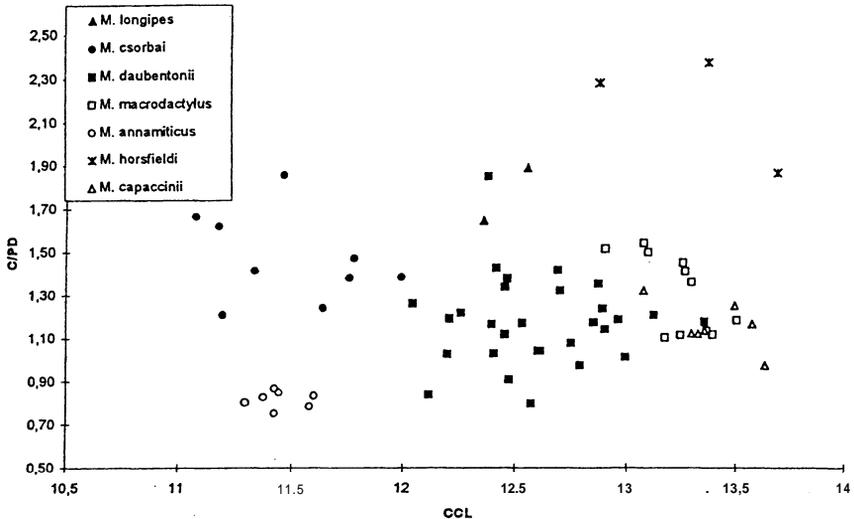


Fig. 4. — Two dimensional plot, showing ratio between condylo-canine length (CCL) and relative sizes of canine and pseudodiastema (C/PD) in the same *Myotis* species as in Fig. 3.

The newly described species differs from *M. daubentonii*, *M. capaccinii* and *M. macrodactylus*, first of all, by small size. In all three of the latter species the rostrum of the skull is robust, not-flattened and lacks a distinct fronto-nasal flexure and rostral depressions. Additionally, in *M. capaccinii* and *M. macrodactylus* the relatively large canine always has a cingulum longer than pseudodiastema, while in *M. daubentonii* this feature is highly variable, only one of specimens examined has a canine cingulum shorter than the pseudodiastema. In all three of the latter species the cusp of the canine has a wide and deep groove, and the cingulum lack a gap on the lateral side. In external features, *M. annamiticus*, besides being smaller in size, differs from *M. macrodactylus* and *M. capaccinii* by the placement of the wing membrane attachment and a relatively shorter hind foot, and from *M. daubentonii* by having relatively longer and more pointed ears. Among *M. daubentonii* only the *M. d. laniger* is of comparable size (Bates and Harrison, 1997), but it also has a much longer forearm. Moreover, according to Topal (1997), *M. d. laniger* has larger mean values for most dental measurements, but these size feature does not agree well with the description given in Bates and Harrison description. This contradiction also has been noted previously (Bates *et al.* 1999). The specimen of *M. d. laniger* described by Bates *et al.* (1999), is in most respect similar with our specimens, but distinctly larger.

Myotis annamiticus differs from *M. longipes* by having a smaller skull and shorter forearm, the absence of a fringe of moderate hairs on the outer margin of the tibia and

in pelage coloration. Compared with *M. annamiticus*, in *M. longipes* the P³ is reduced and displaced inward in the tooth row.

Among the species in the *daubentonii* group, this newly described *Myotis* is most similar to the Nepalese *M. csorbai*. When placed as an unidentified example in a discriminant function analysis, *M. annamiticus* is associated with a higher percentage with the latter species. However, these two species differ in several features. *M. annamiticus* is a little smaller than *M. csorbai* (mean body mass 4,07 and 4,83 gr., FA 32,35 and 35,75 mm, respectively), while their skulls are similar in size. *M. annamiticus* has a distinctly narrower rostrum, its maximum width is 3,65 mm (mean 3,56 ; n = 7), while in *M. csorbai* the minimum width is 3,69 (mean 3,84 ; n = 9). The canine is larger and the pseudodiastema is distinctly shorter in *M. csorbai*, than in the new species. Although in the Nepalese species the P³ is commonly not removed from tooth row, it is compressed between P² and P⁴. The canine of *M. csorbai* has a wider cingulum base than in the new species ; as in other members of the species group, there is no gap on cingulum in this species. The rostral depressions, both medial and lateral, are distinctly deeper in *M. annamiticus*, than in *M. csorbai*.

The baculum of *M. annamiticus* has a marked difference from that of *M. daubentonii*. In general it is similar to the baculum of *M. macrodactylus* (Yoshiyuki, 1989) and *M. csorbai*, but it is smaller, narrower in the distal part and lacks a concavity on the ventral surface and a notch on the proximal border.

Etymology

The name « *annamiticus* » is derived from the Annamit chain of mountains, in whose south-eastern foothills the new species was first found.

Distribution and biology

Myotis annamiticus is known only from the type locality. Animals were observed only while flying over the waters of the small rivers in Yen Hop and Ban On valleys, where they were rather numerous. The most typical flight pattern is one of ovals, 5 - 15 cm above the water's surface, but with occasional shift to 30-60 cm. The foraging behavior is very similar on the whole to that of the European *M. daubentonii* (Jones and Rayner 1988 ; Kaiko and Schnitzler 1989) and to the Nepalese *M. csorbai* (Csorba *et al.* 1999). Echolocation calls are high intensity with steep FM sweep from ca. 60 to 35 kHz and with maximum energy around 45 kHz. Trawling behavior was observed in a very few instances. According to the stages of pregnancy observed, the peak of births is probably confined to the last days of April or beginning of May.

Taxonomical remarks

The newly described *Myotis* is most similar to *M. csorbai*, another small species in the *daubentonii* group, that is found in the foothills of the Himalayas in central Nepal (Topal 1997; Csorba *et al.* 1999). Significant differences in the rostrual and mandibular measurements and the shape of the canines and bacula lead us to treat *M. annamiticus* as a full species. However, further investigations of geographic variability in both species and additional new records in the gap between the Himalayas and central Vietnam probably may show them to be only subspecies of the same species.

Including this new species, the *daubentonii* species group now includes at least 7 species : *M. daubentonii*, *M. capaccinii*, *M. macrodactylus*, *M. longipes*, *M. csorbai*,

M. annamiticus, and *M. pruinosus*. Additionally, various authors include in the group some forms of uncertain taxonomic position, namely *M. laniger* and *M. natalinae* (both probably conspecific with *M. daubentonii* according to Bogdanowitz (1990, 1994); *M. fimbriatus* (probably a subspecies of *M. macrodactylus*, but see Corbet and Hill 1992); and *M. abei*, known from Sakhalin by the single specimen (Yoshikura 1956). Among the seven species recognised here, the first three have a more or less robust rostrum without pronounced rostral depressions and fronto-nasal flexure. The other species, probably including *M. pruinosus*, form a complex of smaller-sized species with a low rostrum and well-seen depressions. So, Findley's *daubentonii* group seems to be rather naturally divided into two subgroups or groups on the basis of skull morphology. For the second one the name *longipes* may be fixed.

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