

**Description of a new species of *Murina* from Cambodia
(Chiroptera: Vespertilionidae: Murinae)**

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A new species of *Murina*, which belongs to the 'cyclotis-group', is described from Cambodia. It is characterised by the attachment point of the plagiopatagium, its large skull size, the distinctive shape of the rostrum, and the relative sizes of the upper incisors. To date, it is only known from Kirirom National Park, where it was collected in disturbed semi-evergreen gallery forest, which had many immature trees.

Key words: Cambodia, taxonomy, new species, *Murina* sp. nov.

**A new species of *Myotis* (Chiroptera: Vespertilionidae)
from central Africa**

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A specimen of *Myotis*, collected by Jean-Paul Adam and later identified as *Myotis megalopus*, was compared with the holotype of *megalopus* and also with *Myotis longipes* from India and Afghanistan (which currently includes *megalopus* as a synonym). It was also compared with *M. bocagii* (which is sympatric and similar in size), *M. daubentonii* from Europe (which several authors reported as being very similar), and *M. scotti* (another sub-Saharan African species of similar size). Based on cranial and external morphology and morphometric data, Adam's specimen was found to be a new species. It differs in having the combination of a very weakly concave forehead region of the skull, relatively long feet, wing membranes attached to the bases of the tibiae, and no backwardly-curved hairs on the margin of the interfemoral membrane. It was collected in a limestone cave at Loudima in the Republic of Congo, in degraded rainforest near a river.

Key words: *Myotis* sp. nov., *Myotis megalopus*, central Africa, description

**Revalidation of *Myotis petax* Hollister, 1912 and its new status
in connection with *M. daubentonii* (Kuhl, 1817)
(Vespertilionidae, Chiroptera)**

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A combined approach based on the complex use of molecular, morphological and ecological data has shown that the 'eastern' group of forms of transpalearctic Daubenton's bat, *Myotis daubentonii* (Kuhl, 1817), deserves a status of distinct species, and conforms to *M. petax*, described by Hollister in 1912 from the Republic of Altai in the south of Western Siberia. In our genetic analysis we used SINEs (short interspersed elements) of nuclear DNA as genetic markers, and by means of Inter-SINE-PCR, have clearly demonstrated a species distinctiveness of *M. petax*. Our further analysis has also shown, that they considerably differ from *M. daubentonii* s.str. in skull proportions, dental features, as well as in bacular shape and size. Both species also differ in their ecology and general appearance, especially coloration.

Key words: *Myotis daubentonii*, *M. petax*, taxonomy, ranges, SINEs, morphology, ecology

Geometric morphometrics and cladistics: testing evolutionary relationships in mega- and microbats

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Traditionally, morphometric data have consisted of distances, angles, or ratios, and have been considered inappropriate for cladistic analyses. Recently, geometric morphometrics, based on homologous landmark point-coordinates, has provided a number of advantages over traditional morphometric data and methods, including the possibility that phylogenetically informative characters and character-states may be extracted and used in cladistic analyses. Using two data sets of 3-dimensional point coordinates collected from skulls of bats, we empirically evaluate this possibility. Partial warps were extracted from the point-coordinate matrix, and these were then re-coded by gap-coding, for use in the cladistic analyses. In the case of samples from *Eidolon helvum* populations (two mainland localities and four islands in the Gulf of Guinea), analyzing males and females separately, our analyses based on these data were unable to detect consistent phylogeographic patterns among the populations. In the case of samples from plecotine bat species, these analyses produced a consensus cladogram showing considerable concordance with an earlier cladistic analysis by us of this group. In both cases, our results reflect those of earlier studies (based on both morphologic and genetic data), suggesting that the data and analytic techniques described herein may have interesting utility in cladistic analyses.

Key words: geometric morphometrics, partial warps, gap-coding, phylogeny, Microchiroptera, Megachiroptera

Reproductive anatomy and cyclicity of the bat *Eonycteris spelaea* Dobson (Chiroptera: Pteropodidae) in West Malaysia

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Previous field studies suggested that *Eonycteris spelaea* reproduces at all times of the year, with peak periods that may be associated with the rainy seasons. This study reports the anatomical and histological features that are associated with this pattern, using specimens obtained from this study. Our data confirm that this species is indeed aseasonal and polyestrous, and that females are monotocous and appear to undergo two pregnancies a year. The gross morphology of the male and female reproductive tracts is described. Adult males were found to have spermatogenic testes and secretory accessory sex glands year around. Adult females also were reproductively active year around. Individuals were pregnant, lactating or pregnant and lactating at each sampling. Both sexes possess specialized para-anal sebaceous glandular organs whose odoriferous secretions may have a role as secondary pheromones in the reproductive behavior of *Eonycteris*.

Key words: baculum, para-anal glands, testes, epididymus, polyestrous, uterus, vagina

Relative size of hearts and lungs of small bats

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We estimated the heart and lung size of several species of small bats (*Tadarida brasiliensis*, *Mormopterus kalinowski*, *Myotis chiloensis*, *Histiotus macrotus*, *H. montanus*, *Lasiurus borealis* and *L. cinereus*) and compared these values to those of bats of larger size and other mammals. Our results confirmed that bats have the largest relative heart and lung size of all mammals. This is associated with the high energetic costs of flight. As expected, the mass-specific lung and heart sizes of small bats were larger than those of large bats. However, although relative heart mass decreased according to body mass, $M_b^{-0.21}$, lung volume was nearly isometric with body mass (exponent = 0.90). This exponent was close to unity, and between exponents reported previously (0.77 and 1.06). This suggests that small bats compensate the energetic cost of flight mainly by changes in cardiovascular morphology. The relative heart mass of both *H. macrotus* and *H. montanus* was particularly large, representing 1.71 and 2.18% of total body mass, respectively. These values correspond to 121.3 and 162.7%, respectively, of the expected values from allometric relationships. In these big-eared bats, the large hearts could be attributed to the energetic costs induced by the ears' drag.

Key words: heart, lung, allometric relationships, *Histiotus*, Chile

Radar data on wing-beat frequencies and flight speeds of two bat species

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This paper presents for the first time radar recorded flight paths and wing-beat pattern of two identified Palaearctic bat species. Simultaneous film recordings confirm the wing-beat pattern reflected by echo signatures. Our results suggest that discrimination of bats and nocturnally migrating birds is usually possible because the recorded bats differed from the regular flapping and pausing phases in passerines' bounding flight as well as from the regular continuous wing-beats of other nocturnal migrants (e.g., waders and waterfowl) by very short and irregularly distributed glides (flap-gliding). Small, medium and large bats may be differentiated according to wing-beat frequency. For the discrimination of the similarly sized *Nyctalus noctula* and *Eptesicus serotinus* (both with mean frequencies of 7–7.5 Hz and variation mainly between 6 and 8 Hz) ecological or behavioural features must be included. The lowest rates of flapping (even below 5 flaps per second) occurred because some flaps were prolonged by very short glides. Measured flight speeds (13.5 and 13.2 m/s, respectively) were higher than most of the previously recorded or predicted speeds. In comparison to other methods, radar studies have the potential to be applied to bats in free flight over relatively large distances. A limitation of the radar method is given by the fact that very low flying targets cannot be tracked because they merge with ground echoes.

Key words: *Nyctalus noctula*, *Eptesicus serotinus*, flight behaviour, wing-beat pattern, speed, radar tracking

Echolocation signals and pinnae movement in the fruitbat
Rousettus aegyptiacus

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The fruit bat *Rousettus aegyptiacus* has highly mobile pinnae. Little is known about the role that such movements play in sound localisation however and whether they interact with the process of echolocation in this species. Here we report the correspondence of echolocation signals in free flight with the downward wingbeat and forward movement of the pinnae, and demonstrate that the ears have a greater sensitivity to click stimuli in front of the animal when directed forwards than when back and to the side. The potential significance of the production of echolocation signals whilst the ears are moving from their least sensitive to their most sensitive position is discussed.

Key words: fruit bat, *Rousettus aegyptiacus*, echolocation, pinnae movement

Development of vocalizations in the flat-headed bats, *Tylonycteris pachypus* and *T. robustula* (Chiroptera: Vespertilionidae)

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The development of vocalizations during post-natal growth in the flat-headed bats, *Tylonycteris pachypus* and *T. robustula* in South China is described. Females of both species gave birth to twins at the end of May, and the infants flew in the last ten days of June. Vocalizations served as precursors to echolocation calls and as isolation calls (i-calls) used to attract mothers. As the infants grew, the frequency of i-calls and precursor calls increased. The duration of i-calls increased little before 6-day old and then decreased. At the same time, the duration of echolocation precursor calls decreased. The directive calls that the mother or the infant emitted when searching for each other are also described. Female directive calls are lower in frequency and longer in duration than their echolocation calls, and the duration of infant directive calls is longer than those of the i-calls and precursor calls.

Key words: directive calls, flat-headed bats, isolation calls, precursor calls, *Tylonycteris pachypus*, *T. robustula*, vocal development

Foraging and roosting ecology of a rare insectivorous bat species, *Laephotis wintoni* (Thomas, 1901), Vespertilionidae

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Laephotis wintoni is a rare bat and little is known about its biology. We studied this species at Algeria Forestry Station in the Western Cape Province, South Africa. A female caught in November 2002 was pregnant and three females caught in November 2004 were all lactating. The three lactating females were radio tagged and roosted in crevices or narrow fissures in a cliff face above the valley where they foraged. *Laephotis wintoni* is a small insectivorous bat (body mass, $\bar{x} \pm SD = 9.6 \pm 0.5$ g, $n = 4$) with low wing loading (7.0 ± 0.7 Nm⁻², $n = 4$), low aspect ratio (5.7 ± 0.5 , $n = 4$), low wingtip shape index (1.2 ± 0.2 , $n = 4$) and long ears (20.9 ± 2.3 mm, $n = 2$). Its morphology suggests that it is a slow manoeuvrable flyer that can fly close to vegetation, or the ground or over water surfaces. Its relatively pointed wings suggest that it probably does not fly in dense clutter. Furthermore, it combines this wing shape with echolocation calls of relatively low intensity, short duration (2.6 ± 0.8 ms, $n = 5$), narrow band (13.5 ± 2.9 kHz, $n = 5$) and surprisingly low peak frequency (22.1 ± 0.6 kHz, $n = 5$). The latter two parameters make it unlikely that the calls are used to overcome masking effects associated with flying in dense clutter. Instead, we propose that its echolocation calls are adapted to be less audible to tympanate insects. This is supported by the fact its diet is dominated by moths in a habitat where tympanate moths comprise 90% of the moth population.

Key words: *Laephotis wintoni*, echolocation, wing morphology, diet, radio telemetry

Diet of wrinkle-lipped free-tailed bat (*Tadarida plicata* Buchanan, 1800) in central Thailand: insectivorous bats potentially act as biological pest control agents

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Insectivorous bats are major predators of nocturnal insects and have the potential to act as biological pest control agents in farmlands. The objective of the present study was to establish the diet of the guano bat, *Tadarida plicata*. The study was carried out at the Khao Chong Pran Cave, which houses 2.6 million bats, and is surrounded by rice fields. A total of 1,925 faecal pellets were collected from 385 bats during their morning return from January to December 2002. Faecal analysis indicated that *T. plicata* fed on at least nine insect orders: Homoptera (28.4%), Lepidoptera (20.8), Hemiptera (16.4), Coleoptera (14.4), Diptera (7.0), Hymenoptera (6.6), Odonata (6.0), Orthoptera (0.5) and Psocoptera (0.1). Light traps indicated that Coleoptera (41.2%), Homoptera (25.3), Hemiptera (18.8) and Diptera (12.7) were the most abundant insects in the study area. Homopterans, most of which were white-backed planthopper (*Sogatella* sp., Delphacidae) had the highest percentage frequency of occurrence in the bats' diet indicating that *T. plicata* potentially plays an important role in controlling this major crop pest. The presence of macropterous planthoppers and a large proportion of moths in its diet suggests that *T. plicata* feeds on windborne migrant insects at high altitude. Female bats fed significantly more on lepidopterans and coleopterans and less on damselflies than males. The diet diversity index of lactating females was higher than pregnant females. Diet did not differ significantly between the dry and rainy seasons for either sex.

Key words: biological pest control, diet, *Tadarida plicata*, planthopper, Thailand

Diet variability of *Micronycteris megalotis* in pristine and disturbed habitats of Northwestern Ecuador

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Feeding strategies in foliage-gleaning bats should be affected by insect availability and the constraints imposed by the environment. Under strong preferences for particular insect prey, habitat should not have an effect on the expected similarities in diet among conspecific bat colonies occupying different environments. We compared the diet of *Micronycteris megalotis* individuals in two colonies located at different sites in the Andean slopes of northwestern Ecuador, based on insect remains collected at feeding roosts. Our analysis revealed that lepidopterans were extremely abundant in the diet of bats that forage in grasslands (52% of all insect remains), whereas the diet of bats that roost in primary forest consists mostly of coleopterans (85%). Log-linear analyses suggested that Lepidoptera is an influential group determining differences in feeding habits between both colonies, and that there are temporal fluctuations in diet independent of the habitats that were sampled. Analyses of the families within Coleoptera exhibited a similar pattern of dietary variability. Our study is the first to determine differences not only through time, but also among habitats in the diet of *M. megalotis*. Although our analysis lacked the benefit of accurate data on prey availability (insect population density), the evidence suggests that, within the margin of potential preys, there was a level of diet plasticity related to differences in habitat.

Key words: *Micronycteris*, insectivory, habitat, seasonality, opportunism, specialization

The guild structure of animalivorous leaf-nosed bats of Barro Colorado Island, Panama, revisited

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We examined data sets on dietary composition of a rich (15 species) assemblage of animal-eating Neotropical leaf-nosed bats (Phyllostomidae: Phyllostominae) that occur syntopically on Barro Colorado Island, Panama. Our aim was to test previously postulated trophic structure of phyllostomines in the light of alternative analytical techniques and new data. The trophic structure of this assemblage, according to new results from Correspondence Analysis, has two main trends of variation: a gradient of increased carnivory (axis 1) and a gradient involving plant and arthropod consumption (axis 2). This rejects previous hypotheses of this guild in which the structure was described as a complex of many independent discrete resources. Although all data sets agree that coleopterans as a group are an important food item for most species, Phyllostominae bats are not typically durophagous; i.e., they lack cranial and dental adaptations for rapid processing of hard-shelled arthropods as found in other bat families. Furthermore, insectivory varies inversely with body size, and is gradually replaced by carnivory in association with increasing mass and limited dental modifications. Together with CA results, this suggests that carnivory is an extreme of animalivory rather than a qualitatively distinct feeding habit among Phyllostominae bats. This conclusion fits biomechanical data that indicate that carnivorous bats are bigger and only modestly modified versions of soft-insect specialists.

Key words: Panama, Phyllostomidae, feeding habits, tropical forest, ecomorphology

Results of a recent bat survey in Upper Myanmar including new records from the Kachin forests

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Recent studies have shown the importance of Myanmar for the conservation of bat diversity. In March–April, 2003, twenty-five localities in Kachin and Shan States and Mandalay and Sagaing Divisions in Upper Myanmar were surveyed using mist nets and harp traps. Of the twenty-three bat species collected, thirteen were recorded from two localities in Kachin State, one of which has already been described as a new species, *Kerivoula kachinensis*, and a further two (a *Rhinolophus* and a *Kerivoula*) are putative new species. *Murina tubinararis*, *Murina cyclotis* and *Rhinolophus shameli* were recorded for the first time in Myanmar for over 65 years, while our records of *Rhinolophus stheno* and *Rhinolophus malayanus* are the most northern localities for these species in Myanmar. Species are discussed individually with external, cranial and dental measurements summarised. We also present descriptive statistics for echolocation calls recorded from five taxa. This represents the first bat survey of northern Myanmar forests for nearly 70 years. Kachin is already known to support high biodiversity and these recent records confirm the importance of its forests for the conservation of Myanmar's mammal fauna.

Key words: Chiroptera, Myanmar, Burma, distribution, harp traps, biodiversity, conservation

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SHORT NOTES

First record of *Thyroptera discifera* (Chiroptera: Thyropteridae) in the Cerrado of Central Brazil

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Key words: Thyroptera discifera, geographic distribution, Cerrado, calcar morphology

**Tent use by *Vampyressa nymphaea* (Chiroptera: Phyllostomidae) in
Cecropia insignis (Moraceae) in Costa Rica**

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Key words: cloud forest, Costa Rica, leaf modification, lowland rain forest, roost, tent-making bats, *Vampyressa nymphaea*

Distributional status of the Indian flying fox *Pteropus giganteus* in Sri Lanka

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Key words: Pteropodidae, Pteropus giganteus, distribution, Sri Lanka

Size-based fruit selection of *Calophyllum brasiliense* (Clusiaceae) by bats of the genus *Artibeus* (Phyllostomidae) in a Restinga area, southeastern Brazil

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Key words: frugivory, seed dispersal, seed size, optimal foraging, Atlantic Forest

**First resident population of *Pipistrellus nathusii* (Keyserling and Blasius, 1839)
in the Iberian Peninsula**

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Key words: Pipistrellus nathusii, Iberian Peninsula, bat boxes, rice paddies, mating