

## **History of the *Pipistrellus pipistrellus* group in Central Europe in light of its fossil record**

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In contrast to proposed paleobiogeographic scenarios based on molecular data, the fossil record suggests that in Central Europe the common pipistrelles, quite rich in the Holocene fossil record, first appeared as late as the present glacial cycle (including the Weichselian interstadials). Bats of this group are completely absent from the rich pre-Weichselian record available from Central Europe but occur in the early Middle Pleistocene record in the Mediterranean (Spain, Malta). Thus, it seems that the European range of common pipistrelles was restricted to the Mediterranean region until their northward spread during the present glacial cycle. The proposed range expansion (supposedly from multiple sources) is explained by climatic specificities of the present glacial cycle, namely with repeated extension of the semiarid, warm open-ground habitats that began in the Mediterranean region by the end of the Eemian.

*Key words:* *Pipistrellus pipistrellus*, fossil record, paleobiogeography, Central Europe, Weichselian, Holocene, dynamic biogeography, range extension

## **A review of the genera *Myotis*, *Ia*, *Pipistrellus*, *Hypsugo*, and *Arielulus* (Chiroptera: Vespertilionidae) from Myanmar (Burma), including three species new to the country**

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Since 1999, the University of Yangon and the Harrison Institute have conducted a series of bat surveys in Myanmar. During this time, six species of vespertilionid bat have been collected that have not been recorded previously from the country. Two, *Myotis horsfieldi* and *Myotis chinensis* were published in 2001 and one, *Kerivoula kachinensis*, which is a new species to science, in 2004. The remaining three, *Myotis mystacinus*, *Ia io* and *Pipistrellus pulveratus* are included here for the first time. The record of *M. mystacinus* is the first authenticated one for South-East Asia. Since small vespertilionid bats are difficult to identify and are generally poorly understood, the paper includes a brief review of all 24 species of *Myotis*, *Ia*, *Pipistrellus*, *Hypsugo*, and *Arielulus* currently listed for Myanmar. Three of these, *Myotis annectans*, *Pipistrellus pipistrellus* and *Hypsugo savii* are removed from the faunal list for lack of supporting data or because of previous misidentifications. The taxon *Pipistrellus peguensis* is included in the synonymy of *Pipistrellus javanicus*. The status of *Pipistrellus anthonyi* is discussed. Ninety-five species of bat, including forty-three species of vespertilionid, are now recorded from the country.

**Key words:** Myanmar, Vespertilionidae, *Myotis mystacinus*, *Pipistrellus pulveratus*, *Ia io*, systematics, distribution, ecology

## **The microchiropteran bat fauna of Singapore**

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The historical mammalian literature and recent surveys document a total of 24 microchiropteran species for the small equatorial island nation of Singapore. Intensive surveys carried out in the 1990s and subsequent records indicate that, of these 24 taxa, 15 are still present, another eight species, including all three hipposiderids, have become locally extinct and one other is indeterminate. Almost half (6) of the surviving species have very low abundances. Three new records of bat species in Singapore, namely *Nycteris tragata*, *Rhinolophus lepidus* and *Murina suilla* are assumed to have been present in the past but not detected in earlier surveys. *Nycteris tragata* and *M. suilla* are categorized as locally endangered. The vespertilionid, *Myotis oreias*, recorded previously only in Singapore, was not found in this survey and may be globally extinct.

*Key words:* bats, diversity, Microchiroptera, Singapore, South-East Asia

## **Phenology, diet, and ectoparasites of Leisler's bat (*Nyctalus leisleri*) in the Western Carpathians (Slovakia)**

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In the Western Carpathians (central Slovakia), we recorded *Nyctalus leisleri* in six foraging habitats. The body condition of foraging females and young varied during the season (May to August). Parturition occurred about mid-June and the first flying young were captured in the first half of July. The ectoparasites were recorded in 56.5% of examined bats and comprised seven arthropod species of mites, fleas and flies; the most common were the mites *Spinturnix helvetiae* (55.4%) and *Steatonyssus spinosus* (31.3%). Pregnant females were the most infested. Ectoparasitic flies *Nycteribia latreillii* and *Nycteribia (Acrocholidia) vexata* were recorded for the first time in this species. Seven orders of insects were found in the faecal pellets examined. By frequency (F%) and volume (V%), the major food items comprised Lepidoptera (F = 100.0, V = 55.7) and Diptera (F = 91.5, V = 25.6). The four most abundant prey categories by volume varied significantly seasonally.

*Key words:* *Nyctalus leisleri*, diet, ectoparasites, parasite load, phenology, roosts

## **Is species identity, sex, age or individual quality conveyed by echolocation call frequency in European horseshoe bats?**

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Horseshoe bats (*Rhinolophus*) use echolocation calls with a prominent part whose frequency is constant over time (CF) and matches the ‘acoustic fovea’ of the bats’ hearing system. The present study on European *Rhinolophus* species investigates whether this CF component contains reliable information on species, sex, age class or quality (size and body condition) of the caller and could therefore have a communicative value. The resting frequencies (RF) were measured from stationary, handheld bats for the species *Rhinolophus blasii*, *R. euryale*, *R. mehelyi* and *R. hipposideros* (the latter with very low sample size) in Bulgaria, where they occur in sympatry. We recorded calls directly onto a laptop computer and used a specially designed analysis algorithm to achieve high and accurate frequency resolution. After silent periods, individuals ‘tuned in’ to their RFs always from lower frequencies, corroborating the recent finding that frequencies below RF might be used for auditory feedback control as well. *Rhinolophus blasii* could reliably be separated from its congeners by RF, while *R. mehelyi* overlapped strongly with both *R. euryale* and *R. hipposideros*. Only *R. blasii* showed sex and age differences in RF, albeit the overlap was large. Adult female *R. blasii* had higher RFs than both adult males and juvenile females. In *R. blasii*, RF was positively correlated with forearm length, body mass and body condition index; in *R. mehelyi* with body mass and body condition index. However, there was no correlation between RF and these body size parameters within a sex or age class for any of the species, suggesting that RF is not a reliable honest signal for intraspecific communication that would indicate the quality of a potential mate or competitor.

*Key words:* *Rhinolophus*, echolocation, resting frequency, body size, sex differences, honest signalling

## **Echolocation behaviour of *Phyllops falcatus* (Chiroptera: Phyllostomidae): unusual frequency range of the first harmonic**

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We studied the echolocation calls emitted by *Phyllops falcatus* (Chiroptera: Phyllostomidae) during foraging, in the field and in the lab. Calls emitted in free flight, in a more or less uncluttered situation, were about 4.5 ms (up to 5.3 ms) long and characterized by a sweep of the first harmonic (= fundamental) from ca. 73 kHz down to about 23 kHz, which is unusually large for phyllostomid bats. A less intense second harmonic was always present. The intervals between pulses varied between 55 and 170 ms with a mean of about 110 ms. During approach to bushes or trees (or during flight in confined space between bushes), or in the flight room, calls became shorter (ca. 2 ms) and more energy was allocated to the second harmonic, sometimes also a third harmonic appeared. During approach to a fruit calls were further shortened (about 1 ms or less), and call frequency increased to about 5 calls/100 ms, calls often being grouped. The large bandwidth of the first harmonic separates *Phyllops* from all other Cuban bat species and allows identification in the field.

*Key words:* phyllostomids, Stenodermatini, echolocation, acoustic identification, Cuba

## **Use of abandoned mines by a community of temperate bats in Durango, Mexico**

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The Guanaceví region has been actively mined at least for the last 500 years. Mining activity has resulted in a large number of abandoned mines, which may represent important refuges for the chiropteran fauna of the region. I surveyed a sample of 25 abandoned mines during an annual cycle to determine which species use the mines, how they use it, and whether occupation is significantly related to a set of environmental variables measured from the mines. Simultaneously I carried out an inventory of the chiropteran fauna in the area, to determine what portion of the assemblage use the mines. I recorded 13 species for the region (12 vespertilionids and 1 molossid), out of 18 that are likely to occur. Five species were never found in mines; the remaining use them as feeding roosts, temporary roosts, or hibernacula, and only *Corynorhinus mexicanus* was found forming a maternity colony. Bats were significantly ( $P < 0.05$ ) more frequent in mines with winter temperature  $< 10^{\circ}\text{C}$ , adits  $> 50$  m, and less than  $3^{\circ}\text{C}$  temperature oscillation throughout the year. Results suggest that bats are more likely to occur in undisturbed mines, although the relationship was not significant ( $P = 0.09$ ).

*Key words:* vespertilionids, molossids, mines, temperature, adits, Durango, Mexico

## **The effect of gates on cave entry by swarming bats**

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Temperate bats make extensive use of caves and mines as nursery roosts, swarming sites and hibernacula. For a variety of reasons, the entrances to many sites have been modified in the past to restrict human access. Early barrier design often gave little regard to bats, leading to massive population declines in many nursery and hibernation sites. Free access to bats has become an increasingly important design feature, as the damaging effects of early gates were recognised. However, given the large number of gates that have been constructed, relatively few studies have looked at either the short or long-term effects of gates on bat behaviour and population sizes. Even fewer studies have examined specifically the effects of different gate designs. We have looked at the immediate effects of gates on the behaviour of swarming bats as they entered a natural cave. Three gates were tested, all with vertical grille spacings of 750 mm, but with horizontal spacings of 150, 130 or 100 mm. The gate with 150 mm spacings had no significant effect on the behaviour of the bats (predominantly *Myotis nattereri*). Gates with both 130 mm and 100 mm spacing caused a significant and substantial increase in the number of bats aborting their first and often subsequent attempts to enter the cave. The consequences to swarming behaviour and long-term use of the site by bats are unknown, but we suggest that following the precautionary principle, the minimum spacing between horizontal bars in gates should be 150 mm.

*Key words:* bats, caves, mines, gates, grilles, hibernacula, underground, swarming

## **Histochemical and immunohistochemical evidence for a gradient in gastric juice production in the greater horseshoe bat, *Rhinolophus ferrumequinum* (Schreber, 1774)**

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Histochemical and immunohistochemical investigations were performed on the gastric mucosa of the greater horseshoe bat, *Rhinolophus ferrumequinum* (Schreber, 1774) to estimate the presence of a gradient of pepsinogen and hydrochloric acid along an oro-aboral axis of the stomach, similar to that found in some non-mammals. Paraffin sections were stained with DBA-lectin binding, Bowie and fluorescent anti-H<sup>+</sup>/K<sup>+</sup>-ATPase  $\alpha$ -subunit immunostaining to detect the chief and parietal cells in the gastric mucosa. The stomach of the bat presents a short cardias, a wide fundus and a small pylorus. Chief and parietal cells were found in the fundic glands and their number varied from the oral to the aboral region of fundus. In the oral region several chief cells with Bowie-positive pepsinogen granules were observed in the basal part of glands, whereas parietal cells positive to DBA-lectin binding and immunoreactive with anti-H<sup>+</sup>/K<sup>+</sup>-ATPase  $\alpha$ -subunit were concentrated in the the upper part of the glands. In the aboral fundus chief cells were lacking, whereas the number of parietal cells increased and they were distributed along the glands. A gradient of pepsinogen and hydrochloric acid secretion similar to that found in some non-mammals can be hypothesised. The possibility that this gradient is the ancestral condition in Chiroptera and Eutheria and its functional meaning are discussed.

*Key words:* *Rhinolophus ferrumequinum*, chief cell, parietal cell, gastric acid secretion, lectin histochemistry, immunohistochemistry

SHORT NOTES

**Rediscovery of the Mexican flat-headed bat *Myotis planiceps* (Vespertilionidae)**

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*Key words:* flat-headed bat, *Myotis*, critically endangered, México, new records

# Acquisition of foraging behavior and insect preferences by naive juvenile red bats (*Lasiurus borealis*)

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*Key words: Lasiurus borealis, foraging, diet, juveniles*

## INTRODUCTION

Little is known about how young insectivorous bats make the transition from a diet of mother's milk to flying insects. It has been hypothesized that young bats need time to acquire the skills necessary for successful flight and to capture flying insects (Davis and Hitchcock, 1965), and that they

may learn these techniques by spending time foraging with their mothers (Brigham and Brigham, 1989).

The red bat (*Lasiurus borealis*) is a solitary, foliage-roosting species that ranges from Canada to Central America (Shump and Shump, 1982). Females typically give birth from two to four pups. In the wild, young *L. borealis* weigh 4–5 g by 3–4