

A review of the *Murina cyclotis* complex (Chiroptera: Vespertilionidae) with descriptions of a new species and subspecies

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Until recently, the taxon *Murina cyclotis* was considered to be a widespread species, albeit one that exhibited considerable individual, sexual and geographical variation. Subsequently however, it was recognised that this taxon was in fact a complex of species. As such, in 2012, two larger forms were recognised as separate and distinct species, namely: *M. peninsularis* in the Sunda region and *M. fionae* in Laos and Vietnam. In the current paper, a new cryptic species of the *cyclotis*-complex is described from peninsular Thailand based on a combination of external, craniodental and genetic differences. In addition, the population previously referred to *M. cyclotis* from the Nicobar Islands is described as a new subspecies of this new species. Despite this work and the research of others, the taxonomy of *M. cyclotis* still requires further study. The description of *M. peninsularis* is emended and the extensive variation in its morphological characters is addressed. The diagnostic characters of each taxon, as well as the additional data on ecology, zoogeography, distribution, echolocation and genetics, where available, are summarised and discussed.

Key words: cryptic species, DNA barcode, Southeast Asia, taxonomy, tube-nosed bat, Thailand, zoogeography

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A new species of South-East Asian *Myotis* (Chiroptera: Vespertilionidae), with comments on Vietnamese ‘whiskered bats’

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A new *Myotis* species is described from Central Vietnam and adjacent area of Laos. The new species resembles smaller specimens of the widespread South Asian *Myotis muricola*, though differs from it and from other small mouse-eared bats by a set of cranial and external characters. Genetic analyses confirm that the new species is distinct from the other named forms of Asian *Myotis*. Comparison of sequence diversity in the DNA barcode region of the COI gene among East Asian members of *Myotis*, highlighted several taxonomic questions related to Asian ‘whiskered bats’, suggesting that common morphological diagnostic traits may be shared by genetically divergent species.

Key words: *Myotis*, new species, South-East Asia, Vietnam, taxonomy, DNA barcoding

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Further evidence for the basal divergence of *Cheiromeles* (Chiroptera: Molossidae)

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The earliest diverging lineages in the subfamily Molossinae have not been well established. The genera *Cheiromeles* and *Mormopterus* have been found in separate studies to be the oldest lineage, however no previous studies using a molecular approach have included an analysis of sequence data from *Cheiromeles* and *Mormopterus* together in the same study. The objective of this study was to test the hypothesis that recombination activating gene 2 (Rag2) sequence data support the basal divergence of *Cheiromeles* in the Molossinae subfamily. Bayesian and Maximum Likelihood analyses of Rag2 sequences from 64 molossid bats (representing 13 genera, 31 species) and five outgroup taxa (*Antrozous pallidus*, *Myotis daubentoni*, *M. velifer*, *M. yumanensis*, and *Natalus stramineus*) obtained from GenBank resulted in the placement of *Cheiromeles* as the most basal lineage within a monophyletic Molossinae. *Mormopterus* was placed as sister to the rest of Molossinae (excluding *Cheiromeles*).

Key words: Molossidae, phylogeny, *Cheiromeles*, *Mormopterus*, Rag2

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A review of the bats (Chiroptera) of the Republic of Congo, including eight species new to the country

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In July–August, 2012, a small collection of bats was made in the Republic of Congo. These 24 specimens represent 14 species, of which eight (belonging to the Hipposideridae, Vespertilionidae and Miniopteridae), are new records for the country. The current paper briefly describes the specimens, illustrates diagnostic characters to assist with future identifications, and provides insights into their taxonomy. In addition, it reviews the literature records and provides distribution data for all 43 bat species, which are included now on the country's faunal checklist. Published collecting localities for bats in Congo are mapped and discussed both in terms of their geographical distribution and in relation to the variety of habitats that have been sampled in the past. Based on the literature, predictions are made about how many species of bat may be present in Congo. Recommendations are made for future bat research and conservation in the country.

Key words: Republic of Congo, Brazzaville, new records, faunal checklist

Diversity of Hipposideridae in the Mount Nimba massif, West Africa, and the taxonomic status of *Hipposideros lamottei*

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Several species complexes exist within the African representatives of the genus *Hipposideros* and the relationships between these taxa are not yet well understood. We present evidence showing that at least seven species of *Hipposideros* co-occur at Mount Nimba at the northern boundary of the Upper Guinean forest zone. The species *H. lamottei* has been misdiagnosed previously, partly as a result of errors in published measurements. This taxon is currently known only from high-altitude grasslands in northern (Guinean) Mount Nimba. Cytochrome *b* sequences and echolocation calls of this species, as well as for *H. marisae*, are presented for the first time. Also, at least two different species groups, previously lumped in *H. ruber*, co-exist syntopically here. Mount Nimba apparently represents a diversity hotspot for species of *Hipposideros* in West Africa, and as a result may be an important site for their conservation.

Key words: cytochrome *b*, echolocation, *Hipposideros*, Mount Nimba

Conservation units of *Pteronotus davyi* (Chiroptera: Mormoopidae) in Mexico based on phylogeographical analysis

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The analysis of genetic diversity is routinely used to identify divergent intraspecific units and contribute to the knowledge base of biodiversity. In this study we used mitochondrial genetic diversity to propose three management units (MUs) for the Davy's naked-backed bat (*Pteronotus davyi*), an insectivorous forest-dwelling species that is distributed in tropical and subtropical areas of America. We analyzed a 555 bp segment of the mitochondrial DNA (mtDNA) control region in 144 individuals from 18 localities spread across the species distribution range in Mexico. Our results demonstrated that the mitochondrial genetic diversity of *P. davyi* is distributed in three MUs, namely Gulf North, Pacific-Veracruz and Southeastern, with conservation priority, due to either the high mitochondrial genetic diversity or the high proportion of unique haplotypes, for the following populations: Playa de Oro, Arroyo del Bellaco and Catemaco in the Pacific-Veracruz region, and Agua Blanca, Sardina, Calakmul, Calcehtok and Kantemó from the Southeastern region. The Gulf North unit shows signs of the recent loss of genetic variability. These proposed conservation units could be considered a generalized model of conservation for other species of cave-dwelling bats that share the same habitats.

Key words: conservation, control region, mtDNA, management units, Mexico, Mormoopidae

Family planning: does variation in reproductive strategies affect vulnerability to extinction in the greater spear-nosed bat *Phyllostomus hastatus*?

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Different reproductive strategies among populations might affect population growth rates, and a population's vulnerability to threats. Population viability analysis may help guide population management and the identification of populations more prone to decline, allowing a preventive approach to avoid population declines and extinctions. The objective of the present study was to evaluate if differences in reproductive strategy translate into differential intrinsic vulnerability among different populations of *Phyllostomus hastatus*. We used the software VORTEX to model the dynamics and viability of *P. hastatus* populations under different reproductive scenarios. We modeled a total of 12 scenarios evaluating variations in reproductive characteristics of the species (monoestry vs polyestry, harem size, and infant mortality rate). *Phyllostomus hastatus* populations were viable under most scenarios, except with scenarios incorporating monoestry and high pup mortality. Our results demonstrate that both reproductive strategies (monoestry and polyestry) found in *P. hastatus* result in viable and stable populations under natural conditions. However, polyestrous populations have higher growth rates, making them more resilient to natural and/or anthropogenic disturbances. A significant portion of the more resilient populations in South America overlap the Amazon Forest, a continuous and preserved habitat under low human pressure, which bodes well for the long-term persistence of these populations. On the other hand, the populations of the species that evolved the monoestrous reproductive strategy are located in Mesoamerica, a Biodiversity Hotspot that is under severe human impacts, particularly from habitat loss. Conservation biologists and managers must take into account intra-specific demographic differences of species when planning for their long-term persistence.

Key words: monoestry, polygyny, population viability analysis, VORTEX

Reproductive status and vocalisation in swarming bats indicate a mating function of swarming and an extended mating period in *Plecotus auritus*

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Subterranean swarming of bats takes place in the autumn and it is presumed that its main function is to facilitate mating. However, *Plecotus auritus* (brown long-eared bat) swarms twice a year, in spring (in March and April), and in autumn (from the end of August to October). The premise that both the autumn and spring swarming events have a mating function was tested by measuring the vocalisation activity and reproductive state of males at two subterranean swarming sites and at several maternity colony roosts in southwestern Poland. Vocal activity, as defined by the number of social calls emitted by swarming bats, was about ten times higher in the spring than in the autumn. The bats also emitted a wider range of call types in spring. From 45 to 100% of males examined in spring had distended caudae epididymides. Enlarged and distended epididymides contain spermatozoa and indicate that males are still able to copulate in spring. There was a significant positive correlation between the proportion of males with distended caudae epididymides and the vocal activity of swarming bats. This indicates that swarming behaviour plays a role in mating and that the mating season extends from autumn to spring. For the first time, a biphasic pattern of active mating behaviour has been observed in a European bat species. Mating occurs during swarming in autumn and spring and is accompanied by vocal advertisement. We suggest that the low number of females in spring increases competition between males and significantly increases the amount and diversity of vocal activity.

Key words: reproduction, spermatogenesis, social calls, epididymides, sex ratio

Dawn swarming in tree-dwelling bats — an unexplored behaviour

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In colonial tree-dwelling bats, it is vital to prevent disintegration of the group during frequent roost-switching. Thus some mechanisms which maintain group cohesion are expected. Dawn swarming is a set of behavioural displays observed in many such bats before they enter the roost. It is suggested that this behaviour plays a role in transferring information about the roost position. However this phenomenon had not been explored in detail. Based on qualitative and quantitative description of behaviour we suggest its potential function. Using field-based video-recordings of swarming sessions made on maternity colonies of Leisler's bat (*Nyctalus leisleri*), we constructed ethograms which revealed remarkably similar behavioural sequences among individuals. For more than two hours prior to sunrise, individual flybys in front of the roost entrance predominated, followed by landings and leaps, which preceded the final entering of the roost. Interestingly, no obvious peak of behavioural activity was found at any particular time during swarming but a wave-like pattern was observed. We suggest that individuals are swarming in close proximity to the roosting tree with some purpose, most probably serving as a beacon for other group members and thus marking the current location of the roost.

Key words: communication, acoustical signalling, visual clues, social bonding, cooperation

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Foraging activity by bats in a fragmented landscape dominated by exotic pine plantations in central Chile

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We assessed foraging activity of insectivorous bats in a fragmented landscape of central Chile including native temperate forest, forest fragments, commercial pine plantations and local human settlements. Overall bat activity was noticeably greater along adult pine plantation edges, local human settlements and the edge of continuous forest than over interior habitats and unplanted forest plantation clear-cuts. *Tadarida brasiliensis* foraged mostly above human settlements and edges of adult pine plantations but avoided interior habitats. *Lasiurus cinereus* was more active along edges of both adult pine plantations and continuous forest than in clear-cuts and interior habitats of forest fragments. In contrast, *Lasiurus varius*, *Histiotus montanus* and *Myotis chiloensis* occurred not only along vegetation edges but also within the interior habitats of adult pine plantations. The high activity levels suggest that bats not only pass through exotic pine plantations, but that they are active in these habitats commuting and feeding, thus enhancing their capacity to persist in landscapes modified by humans in which exotic forestry plantations are an important component.

Key words: acoustic survey, insectivorous bats, forest fragmentation, pine-dominated landscape, Chile

Response of phytophagous bats to patch quality and landscape attributes in fragmented tropical semi-deciduous forest

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Forest fragmentation reduces the amount of forest cover and negatively affects the habitat quality of forest remnants. Landscape attributes and habitat quality should therefore be evaluated together to improve our understanding of how fauna respond to fragmentation. We evaluated how patch quality (vegetation structure) and landscape characteristics influence the abundance of phytophagous bats in two contrasting types of landscape that differ in percent forest cover and matrix type: landscapes dominated by man-made pastures and landscapes with large tracts of continuous forest (tropical semi-deciduous forest). Bats were sampled in forest patches in both types of matrices, and for each matrix two sites with a cenote (water filled sink-holes, typical of the Yucatan) and two with no cenotes were sampled. Sites with cenotes offer better habitat quality than sites without cenotes: the richness and basal area of plants eaten (flower or fruit) by bats are higher in the forest vegetation surrounding them. At the landscape level, phytophagous bat abundance was negatively correlated with the amount of forest cover and proximity to other forest fragments, but positively correlated with forest edge density, patch density and landscape heterogeneity. At the patch level, bat abundance was positively correlated with plant richness and the basal area of edible tree species. In the Yucatan's agricultural landscapes the area and spatial distribution of forest remnants are not the only variables affecting bats. Habitat patch quality and high heterogeneity of land cover types are also important, and have a positive effect on phytophagous bat abundance and movement.

Key words: frugivorous bats, landscape complementation, landscape heterogeneity, nectarivorous bats, vegetation structure

High dispersal and generalist habits of the bat *Artibeus jamaicensis* on Cozumel Island, Mexico: an assessment using molecular genetics

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Islands and insular biotas have been recognized as ideal models for studying adaptive radiations and evolutionary processes. In the present study we investigated the Jamaican fruit-eating bat, *Artibeus jamaicensis* from Cozumel Island, to evaluate the effect of ecological features on genetic diversity and structure across three different environments, semi-evergreen tropical forest, mangrove, and cenotes, using six microsatellite loci in 105 individuals. Genetic diversity was relatively high (forest $H_O = 0.693$, $H_{Nei} = 0.825$; mangrove $H_O = 0.702$, $H_{Nei} = 0.710$; cenotes $H_O = 0.695$, $H_{Nei} = 0.847$). Pairwise genetic differentiation measures between localities were not significant and the overall level of differentiation was markedly low ($F_{ST} = 0.009$, $G'_{ST} = 0.088$). Likewise, results showed that *A. jamaicensis* consists of one genetic group and relatedness among individuals was low. Results are concordant with our predictions that the island population will show high genetic diversity and null structure at the fine spatial scale examined. We conclude that ecological features like dispersal and generalist habits are the factors influencing population structure and genetic diversity of *A. jamaicensis* on the island, and that factors like the species polygynous mating system, female philopatry and male differential dispersal do not prevail in the island population. Cozumel Island is facing severe conservation problems, mainly from habitat perturbation, urbanization and introduction of exotic species, hence the present genetic information is of great value as a basis for future research and protection of the species.

Key words: adaptation, genetic variability, genetic structure, Jamaican fruit-eating bat, oceanic islands, Phyllostomidae

Summer home range size of female Indiana bats (*Myotis sodalis*) in Missouri, USA

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Knowledge of space use by wildlife that are a conservation concern is critical to ensure that management and conservation provides adequate resources to ensure survival and reproductive success. We radio tracked 13 pregnant and 12 lactating *Myotis sodalis* (Indiana bat) during the maternity season in northern Missouri. Mean (\pm SE) home range area for all individuals based on the fixed kernel method for the 50% and 95% probability contours was 204.52 ± 28.87 ha and 1137.13 ± 144.06 ha, respectively. Home range size did not differ significantly ($P > 0.16$) between pregnant and lactating females. However, the mean home range area based on the 95% probability contour for lactating individuals (1361.00 ± 267.16 ha) was 32% larger than the area used by pregnant individuals (930.47 ± 109.59). The mean maximum distance pregnant and lactating individuals were located from the roost was 3.75 km (range: 1.89–5.13 km) and 4.85 km (range: 2.17–9.40 km), respectively. Home range size and maximum distance traveled during the maternity season were greater than previously reported for *M. sodalis*. Our sample size is modest due to the rarity and patchy distribution of this endangered species, but we provide meaningful information on spatial area used to acquire necessary resources during the maternity season.

Key words: fixed kernel, foraging, home range, reproductive condition, spatial movement, utilization distribution

Morphological and echolocation call variation in Malagasy trident bats, *Triaienops* Dobson, 1871 (Chiroptera: Hipposideridae)

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Patterns of interspecific and intraspecific variation in the three endemic species of Malagasy *Triaienops* bats were investigated using morphology and bioacoustics. Adult bats were captured at different localities across the island, measured, and their echolocation calls recorded. On average, male *T. auritus* and *T. furculus* have shorter forearms (47.0 and 44.0 mm, respectively) and emit higher frequency calls (107.8 and 113.1 kHz, respectively) than females (47.5 and 45.7 mm and 95.6 and 98.2 kHz, respectively), representing a form of reversed sexual dimorphism (females larger than males). However, *T. menamena* shows typical patterns of sexual size dimorphism with males having a longer forearm (51.7 mm) and lower frequency echolocation calls (82.3 kHz) than females (49.0 mm and 93.5 kHz, respectively). When segregated by sex, there was a strong allometric relationship between forearm length, used as a measure of body size, and the resting frequency in these three species, as well as two African hipposiderids (*T. afer* and *Cloeotis percivali*). *Triaienops auritus* males and both sexes of *T. furculus* deviated from the relationship between these two variables. Hypotheses are explored to explain the drivers of these sexual dimorphism patterns. On the basis of the allometric relationship, the strong correlation is in parallel to other groups of bats and is probably associated with ecological constraints. Recent phylogenetic analyses showed a separation of Afro-Malagasy *Triaienops* into two sister clades: *T. auritus*/*T. furculus* (suggested to be placed in a new genus, *Paratriaenops*) and *T. menamena*/*T. afer*. The patterns of sexual dimorphism in these taxa are congruent with clade membership. Further studies are needed to understand strategies used by these taxa when in sympatry to share habitat and ecological niches.

Key words: *Triaienops*, echolocation calls, reversed sexual dimorphism, allometric relationship, phylogeny, *Paratriaenops*, Madagascar

Canines as a measuring tool for leaf tent construction in *Dermanura watsoni*

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Many animals are capable of constructing structures to modify the environment for their own benefit. The design of these structures requires animals to perceive dimensions. However, how animals take measurements to achieve the final design of the structures they construct is known for only very few species. In the Neotropics, a few bat species build roosts or leaf tents that serve different purposes. Thomas's fruit-eating bat (*Dermanura watsoni*) constructs tents that have complex designs, when compared to other tent building bats. The bifid tent is a design built by producing a long, J-shaped cut on each side of understory plant leaves. We expect that to accomplish this complex design bats would require precise measurements during tent construction. We measured several bat morphological traits to infer which of them, if any, was used by the bats as a measuring device. *Dermanura watsoni* uses the distance between their lower canines to increase the perpendicular distance of the J-cut to the central vein of the leaf along the J-cut. The bat adds the distance between the canines to each subsequent secondary vein cut. This is the first study to infer which body part *D. watsoni* most likely uses as a measuring tool. Our results provide new insight into the evolution of body parts as measuring devices during tent construction in related and unrelated tent-building bat species.

Key words: tent-making bats, *Dermanura watsoni*, web construction, understory palms

Review on the geographic and elevational distribution of the mountain long-eared bat *Plecotus macrobullaris*, completed by utilising a specific mist-netting technique

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The mountain long-eared bat, *Plecotus macrobullaris*, is a recently described species, and characterisation of its geographic and elevational distribution is still in progress. Captures in various environments led to a controversial ecological perception, with *P. macrobullaris* initially defined as an alpine species but subsequently found in the Mediterranean seashore and other lowland areas. Sampling efforts hitherto were uneven; this bat has been studied more thoroughly in Western Europe than in the eastern portion of its range, and in lowlands more than highlands or alpine environments. For greater insight into its distribution pattern, we conducted a field survey in several mountain areas of its known range, using a novel mist-netting technique (described herein) that has proven very useful for targeting and capturing low-flying open-space bats in alpine environments. We also gathered all available distribution data on this species from published resources and by contacting researchers, obtaining records at 351 total localities (including 113 from other authors' unpublished reports and 45 from our own fieldwork). We concluded that *P. macrobullaris* is present in the main Western Palearctic mountain ranges, extending from the Pyrenees to the Middle East, and has an elevational distribution from sea level up to 2,800 m. The high number of these bats captured foraging above the timberline, in addition to the exclusively mountainous distribution, indicate that the species is indeed alpine, showing a pattern similar to other highly mobile vertebrates restricted to mountain areas and absent from flatlands. Nevertheless, its apparent elevational distribution may still be biased toward lower areas, due to the scarcity of surveys in high mountain habitats.

Key words: alpine, biogeography, capture technique, mist-netting, sampling bias

The effect of ectoparasites on the grooming behaviour of Gould's wattled bat (*Chalinolobus gouldii*): an experimental study

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Grooming is an important behaviour for the control of ectoparasites in mammals but it is also energetically costly. Therefore, the time an animal allocates to grooming may be used to evaluate the potential cost of an ectoparasite to its host. Most mammals are host to more than one ectoparasite species, which may impose different costs. We experimentally evaluated the relative cost of three ectoparasite species by observing the grooming response of their host, Gould's wattled bat (*Chalinolobus gouldii*), to the manipulation of parasite load. The parasite that spent its entire lifecycle on the host, the mite *Spinturnix novaehollandiae*, triggered the greatest increase in grooming. A grooming response was not as evident for the other parasites (a smaller mite, *Trichonyssus womersleyi*, and a bat fly, *Basilia trougtoni*), possibly because part of their lifecycle occurred in the roost, which the host may avoid by discriminative roost selection. Grooming behaviour, although not significantly altered by parasites other than *S. novaehollandiae*, was performed by most bats, which maintained a baseline grooming rate even when relatively parasite free. This study suggests heterogeneity in the costs imparted on a host by members of its ectoparasite community and the potential importance of considering parasite life-history when evaluating the influence of parasites on the host.

Key words: grooming, *Chalinolobus gouldii*, ectoparasites, *Spinturnix*, Nycteribiidae, mites, bat fly

Description of a new species of *Myotis* (Vespertilionidae) from Vietnam

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During the examination of a series of specimens, formerly referred to *Myotis montivagus*, recently collected in Vietnam and Lao PDR, we found that they differ in several important ways from any species formerly included in *M. montivagus*. We describe them as a new species characterised by a relatively long forearm, moderately long ears, flat cranial profile and wide anteorbital bridge. Based on characters classically used to separate the ‘subgenera’ of *Myotis* the new species shows affinities to both the nominate subgenus ‘*Myotis*’ and ‘*Selysius*’. Our morphological investigations support recent phylogenetic analyses showing that the former ‘subgenera’ of *Myotis* are in fact paraphyletic groups, even within Southeast Asia. Nevertheless, many of the external and craniodental features formerly used to separate these subgenera provide a practical means of grouping species. Using these characters we provide an identification key to identify the new species, as well as other currently recognized medium and large sized, small-footed *Myotis* species from the Indomalayan Region.

Key words: identification key, Indochina, Indomalayan Region, morphology, Myotinae, taxonomy