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A new species of pipistrelle bat (Chiroptera: Vespertilionidae) from southern Arabia

PETR BENDA[1, 2, 6], ANTONÍN REITER[3], MARCEL UHRIN[4, 5], and ZUZANA VARADÍNOVÁ[1, 2]

[1]*Department of Zoology, National Museum (Natural History), Václavské nám. 68, CZ-115 79 Praha 1, Czech Republic*
[2]*Department of Zoology, Faculty of Science, Charles University, Viničná 7, CZ-128 44 Praha 2, Czech Republic*
[3]*South Moravian Museum in Znojmo, Přemyslovců 129/8, CZ-669 02 Znojmo, Czech Republic*
[4]*Institute of Biology and Ecology, Faculty of Science, P. J. Šafárik University in Košice, Moyzesova 11, SK-040 01 Košice, Slovakia*
[5]*Department of Forest Protection and Wildlife Management, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences, Kamýcká 1176, CZ-165 21 Praha 6, Czech Republic*
[6]*Corresponding author: E-mail: petr_benda@nm.cz*

A new species of the genus *Pipistrellus* is described from the Dhofar region, southern Arabia. The new species occurs in a very limited area lesser than 1,000 km^2, situated in the belt of relative humid savannah habitats of coastal Arabia between easternmost Yemen and south-western Oman. This bat represents the eighth pipistrelle species known from Arabia and fourth bat species endemic to southern Arabia. The new species is positioned morphologically and genetically very close to the group of the Oriental species of the genus *Pipistrellus* and represents the westernmost offshoot of the Oriental vespertilionid bat fauna, isolated for more than 1,500 km across the Indian Ocean from the area of continuous distribution of this fauna in the Indian Subcontinent.

Key words: mtDNA, morphometry, taxonomy, pipistrelle bats, Middle East

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Comparative phylogeography of *Pteropus samoensis* and *P. tonganus* (Pteropodidae: Chiroptera) in the South Pacific

AMY L. RUSSELL[1, 5], VERONICA A. BROWN[2], RUTH C. B. UTZURRUM[3], ANNE P. BROOKE[3], LISA A. WOLF[4], and GARY F. MCCRACKEN[2]

[1]*Department of Biology, Grand Valley State University, Allendale, Michigan 49401, USA*
[2]*Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996, USA*
[3]*Department of Marine and Wildlife Resources, Pago Pago, American Samoa 96899, USA*
[4]*Department of Biology, University of Oregon, Eugene, Oregon 97403, USA*
[5]*Corresponding author: E-mail: russelam@gvsu.edu*

Pteropids are large, highly mobile bats that are distributed widely across islands of the Pacific and Indian Oceans, southern Asia, and Australia. Dispersal behaviors and colonization patterns of pteropid species among oceanic islands are poorly known. In the southern Pacific, *Pteropus samoensis* and *P. tonganus* have partially overlapping ranges, existing in sympatry on the Samoan and Fijian archipelagos. These species exhibit differences in morphology and roosting behavior, with *P. samoensis* being smaller and tending to roost solitarily or in small groups. Here, we use genetic data to explore whether these species also exhibit differences with regard to patterns of population genetic structure within and between these archipelagos. Phylogenetic analyses of mitochondrial DNA are consistent with earlier morphological recognition of different subspecies of *P. samoensis* on the Samoan vs. Fijian archipelagos. Patterns of mtDNA haplotype sharing suggest that *P. tonganus* experiences restricted gene flow between, but not within archipelagos, while *P. samoensis* shows significant structuring both between and within archipelagos. Species-level differences in patterns of population structure among islands within archipelagos may be due to interspecific differences in morphology, roosting ecology, and/or feeding ecology that can be affected by human influences. Our results directly bear on the conservation of these species, suggesting that (1) populations of both species from the archipelagos of Samoa and Fiji should each be considered as separate conservation units, (2) *P. samoensis* are much less likely than *P. tonganus* to naturally supplement local populations through inter-island dispersal, and (3) *P. tonganus* may experience more severe population bottlenecks during and following cyclones resulting in lower mitochondrial genetic diversity than in *P. samoensis*.

Key words: dispersal, Fiji, phylogeography, population genetics, *Pteropus samoensis*, *P. tonganus*, Samoan archipelago, South Pacific

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Patterns of genetic divergence among *Myotis californicus*, *M. ciliolabrum*, and *M. leibii* based on amplified fragment length polymorphism

LOREN K. AMMERMAN[1, 5], DANA N. LEE[2, 3], and RUSSELL S. PFAU[4]

[1]*Angelo State University, ASU Station #10890, San Angelo, TX 76909, USA*
[2]*Department of Biology, McMurry University, Abilene, TX 79697, USA*
[3]*Present address: Department of Agriculture and Biological Sciences, Cameron University, Lawton, OK 73505, USA*
[4]*Department of Biological Sciences, Tarleton State University, Stephenville, TX 76402, USA*
[5]*Corresponding author: E-mail: loren.ammerman@angelo.edu*

The California myotis (*Myotis californicus*) and the western small-footed myotis (*Myotis ciliolabrum*) are largely sympatric in western North America, and are especially similar morphologically such that only subtle features of their skull distinguish the two species. Previous analysis of mitochondrial DNA (mtDNA) sequence data resulted in paraphyly of these two species. Our objective was to examine genetic differences in nuclear loci between *M. californicus* and *M. ciliolabrum*, investigate their relationship with *M. leibii*, and to address the conflicting morphological and mtDNA data sets. We analyzed 198 amplified fragment length polymorphism (AFLP) fragments from 17 *M. californicus*, 16 *M. ciliolabrum*, and 10 *M. leibii* using principal coordinate (PCoA), neighbor-joining, Bayesian, and parsimony analyses. Our analyses recovered well-supported separation of *M. californicus* and *M. ciliolabrum* based on nuclear markers, suggesting the failure of the mitochondrial markers to recover monophyletic lineages was due to a lack of lineage sorting. Unexpectedly, *M. ciliolabrum* was paraphyletic with respect to *M. leibii* individuals from the eastern United States. In conclusion, our analysis of nuclear AFLP markers recovered distinct genetic lineages or clusters that corresponded to the recognized species defined by morphology, *M. californicus*, *M. ciliolabrum*, and *M. leibii*. We propose that these divergences are somewhat incomplete and the divergence between *M. ciliolabrum* and *M. leibii* occurred more recently than the speciation events separating the currently sympatric species *M. californicus* and *M. ciliolabrum*.

Key words: amplified fragment length polymorphism, AFLP, *Myotis californicus*, *M. ciliolabrum*, *M. leibii*, North America

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Swarming behaviour, catchment area and seasonal movement patterns of the Bechstein's bats: implications for conservation

DAAN DEKEUKELEIRE[1, 6], RENÉ JANSSEN[2], ANNE-JIFKE HAARSMA[3], THIJS BOSCH[4], and JAAP VAN SCHAIK[5]

[1]*Terrestrial Ecology Unit, Department Biology Ghent University, K. L. Ledeganckstraat 35, B-9000 Gent, Belgium*
[2]*Bionet Natuuronderzoek, Valderstraat 39, 6171EL, Stein, The Netherlands*
[3]*Animal Ecology & Ecophysiology group, Institute for Water and Wetland research, Radboud University Nijmegen, P.O. Box 9010, 6500GL Nijmegen, The Netherlands*
[4]*Ad Hoc Zoogdieronderzoek, Oude Velperweg 34, 6824HE, Arnhem, The Netherlands*
[5]*Department of Behavioural Ecology and Evolutionary Genetics, Max Planck Institute for Ornithology, Eberhard-Gwinner-Strasse, 82319 Seewiesen, Germany*
[6]*Corresponding author: E-mail: daan.dekeukeleire@gmail.com*

Bats display marked seasonality throughout the temperate zone and use different habitats during different parts of the year. Unfortunately, detailed information regarding seasonal distribution and movements is often lacking, thereby hampering the development of adequate conservation measures. In this study we used radio telemetry to track females of the endangered Bechstein's bat (*Myotis bechsteinii*) from autumn swarming sites to their summer maternity colony ranges. We were able to tag 22 individuals, 18 of which were subsequently recovered at nine roost sites up to 20.6 km away. Females from multiple colonies visited the same swarming site on a single night. Concurrently, we recovered females from a single maternity colony at different swarming sites on the same night. The catchment area of the investigated swarming sites measured 27.1 km^2, and was skewed to the northwest. Tagged bats were recovered in forest fragments ranging in size from 5.42 to 128.98 ha. Notably, all but one of the recovered roosts were found in forests that have been continuously wooded since at least 1775. Surveys during the summer at these sites confirmed the presence of maternity colonies at six out of seven locations that could be investigated. Our study contributes to our understanding of swarming behavior and seasonal movement patterns, and exemplifies how these can be used to complete the year-round habitat use of bat species.

Key words: telemetry, *Myotis*, hibernation site, swarming site, *Myotis bechsteinii*, radio tracking, ancient forest

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An African bat hotspot: the exceptional importance of Mount Nimba for bat diversity

ARA MONADJEM[1, 2, 5], LEIGH RICHARDS[3], and CHRISTIANE DENYS[4]

[1]*All Out Africa Research Unit, Department of Biological Sciences, University of Swaziland, Private Bag 4, Kwaluseni, Swaziland*
[2]*Mammal Research Institute, Department of Zoology & Entomology, University of Pretoria, Private Bag 20, Pretoria, South Africa*
[3]*Durban Natural Science Museum, P.O. Box 4085, Durban, South Africa*
[4]*UMR 7205, CNRS, MNHN, EPHE, Sorbonne Université, Paris VI, Institut de Systématique et Evolution de la Biodiversité, Museum National d'Histoire Naturelle, 55 rue Buffon, 75005 Paris, France*
[5]*Corresponding author: E-mail: ara@uniswa.sz*

Mount Nimba, covering 674 km^2, straddles Liberia, Guinea and Côte d'Ivoire (Ivory Coast) in West Africa and is situated in the transition zone between the tropical forest zone to the south and moist woodlands to the north. Mount Nimba supports an exceptional biodiversity, with a number of endemic plants, invertebrates and vertebrates restricted to the massif, including the bat *Hipposideros lamottei*. Previous surveys suggested a high bat richness of 41 species associated with the mountain. During a series of surveys conducted in 2008–2012, we found that the bat diversity in this region far surpasses earlier figures and currently is 59 species. At least one bat species is entirely restricted to the mountain, with several other near-endemics or Upper Guinea forest endemics. Three species are listed as threatened by the IUCN, including one Critically Endangered. Furthermore, the conservation statuses of nine taxa have yet to be evaluated by the IUCN, several of which are recently described species and are likely to be threatened. This study highlights the irreplaceability of Mount Nimba for the conservation of bat diversity on the African continent, and draws attention to its protection.

Key words: Mount Nimba, West Africa, hotspot, bat diversity, conservation

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The effects of human-mediated habitat fragmentation on a sedentary woodland-associated species (*Rhinolophus hipposideros*) at its range margin

SERENA E. DOOL[1, 5], SÉBASTIEN J. PUECHMAILLE[1, 2], CONOR KELLEHER[3], KATE MCANEY[4], and EMMA C. TEELING[1]

[1]*School of Biology and Environmental Science, University College Dublin, Belfield, Dublin 4, Ireland*
[2]*Zoological Institute and Museum, Greifswald University, Soldmann-Straße 14, D-17489, Greifswald, Germany*
[3]*Spring Lane, Carrigagulla, Ballinagree, Macroom, County Cork, Ireland*
[4]*The Vincent Wildlife Trust, Donaghpatrick, Headford, County Galway, Ireland*
[5]*Corresponding author: E-mail: serena.dool@gmail.com*

Among the many anthropogenic modifications to earth's ecosystems, habitat loss and degradation pose the most immediate threat to many biota. The predicted consequences of fragmented habitats include lower species diversity, smaller population sizes, disrupted gene flow, increased drift and inbreeding and increased differentiation between neighbouring populations; all of which are thought to be further enhanced in species with low dispersal abilities. These factors, especially when occurring in tandem, can lead to an increased risk of extinction. To examine the genetic consequences of habitat fragmentation we selected an isolated population of a sedentary woodland specialist species (*Rhinolophus hipposideros*) to act as an indicator of disruptions to landscape level connectivity. Based on 491 individuals from 37 colonies our results revealed the presence of a broad North-Range/South-Range differentiation within this species in Ireland; a finding supported across datasets (mtDNA and nuclear microsatellites) and analyses. Analyses of echolocation data and microsatellites suggested further differentiation of the northern-most colonies. A landscape genetics framework to assess the impact of habitat versus geographic distance on population differentiation showed that habitat features (at a five km resolution) were equally likely to be correlated with differentiation as geographic distance considered alone. Further differentiation of the geographically disjunct groups is likely to occur in the future. The viability of either group alone is uncertain given their restricted distribution, small population sizes (based on census data and N_e estimates) and isolation. Roost provision and habitat restoration in the geographic region separating the differentiated groups will be fundamental to the recolonization of this area and the reestablishment of connectivity between the regional groups.

Key words: Anthropocene, connectivity, conservation, *Rhinolophus hipposideros*, extinction risk, population decline, landscape genetics

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Influence of reservoirs created by small dams on the activity of bats

FREDERICO HINTZE[1, 2, 5], VIRGÍNIA DURO[1, 2], JOSÉ CARLOS CARVALHO[1, 4], CATARINA EIRA[1, 3], PEDRO CORREIA RODRIGUES[1, 2, 3], and JOSÉ VINGADA[1, 2, 3]

[1]*SPVS — Portuguese Wildlife Society*, *Department of Biology*, *Minho University*, *Campus de Gualtar*, *4710-057 Braga*, *Portugal*
[2]*CBMA — Centre of Molecular and Environmental Biology*, *Minho University*, *Biology Department*, *Campus de Gualtar*, *4710-057 Braga*, *Portugal*
[3]*CESAM — Centre for Environmental and Marine Studies & Department of Biology*, *University of Aveiro*, *Campus Universitário de Santiago*, *3810-193 Aveiro*, *Portugal*
[4]*Azorean Biodiversity Group*, *Department de Ciências Agrárias, University of Azores*, *Rua Capitão João d´Ávila*, *sn. Pico da Urze*, *9700-042 Angra do Heroísmo*, *Portugal*
[5]*Corresponding author: E-mail: fredhintze@gmail.com*

Freshwater systems have been profoundly changed by the construction of dams, and the influence of dams on bat activity is poorly understood. In this study, we analyzed the effects of small dams along mountain streams on local bat communities. This work was carried out in five small streams located in the NE of Portugal using bioacoustic surveys during the summer of 2011. The present study confirms that, in the northeast areas of Portugal, the majority of bat species use artificial bodies of water for either drinking or foraging, but species differed in terms of their activity levels over the reservoirs when compared with intact stream habitats. As predicted, small dams in the study area were important centers of overall bat activity relative to other sampling areas. At the same time, feeding activity was also higher in the flooded areas. We also found that *Pipistrellus pipistrellus*, *Myotis daubentonii*, *Pipistrellus kuhlii*, *Pipistrellus pygmaeus*/*Miniopterus schreibersii*, *Tadarida teniotis* and *Nyctalus leisleri*/*Eptesicus serotinus* benefited from the presence of dam reservoirs. *Hypsugo savii* activity was also mostly recorded at reservoir points. However, the highest number of endangered and rare species was recorded at an intact stream habitat. This result emphasizes the relevance of riparian habitats for bats, especially for the most endangered species. The relationship between dam availability, riparian quality and bat diversity suggested that the changes in the streams promoted by damming could affect both bat species richness and activity levels, leading to changes in the overall composition of the bat community. In conclusion, this study found that small reservoirs have a significant influence on bat activity. However, dams appear to primarily benefit the most common species, while the endangered species were associated with riparian habitats. Therefore, for conservation proposes of the local bat community, riparian areas appear to be more important than reservoirs. Thus, this study provides a better understanding of the impact of small dams on bats contributing to the future management and conservation of bat species.

Key words: echolocation, Anabat, dams, water reservoirs, riparian habitats, bat activity, *Pipistrellus*, *Myotis*

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Activity of insectivorous bats is related to water availability in a highly modified Mexican temperate forest

CELIA LÓPEZ-GONZÁLEZ[1, 4], ABRAHAM LOZANO[1], EMMA P. GÓMEZ-RUIZ[2], and RICARDO LÓPEZ-WILCHIS[3]

[1]*Instituto Politécnico Nacional, Centro de Interdisciplinario de Investigación para el Desarrollo Integral Regional (CIIDIR) Unidad Durango, Sigma 119 Fraccionamiento 20 de Noviembre II Durango, Durango 34220, Mexico*
[2]*Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station TX 77843, USA*
[3]*Departamento de Biología, Universidad Autónoma Metropolitana -Iztapalapa, Av. San Rafael Atlixco N° 186, Col. Vicentina, 09340, Iztapalapa, México D.F., Mexico*
[4]*Corresponding author: E-mail: celialg@prodigy.net.mx*

Artificial ponds are important foraging and drinking resources for bats at La Michilía, a temperate forest with a marked seasonal drought. Using acoustic data we tested the hypothesis that water availability restricts bat activity in the dry season to ponds, whereas in the rainy season resources are widely available and therefore used throughout the area. We compared bat activity at six ponds with that of a 500-meter transect perpendicular to each pond. We predicted that activity would be higher at ponds in the dry season, whereas in the rainy season activity should be equal or higher at transects. Also, all species guilds would use ponds in the dry season, whereas gleaners, edge aerial and open aerial foragers would be more frequent at transects in the rainy season. In no instance activity was higher at transects than at ponds during the rainy season. Open areas showed little or no bat activity in the dry season, but were very active in the rainy season. One transect located in dense forest and one near human dwellings were active both seasons. Open aerial foragers were present mostly on ponds in the dry season, and on ponds and transects in the rainy season; edge aerial bats were common in ponds in the dry season, but rare in transects in the rainy season. Trawling bats used ponds and transects in both seasons; and gleaners were rare over ponds and transects in both seasons. Because bats use the local habitat differently depending on season and feeding guild, and climate and seasonality vary greatly in Mexican temperate forests, conservation strategies can not be generalized, but should be implemented on a case-by-case basis.

Key words: acoustic monitoring, Chiroptera, echolocation, foraging activity, protected areas, seasonal environments

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Habitat use by the endemic Malagasy bat *Hipposideros commersoni* in a littoral forest

Julie Hanta Razafimanahaka[1, 2], Mahefatiana Ralisata[1], Felicien Randrianandrianina[1], Richard K. B. Jenkins[1], Joelisoa Ratsirarson[2], and Paul A. Racey[3, 4]

[1]*Madagasikara Voakajy, BP 5181, Antananarivo, Madagascar*
[2]*Département des Eaux et Forêts, Ecole Supérieure des Sciences Agronomiques, Université d'Antananarivo, BP 175, Antananarivo, Madagascar*
[3]*Centre for Ecology and Conservation, School of Biosciences, University of Exeter, Cornwall campus, Penryn, TR10 9FE, United Kingdom*
[4]*Corresponding author: E-mail: p.a.racey@exeter.ac.uk*

We investigated habitat use by the endemic Malagasy bat *Hipposideros commersoni* in evergreen littoral rainforest during the wet season in 2006, in order to better inform conservation guidelines. We used radiotracking to locate roosting and foraging sites. Roosts, typically 5.4 ± 0.2 m from the ground, were always occupied by single bats and were found on branches of trees with a diameter at breast height of 8.2 ± 0.7 cm. Home range size was 31.8 ± 9.2 ha for males and 41.7 ± 12.9 ha for females. Roosts were always located within the foraging areas and only five (5.4%) of the 91 located were situated outside the sheltered littoral forest. Foraging bats made greatest use of natural, sheltered littoral forest and relatively few foraging sorties occurred beyond the forest edge. Females were not trapped during January and may undergo local movements at that time. There are no known caves in the vicinity of the study area and *H. commersoni* roosted only on trees. Previous studies in Madagascar have highlighted the importance of caves for bats and we now extend this to include tree roosts, within the evergreen rainforest.

Key words: forest dependency, habitat use, *Hipposideros commersoni*, home range, Madagascar, radiotracking, Tampolo

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Bats attend to plant structures to identify roosting sites

Michael G. Schöner[1, 3], Caroline R. Schöner[1], Gerald Kerth[1], Liaw Lin Ji[2], and T. Ulmar Grafe[2]

[1]*Zoological Institute and Museum, University of Greifswald, J.-S.-Bach-Strasse 11/12, 17489 Greifswald, Germany*
[2]*Faculty of Science, University Brunei Darussalam, Tungku Link, Gadong 1410, Brunei Darussalam*
[3]*Corresponding author: E-mail: schoenerm@uni-greifswald.de*

More than half of the extant bat species rely on plants as roosts. Nevertheless, it is largely unknown how bats find these roosts and whether they use characteristic plant structures for their identification. The bat *Kerivoula hardwickii* regularly roosts in damaged pitchers of the carnivorous pitcher plant *Nepenthes bicalcarata*. These pitchers are characterized by two sharp, long thorns directly above the pitchers' opening. In two behavioural experiments we tested, if 1) the length of the thorns or 2) the distance between thorns and pitcher opening has an attractive or deterrent effect on *K. hardwickii*. The bats preferred pitchers with longer thorns while the distance between thorns and pitcher opening did not influence them. This shows that the bats are not deterred by the thorns. It also suggests that they do not exploit the pitchers' thorns as a protection against being preyed on while roosting. In this case the bats should have chosen pitchers with thorns close to the pitcher's opening that provide the most effective protection. Instead, *K. hardwickii* seem to use the thorns as identification cues to find suitable roost sites. Generally, our study suggests that bats even attend to plant structures that do not provide them with a direct benefit.

Key words: roost finding, bat-plant interaction, *Kerivoula*, *Nepenthes*, pitcher plant

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Testing the coexistence of *Artibeus lituratus* and *A. planirostris* in a Neotropical savanna

THALES SIMIONI AMARAL[1, 2], LUCAS MOUSINHO MACÁRIO[1], and LUDMILLA MOURA DE SOUZA AGUIAR[1]

[1]*Laboratório de Biologia e Conservação de Morcegos, Departamento de Zoologia, Universidade de Brasília, Campus Universitário Darcy Ribeiro, Brasília - CEP 70910-900, Brazil*
[2]*Corresponding author: E-mail: amaral.thales@gmail.com*

Dissimilarity of relevant ecomorphological traits between species is expected to promote coexistence within a community. In this study, we tested hypotheses concerning differences in occurrence, in periods of activity and reproduction, in morphology and diet between two sympatric and phylogenetically related bat species (*Artibeus lituratus* and *A. planirostris*) in the Cerrado region of Central Brazil. No differences were found in the occurrence, activity patterns, or breeding season between species. In contrast, the species presented dissimilar morphological traits and diets (28% of overlap in diet). Our analysis suggests that *A. lituratus* and *A. planirostris* do not compete strongly with each other. This lack of competition between species facilitates coexistence on a local scale in the studied Neotropical savanna.

Key words: Cerrado, Chiroptera, competition, co-occurrence, niche overlap, Rosario test, savanna

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Sex-specific habitat preferences of foraging and commuting lesser horseshoe bats *Rhinolophus hipposideros* (Borkhausen, 1797) in lowland England

NICK C. DOWNS[1, 5, 6], WARREN J. CRESSWELL[1], PAOLA REASON[1], GILES SUTTON[2], DAVID WELLS[3], and STEPHANIE WRAY[4]

[1]*Arcadis*, *The Mill*, *Brimscombe Port*, *Stroud*, *Gloucestershire*, *GL5 2QG, United Kingdom*
[2]*GS Ecology*, *119 Highgrove Street*, *Reading*, *Berks*, *RG1 5EJ, United Kingdom*
[3]*Collins Environmental Consultancy*, *Epsilom Dome*, *Cleve Mill Business Park*, *Newent*, *Gloucestershire*, *GL18 1EP*, *United Kingdom*
[4]*Peter Brett Associates*, *10 Queen Square*, *Bristol*, *BS1 4NT*, *United Kingdom*
[5]*University of Bristol*, *School of Biological Sciences*, *Woodland Road*, *Bristol*, *BS8 1UG, United Kingdom*
[6]*Corresponding author: E-mail: nick.downs@arcadis.com*

The lesser horseshoe bat (*Rhinolophus hipposideros*) is a widespread but rare bat in central and southern Europe, having undergone a dramatic population decline in the 1950s and 1960s. However, an internationally significant population has persisted in the United Kingdom, which now appears to be increasing. The present study extends previous radio-tracking studies on *R. hipposideros* to confirm and extend species-specific habitat management recommendations. It is also the first to radio-track adult males in lowland England. Thirteen lesser horseshoe bats (eight males and five females, from two maternity roosts) were radio-tracked within and around the National Trust Sherborne Park Estate, Gloucestershire (UK), between June and October 2003. A total of 2599 fixes were obtained from active bats, classified as emergence circling (2.7%), commuting (10.3%), foraging (85.2%) and return circling (1.8%). Although commuting bats were mainly recorded along the edges of fields near to hedgerows or woodlands, more open commuting routes were also identified. The longest of these (used by a single bat) was in excess of 200 m through long-established open parkland during the darkest period of the night. Shorter distances (typically 30–100 m) were also flown between mature parkland trees. It is also notable that, immediately after emergence, a significant number of bats tracked from both maternity roosts crossed low over an unlit narrow two-lane country road. Habitat selection, assessed using compositional analysis based on the radio-tracking data, identified a preference for woodland habitats above all others, particularly broadleaf woodland. Wet broadleaf woodland was used for foraging by five of the 13 tracked bats. Parkland, grazed grassland and un-grazed grassland were also selected. Arable land was the least selected. This is the first study in which compositional analysis has revealed a preference for grazed over un-grazed grassland. Grazed grassland was also selected above parkland (only some of which was grazed), suggesting that the presence of cattle may be more important than mature parkland trees. Low sample sizes prohibited the use of sex-specific compositional analyses. However, it was still notable that when comparing the sexes, females showed an increased preference for woodland and a decreased preference for grassland. It is apparent from the present study that lesser horseshoe bats are flexible in their use of foraging habitat. They are able to forage within habitats other than woodland (such as scrub and isolated trees), and cross open gaps to reach these areas. However, these foraging situations are likely to be sub-optimal. Landscape management around lesser horseshoe maternity colonies should focus on optimal foraging habitats. These comprise linear landscape elements (such as hedges, tree-lines, rivers and woodland edges), woodland, and grazed parkland containing mature trees. Additionally, future conservation studies should consider both sexes, due to the possibility that sex-specific differences in habitat use exist.

Key words: compositional analysis, conservation, habitat, bat, lesser horseshoe

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Mating and courtship behaviour of two sibling bat species (*Pipistrellus pipistrellus*, *P. pygmaeus*) in the vicinity of a hibernaculum

LENKA BARTONIČKOVÁ[1], ANTONÍN REITER[2], and TOMÁŠ BARTONIČKA[3, 4]

[1]*Riegrova 1, CZ-612 00 Brno, Czech Republic*
[2]*South Moravian Museum in Znojmo, Přemyslovců 8, CZ–669 45 Znojmo, Czech Republic*
[3]*Department Botany and Zoology, Faculty of Science, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic*
[4]*Corresponding author: E-mail: bartonic@sci.muni.cz*

In comparison with *Pipistrellus pipistrellus*, very little is known about the mating behaviour and hibernation of *P. pygmaeus*. The phenology of display and swarming behaviour were studied using bat detectors and mist nettings in the ruins of Nový Hrádek castle (southwestern Moravia, Czech Republic), where *P. pipistrellus* and *P. pygmaeus* hibernate in mixed-species clusters. We hypothesize that if both pipistrelle species share the same swarming site and hibernaculum they can compete with each other and their mating and courtship activity can be separate over time. The highest songflight activity was found between mid-August and mid-September. At the beginning of the mating period, songflights of both species were recorded in the second third of the night, whereas from the end of September, the peak of display activity moved to the first third of the night. We did not find clear evidence for temporal niche partitioning between species during autumn mating behaviour at locality of study. Proportion of *P. pygmaeus* observed in the hibernaculum was significantly higher than its observed in acoustic recordings and in mist-netted bats. It may show different mating behaviour between both pipistrelle species. Males of *P. pipistrellus* produced display calls close to hibernacula, whereas males of *P. pygmaeus* probably mate elsewhere, likely before any long autumnal migration near nursery colonies.

Key words: mating, strategies, pipistrelles, swarming, behaviour, hibernation

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Echolocation calls and flight behaviour of the elusive pied butterfly bat (*Glauconycteris superba*), and new data on its morphology and ecology

Ros Kiri Ing[1], Raphaël Colombo[2], Guy-Crispin Gembu[3], Yves Bas[4], Jean-François Julien[4], Yann Gager[5], and Alexandre Hassanin[6, 7]

[1]*Institut Langevin, UMR 7587 CNRS, Université Paris Diderot (Paris 7), 1 rue Jussieu, 75238 PARIS Cedex 05, France*
[2]*Asellia Ecologie, 60 chemin de la Nuirie, 04200 Sisteron, France*
[3]*Faculté des Sciences, Université de Kisangani, République Démocratique du Congo*
[4]*Centre d'Ecologie et de Sciences de la Conservation, UMR 7204 CNRS MNHN, Museum national d'Histoire naturelle, 43, rue Buffon, 75005 Paris, France*
[5]*Department of Migration and Immuno-Ecology, Max Planck Institute for Ornithology, 78315 Radolfzell, Germany*
[6]*Institut de Systématique, Evolution, Biodiversité, UMR 7205 CNRS MNHN UPMC, Muséum national d'Histoire naturelle, 55, rue Buffon, 75005 Paris, France*
[7]*Corresponding author: E-mail: hassanin@mnhn.fr*

The pied butterfly bat, *Glauconycteris superba*, is endemic to the tropical forest zone of Africa, where it was previously known from only five specimens. Here we report the capture of 10 individuals in two localities of the Democratic Republic of the Congo (Mbiye Island and Yoko forest reserve), and we present the first acoustic data of the species recorded using a conventional microphone and a home-made acoustic system for real time 3D localization. Our morphological comparisons show that females are larger and heavier than males, and that the two sexes exhibit the same fur coloration pattern. We found some individual variations concerning the width of the two lateral white stripes on the belly, and the number and extension of white shoulder-spots. The echolocation recordings show evidence for alternation between two call types (A and B), differing in frequency, bandwidth, and duration. The acoustic signals obtained before captures and after releases revealed important variations depending on the trajectories and environmental conditions. Acoustic characteristics, wing measurements, and the unique black and white fur pattern of *G. superba* suggest that it is a canopy species able to fly at high speeds. Our findings will be useful for future ecological studies to provide new data on the range, population size, trend and threats of *G. superba* in order to better assess its conservation status.

Key words: Vespertilionidae, acoustic, flight path reconstruction, frequency alternation, sexual dimorphism, fur colour pattern, canopy

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Are leaves a good option in Caatinga's menu? First record of folivory in *Artibeus planirostris* (Phyllostomidae) in the semiarid forest, Brazil

Eugenia Cordero-Schmidt[1, 4], Maricélio Medeiros-Guimarães[2], Juan Carlos Vargas-Mena[1], Bruna Carvalho[1], Rodrigo Lopes Ferreira[2], Bernal Rodriguez-Herrera[3], and Eduardo M. Venticinque[1]

[1]*Departamento de Ecologia, Universidade Federal do Rio Grande do Norte, 59078900 Lagoa Nova Natal, RN, Brazil*
[2]*Centro de Estudos em Biologia Subterrânea, Departamento de Biologia, Universidade Federal de Lavras, 37200000 Lavras, Minas Gerais, Brazil*
[3]*Escuela de Biología, Universidad de Costa Rica, 2060 Montes de Oca, San José, Costa Rica*
[4]*Corresponding author: E-mail: ecordero.s@gmail.com*

Folivory can be defined as the consumption of foliage, including leaves, stems and leaf content. This trophic strategy has been documented in two families of bats, Pteropodidae (Old World fruit bats) and Phyllostomidae (New World leaf-nosed bats). Existing folivory hypotheses for bats suggest this behavior provides a dietary supplement of protein and other essential minerals due to a deficiency of these in a frugivorous diet. The Caatinga is a seasonally deciduous tropical dry forest where most of the vegetation is leafless and dormant during the extended dry season. Here we present the first evidence of folivory in bats from the Brazilian Caatinga, with evidence for the phyllostomid *Artibeus planirostris* ingesting the leaves of at least 16 species of plants. We include a bibliographic review of bat folivory in the tropics. Additionally, we propose a new hypothesis on folivory in bats for this semiarid environment.

Key words: Phyllostomidae, caves, feeding habits, folivory, Pteropodidae, Caatinga

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Diet of a Nearctic species, the evening bat (*Nycticeius humeralis*), at the northern edge of its range

OLIVIA M. MÜNZER[1, 2, 3], BRIAN A. SCHAETZ[1], and ALLEN KURTA[1]

[1]*Eastern Michigan University, Biology Department, 441 Mark Jefferson, Science Complex, Ypsilanti, MI 48197, USA*
[2]*Cardno, Inc., 5400 Glenwood Avenue, Suite G-03, Raleigh, NC 27612, USA*
[3]*Corresponding author: E-mail: Liefvir@yahoo.com*

Evening bats (*Nycticeius humeralis*) are ubiquitous in the southeastern United States, but only one maternity colony occurs in the Great Lakes region, in Michigan, and it is the northernmost colony known in North America. We hypothesized that diet would vary throughout the season and between years and that diet of evening bats in northern areas would differ from diet of those in more southern parts of the continent. Almost 600 fecal pellets of evening bats were collected and analyzed from May through August 2006–2007. Thirteen orders of insects and two orders of arachnids were found, but Coleoptera, Diptera, Hymenoptera, and Hemiptera composed 87% of dietary volume. Lepidoptera, which forms a substantial portion of the diet for most vespertilionids in eastern North America, contributed only 4.7% to the volume. Diet was broadly similar to evening bats in the core of their range, although evening bats in Michigan incorporated substantially more Diptera into their diet. Dietary composition and diversity differed little between years but showed variation among weeks within years. The lack of dietary specialization and similarity in major components in different parts of the range suggest that availability of prey or dietary competition with other species at the ordinal level are not factors limiting the northern distribution of the evening bat.

Key words: diet, insects, *Nycticeius humeralis*, Michigan, geographic range, temporal variation, evening bat

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What is for dinner? First report of human blood in the diet of the hairy-legged vampire bat *Diphylla ecaudata*

FERNANDA ITO[1], ENRICO BERNARD[1, 3], and RODRIGO A. TORRES[2]

[1]*Laboratório de Ciência Aplicada à Conservação da Biodiversidade, Departamento de Zoologia, Universidade Federal de Pernambuco, Recife, 50670901 Brazil*
[2]*Laboratório de Genômica Evolutiva & Ambiental, Departamento de Zoologia, Universidade Federal de Pernambuco, Recife, 50670420 Brazil*
[3]*Corresponding author: E-mail: enrico.bernard@ufpe.br*

Blood-feeding is one of the most specialized foraging habits, as it demands extreme morphological, physiological, and behavioral adaptations. Three species of vampire bats (*Desmodus rotundus*, *Diaemus youngi*, and *Diphylla ecaudata*) rely on blood as their only food. The first two are considered less specialized, whereas *D. ecaudata* is frequently pointed out as a bird-specialist. We assessed what prey *D. ecaudata* consumes in the Caatinga dry forests of northeastern Brazil, a highly modified biome. How the species would behave in a situation of scarcity of wild birds and increase in the availability of domestic animals? Could *Diphylla* have been induced to include also mammals in its diet? Using PCR-amplification of DNA fragments in the feces of *D. ecaudata*, we detected the regular consumption of chicken blood and human blood — a novel prey for this species. Our results suggest that the diet of *D. ecaudata* is more flexible than expected. The record of humans as prey and the absence of blood from native species may reflect a low availability of wild birds in the study site, reinforcing the impact of human activities on local ecological processes. This also opens a range of research possibilities on vampire bats in the Caatinga, both on the species' biology and the consequences for public health, considering the potential increase in the transmission of rabies in the region.

Key words: blood-feeding, Brazil, Caatinga, Chiroptera, Desmodontinae, faecal DNA

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Geographical and seasonal patterns of spleen mass and acarine load in tropical and subtropical leaf-nosed bats

L. Gerardo Herrera M.[1, 7], Stephanie Ortega-García[2], Juan B. Morales-Malacara[3], José Juan Flores-Martínez[4], Gerardo López-Ortega[5], and Adam D. Richman[6]

[1]*Estación de Biología Chamela*, *Instituto de Biología*, *Universidad Nacional Autónoma de México*, *A.P. 21*, *San Patricio*, *Jalisco, 48980 México*
[2]*Posgrado en Ciencias Biológicas*, *Instituto de Biología*, *Universidad Nacional Autónoma de México*, *A.P. 70-153*, *México D.F., 04510 México*
[3]*UMDI*, *Facultad de Ciencias*, *Universidad Nacional Autónoma de México*, *Campus Juriquilla*, *Boulevard Juriquilla 3001*, *Querétaro*, *Querétaro*, *76230 México*
[4]*Departamento de Zoología*, *Instituto de Biología*, *Universidad Nacional Autónoma de México*, *A.P. 70-153*, *México D.F., 04510 México*
[5]*Departamento de Biología*, *División de C.B.S.*, *Unidad Iztapalapa*, *Universidad Autónoma Metropolitana*, *A.P. 55-535*, *México D.F.*, *09340*, *México*
[6]*Plant Sciences Department*, *119 ABS Building*, *Montana State University*, *Bozeman*, *Montana 59717, USA*
[7]*Corresponding author: E-mail: gherrera@ib.unam.mx*

We investigated intra-annual variability in acarine parasite load (species richness, prevalence and abundance) and spleen mass in populations of leaf-nosed bats in highly seasonal tropical and subtropical climates: one population of California leaf-nosed bat (*Macrotus californicus*) in a subtropical thorn forest, one population of Waterhouse's leaf-nosed bat (*M. waterhousii*) in a subtropical desert, and one population of Waterhouse's leaf-nosed bat in a tropical deciduous forest. We tested the hypothesis that hosts in highly seasonal tropical and subtropical climates exhibit significant seasonal changes in immune response and parasite load. Prevalence was 100% in most populations examined, except in the subtropical population of *M. waterhousii* in the rainy season. The tropical population had the highest parasite richness in both seasons and presented species belonging to the four acarine orders examined: Mesostigmata, Ixodidae, Trombidiformes, and Sarcoptiformes. Abundance values of Trombidiformes in *M. californicus*, and of Ixodida and Sarcoptiformes in the tropical *M. waterhousii* population were higher in the rainy than in the dry season. Spleen mass was larger in the tropical population in the rainy season and in the subtropical population in the dry season. Spleen mass was not related to abundance of any of the acarine orders (Mesostigmata, Ixodidae, Trombidiformes, and Sarcoptiformes) analyzed. Our findings suggest that bats in highly seasonal tropical and subtropical environments experience significant seasonal changes in parasite burden and in immune response.

Key words: ectoparasites, immune response, insectivorous bats, subtropics, tropics

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Morphometric analysis of body and claw dimensions of building dwelling UK bat species: to aid knowledge of bat interactions with roosting surfaces

STACEY D. WARING[1, 3] and EMMANUEL A. ESSAH[2]

[1]*Technologies for the Sustainable Built Environment Centre, School of the Built Environment, University of Reading, Reading, RG6 6AF, United Kingdom*
[2]*School of the Built Environment, University of Reading, Reading, RG6 6AF, United Kingdom*
[3]*Corresponding author: E-mail: s.d.waring@reading.ac.uk*

The increasing use of non-woven materials, such as breathable roofing membranes (BRMs) within buildings that either currently contain a bat roost or may do in the future, has led to concerns over bat safety by those involved in bat conservation in the UK. Whilst some information is currently available on the selection of roosts in roofs by bats, along with technical specifications of individual membranes, there is no research that has investigated the interactions between the two. Prior to determining the methods needed to test interactions between bats and BRMs, a series of preliminary investigations were conducted; including research and physical measurements on selected anatomical features of bats commonly found roosting in buildings in the UK. Data on body size and shape were gathered from a combination of experimental measurements of bat specimens (deceased) and information collated from literature. Data on bat claw morphology were collected by applying a method used to measure raptor talons, measurements obtained included; width, length and the curvature (hook ratio) of their claws. The results of this research provide additional information about bat body and claw morphometrics. It was found that bat species/group had a significant effect upon the length, width and curvature of the claws (to varying degrees). Pipistrelle species have the shortest and third narrowest claws, whereas serotines have the longest and widest claws on average. The curvature of the claws does not vary greatly between species; however, more variation was seen in the lower portion of the claws. The results from this research also demonstrate that the current standard industry tests do not represent the fine scale at which a bats claws interact with their roosting surfaces. Consequently, this information can be used to aid the development of industry tests for determining the suitability of BRMs for use in bat roosts.

Key words: bats, claws, length, curvature, morphometrics, roosting surfaces