BAT RESEARCH NEWS

VOLUME 57: NO. 1 SPRING 2016

BAT RESEARCH NEWS

VOLUME 57: NUMBER 1 **SPRING 2016**

Table of Contents

Front Cover

Platyrrhinus helleri (Heller's Broad-nosed Bat), Paramaribo, Suriname. Photo by Keith Christenson. Thank you once again, Keith!

BAT RESEARCH NEWS

Volume 57: Number 1 Spring 2016

Publisher and Managing Editor: Dr. Margaret A. Griffiths, 8594 Berwick Circle, Bloomington, IL 61705; E-mail: margaret.griffiths01@gmail.com

Editor for Feature Articles: Dr. Allen Kurta, Dept. of Biology, Eastern Michigan University, Ypsilanti MI 48197; E-mail: akurta@emich.edu

Editor for Recent Literature: Dr. Thomas A. Griffiths, 8594 Berwick Circle, Bloomington, IL 61705; E-mail: thomas.alan.griffiths@gmail.com

Emeritus Editor: Dr. G. Roy Horst

Bat Research News is published four times each year, consisting of one volume of four issues. *Bat Research News* publishes short feature articles and general interest notes that are reviewed by at least two scholars in that field. *Bat Research News* also includes abstracts of presentations at bat conferences around the world, letters to the editors, news submitted by our readers, notices and requests, and announcements of future bat conferences worldwide. In addition, *Bat Research News* provides a listing of recent bat-related articles that were published in English. *Bat Research News* is abstracted in several databases (e.g., BIOSIS).

Communications concerning feature articles and "Letters to the Editor" should be addressed to Dr. Al Kurta (akurta@emich.edu), recent literature items to Dr. Tom Griffiths (thomas.alan.griffiths@gmail.com), and all other correspondence (e.g., news, conservation, or education items; subscription information; cover art) to Dr. Margaret Griffiths (margaret.griffiths01@gmail.com).

The prices for one volume-year (4 issues within a single volume) are:

Institutional/Group subscriptions	US $50.00
Individual subscriptions:	
printed edition (U.S.A.)	US $25.00
printed edition (outside U.S.A)	US $35.00

Subscriptions may be paid by check or money order, payable to "***Bat Research News***." Please include both mailing (postal) and e-mail addresses with your payment, and send to Dr. Margaret Griffiths at the address listed above. To pay by credit card (Visa or MasterCard only) or for further information, please go to the *Bat Research News* website at http://www.batresearchnews.org/ and click on the "Subscription Information" link.

Back issues of *Bat Research News* are available for a small fee. Please contact Dr. Margaret Griffiths (margaret.griffiths01@gmail.com) for more information regarding back issues. Thank you!

Bat Research News is ISSN # 0005-6227.
Bat Research News is printed and mailed at Illinois Wesleyan University, Bloomington, Illinois, U.S.A.

This issue printed April 5, 2016.

An Accidental Record of the Southern Yellow Bat, *Lasiurus ega*, in Michigan

Allen Kurta[1], Thomas Cooley[2], Julie Melotti[2], and M. R. Boersen[3]

[1]*Department of Biology, Eastern Michigan University, Ypsilanti, MI 48197;*
[2]*Michigan Department of Natural Resources, Wildlife Disease Laboratory, 425 Beaumont Road, Room 250, Lansing, MI 48910; and*
[3]*Michigan Department of Natural Resources, Wildlife Division, 8717 North Roscommon Road, Roscommon, MI 48653*
E-mail: akurta@emich.edu

The southern yellow bat, *Lasiurus ega*, is a solitary species that typically roosts in dead fronds of palm trees (Kurta and Lehr, 1995). Its geographic range extends from extreme southern Texas, along the Gulf Coast of Mexico, south to Central and South America, as far as Argentina. In this note, though, we report a southern yellow bat from a locality that is more than 2,000 km north of its normal distribution.

The bat was found alive in a shipping container filled with automobile parts that was delivered to a supplier in Roscommon, Michigan (N44.4824 W-84.5990), on 6 November 2015. The parts were manufactured in Matamoras, Mexico (N25.8421 W-97.4356), and transported to a facility in Brownsville, Texas (N25.9069 W-97.4164), which is located across the Rio Grande River from Matamoras. In Brownsville, the parts were loaded into a closed shipping container and trucked to Michigan. Thus, the bat could have originated in either Matamoras, with the parts, or in Brownsville, with the container. Upon discovery in Michigan, the animal was euthanized by personnel of the Michigan Department of Natural Resources and submitted to virologists at the Michigan Department of Health and Human Services, who found the bat to be negative for rabies. The carcass was frozen after testing and ultimately preserved as a skin and skull in the T. L. Hankinson Vertebrate Museum at Eastern Michigan University (EMU M1041).

Measurements (mm) of the dark-faced animal, an adult female, were total length 115, tail length 51, hindfoot length 9, and ear height 15. Both forearms were 49 mm in length, although both had been broken, presumably at the time of capture. Body mass was 9.5 g, without the brain, which typically weighs 0.2–0.3 g in a 10-g vespertilionid (Pitnick et al., 2006). Although the braincase was damaged during testing for rabies, the maxillary toothrow was intact, and its length was 5.4 mm.

The mammal was obviously a yellow bat (subgenus *Dasypterus*), based on its beige-brown coloration, a dorsal tail membrane that was furred only on the proximal half, and presence of only four upper cheek teeth. The southern yellow bat is similar in appearance to the northern yellow bat (*L. intermedius*) and western yellow bat (*L. xanthinus*). However, we identified the animal as a southern yellow bat, because the northern species is larger in most dimensions and because the light-faced, western form does not occur along the Gulf Coast (Ammerman et al., 2012; Ceballos, 2015).

Constantine (2003) describes many cases of inadvertent, long-distance transport of bats by ships and airplanes but only one of accidental movement by truck. Nevertheless, many of his examples (Constantine, 2003) involve containers that were stacked on ships. Similar containers also can be transported on a railroad car or, as in the case of this southern yellow bat, on a truck. Millions of

these containers are in use world-wide (Levinson, 2006), and we suspect that accidental transport by container trucks is more common than previously reported.

Literature Cited

Ammerman, L. K., C. L. Hice, and D. J. Schmidly. 2012. Bats of Texas. Texas A&M Press, College Station, Texas.

Ceballos, G., ed. 2015. Mammals of Mexico. Johns Hopkins University Press, Baltimore, Maryland.

Constantine, D. G. 2003. Geographic translocation of bats: known and potential problems. Emerging Infectious Diseases, 9:17–21.

Kurta, A., and G. C. Lehr. 1995. *Lasiurus ega*. Mammalian Species, 515:1–7.

Levinson, M. 2006. The box: how the shipping container made the world smaller and the world economy bigger. Princeton University Press, Princeton, New Jersey.

Pitnick, S., K. E. Jones, and G. S. Wilkinson. 2006. Mating system and brain size in bats. Proceedings of the Royal Society B, 273:719–724.

Letters to the Editor

Editor's Note: Unlike technical articles, letters are not peer-reviewed, but they are edited for grammar, style, and clarity. Letters provide an outlet for opinions, speculations, anecdotes, and other interesting observations that, by themselves, may not be sufficient or appropriate for a technical article. Letters should be no longer than two manuscript pages and sent to the Feature Editor.

An Effective One-way Exit for Townsend's Big-eared Bat (*Corynorhinus townsendii*)

Greg Tatarian

Wildlife Research Associates, 1119 Burbank Avenue, Santa Rosa, California 95407
E-mail: gregbat@wildliferesearchassoc.com

Townsend's big-eared bats **(***Corynorhinus townsendii*) roost in a variety of settings, primarily on open surfaces in caves and cave-like structures, such as mines, buildings, bridges, and water-diversion tunnels (Keeley and Tuttle, 1998; Kunz and Martin, 1982; Pierson and Rainey, 1998), and occasionally large tree hollows (e.g., Mazurek, 2004). Unlike most species of bats, *C. townsendii* prefers openings into the roosting area that are large enough to permit flight, without individuals having to land and crawl through a restricted opening. For example, Pierson and Rainey (1998) indicated that a minimum size of 15 by 31 cm was necessary, which is similar to openings into roosts observed by the author for this species. In this note, I describe a one-way exit that permits the species to fly from inside the roost into an opening that is 15 by 31 cm or larger and redirects bats 90 degrees downward to drop eventually through a narrowed external opening (Fig. 1).

Plywood (1.3-cm thick) is used to make the mounting strips, floor panels, and sidewalls, and the unit is assembled using wood glue and pneumatic crown staples (0.6 cm by 2.5 cm). The top edges of the sidewalls are cut on an arc from the roost entry, 90 degrees down to a vertical external exit that is lower than the roost opening. A clear polycarbonate sheet (0.16-cm thick) is attached with pneumatic staples to the edge of each sidewall, forming a smooth, curved front wall that guides the flying bats downward to where they drop out the external exit. Unlike acrylic plastic, polycarbonate bends easily and does not crack or split when mechanical fasteners are used without pre-drilling holes. Clear polycarbonate transmits light and allows bats to see through the front wall, as would occur through an unobstructed roost opening. Not all bats may pass through the exit on the first night of use, but in the author's experience, including a transparent front wall reduces the number of nights required for emergence by all individuals in a roost.

The floor can be made with two panels of plywood attached to the lower edges of the side walls and angled toward the front wall to form an 8-cm-wide exterior opening (Fig. 1). The width and angles of the floor panels will vary with the overall size of the one-way exit and will require adjustment during layout and construction to achieve an 8-cm-wide exterior opening. The plywood floor panels should be covered with aluminum flashing to create a slippery surface, and the sharp edges of the flashing should be covered by aluminum duct tape to protect the bats. As an alternative to angled plywood, the lower edge of the side

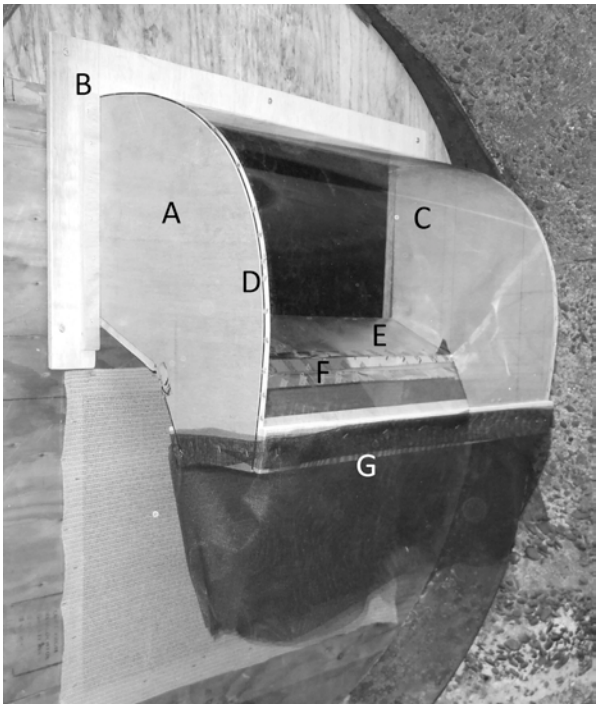

Figure 1. (A) Plywood sidewalls. (B) Plywood mounting pieces. (C) Clear polycarbonate sheet front wall. (D) Pneumatic crown staples attaching polycarbonate to edge of plywood. (E) Aluminum flashing stapled over bottom plywood panel to provide slippery surface. (F) Aluminum duct tape covering sharp edges. (G) Fiberglass window screen stapled to plywood strips at bottom of opening.

walls can be cut with an arc smaller than that for the front wall, and a polycarbonate sheet attached to form a curved floor. The result in either case is a sloped, smooth floor that reduces the potential for bats to land and fly back into the roost or to crawl in from the lower, external opening. Fiberglass window screen, extending down 16–20 cm, is stapled to plywood strips around the bottom of the exterior opening to form a tapered, flexible chute that is open at the bottom; the chute permits bats to drop out but eliminates re-entry by crawling or flying bats.

These one-way exits have been used for successful eviction of ca. 55 *C. townsendii* and bats of several other species from a large building and ca. 12 *C. townsendii* and at least 24 Yuma myotis (*Myotis yumanensis*) roosting in a water pipe with a diameter of 150 cm. The one-way exit can be scaled for use on windows of various size, openings through walls, or entrances to tunnels or adits. The exit can be attached directly to small roost openings or over an opening in a panel constructed to block large entrances, as in Figure 1. The one-way exit is robust, and after successful eviction of bats and sealing of the roost opening, it can be removed as a unit and reused at different locations.

Literature Cited

Keeley, B. W., and M. D. Tuttle. 1998. Bats in American Bridges. Bat Conservation International, Resource Publication, 4:1–41.

Kunz, T. H., and R. A. Martin. 1982. *Plecotus townsendii*. Mammalian Species, 175:1–6.

Mazurek, M. J. 2004. A maternity roost of Townsend's big-eared bats (*Corynorhinus townsendii*) in coast redwood basal hollows in northwest California. Northwestern Naturalist, 85:60–62.

Pierson, E. D., and W. E. Rainey. 1998. The distribution, status and management of Townsend's big-eared bat (*Corynorhinus townsendii*) in California. URL: http://dfg.ca.gov/wildlife/nongame/publications/bm_research/docs/96_07.pdf (accessed 25 March 2016).

RECENT LITERATURE

Authors are requested to send reprints (PDF files) of their published papers to the Editor for Recent Literature, **Dr. Thomas A. Griffiths**, (e-mail: **thomas.alan.griffiths@gmail.com**) for inclusion in this section. Receipt of reprints is preferred, as it will facilitate complete and correct citation. However, if reprints and/or PDF files are unavailable, please send a complete citation (including complete name of journal and corresponding author mailing address) by e-mail. The Recent Literature section is based on several bibliographic sources and for obvious reasons can never be up-to-date. Any error or omission is inadvertent. Voluntary contributions for this section, especially from researchers outside the United States, are most welcome and appreciated.

BEHAVIOR

Rose, A., M. Kolar, M. Tschapka, and M. Knörnschild. 2016. Learning where to feed: the use of social information in flower-visiting Pallas' long-tongued bats (*Glossophaga soricina*). Animal Cognition, 19(2): 251–262. [andreas.rose@uni-ulm.de]

CONSERVATION

Cruz, J., P. Sarmento, G. Rydevik, H. Rebelo, and P. C. L. White. 2016. Bats like vintage: managing exotic eucalypt plantations for bat conservation in a Mediterranean landscape. Animal Conservation, 19(1): 53–64. [anne.goffard@univ-lille2.fr]

Hoffmaster, E., J. Vonk, and R. Mies. 2016. Education to Action: Improving Public Perception of Bats. Animals, 6(1): 1–9. [vonk@oakland.edu]

Newson, S. E., H. E. Evans, and S. Gillings. 2015. A novel citizen science approach for large-scale standardised monitoring of bat activity and distribution, evaluated in eastern England. Biological Conservation, 191: 38–49. [stuart.newson@bto.org]

Salvarina, I. 2016. Bats and aquatic habitats: a review of habitat use and anthropogenic impacts. Mammal Review, 46(2): 131–143. [Ioanna.Salvarina@uni-konstaflZ.de; isalvarina@gmail.com]

Wu, J. 2016. Detection and attribution of the effects of climate change on bat distributions over the last 50 years. Climatic Change, 134(4): 681–696. [wujg@craes.org.cn]

Zeale, M. K., E. Bennitt, S. E. Newson, C. Packman, W. J. Browne, S. Harris, G. Jones, and E. Stone. 2016. Mitigating the impact of bats in historic churches: The response of Natterer's bats *Myotis nattereri* to artificial roosts and deterrence. Plos ONE, 11(1): 1–23. [gareth.jones@bristol.ac.uk]

DISTRIBUTION/FAUNAL STUDIES

Alonso Durán, A., and S. Canchila Pérez. 2015. Ensamblaje de murciélagos (Mammalia: Chiroptera) en dos zonas del Departamento de Sucre, Colombia. Acta Zoológica Mexicana, 31(3): 358–366. [adurandelaossa@gmail.com]

Al-Sheikhly, O. F., M. K. Haba, T. Görfö, and G. Csorba. 2016. First confirmed records of two bat species for Iraq: *Rhinolophus euryale* and *Myotis emarginatus* (Chiroptera). Mammalia: International Journal of The Systematics, Biology & Ecology Of Mammals, 80(1): 111–115. [Csorba: csorba@nhmus.hu]

Deshpande, K., M. Gangal, and N. Kelkar. 2016. First record of a bat from the Lakshadweep archipelago, southwestern India. Mammalia: International Journal of the Systematics, Biology & Ecology of Mammals, 80(2): 223–225. [Deshpande: kvd.novel@gmail.com]

Herkt, K. B., G. Barnikel, A. K. Skidmore, and J. Fahr. 2016. A high-resolution model of bat diversity and endemism for continental Africa. Ecological Modelling, 320: 9–28. [matthias.herkt@gmail.com]

ECHOLOCATION

Alonso, J. B., A. Henríquez, P. Henríquez, B. Rodríguez-Herrera, F. Bolaños, P. Alpízar, C. M. Travieso, and J. Cabrera. 2015. Advance in the bat acoustic identification systems based on the audible spectrum using nonlinear dynamics characterization. Expert Systems with Applications, 42(24): 9528–9538. [jalonso@dsc.ulpgc.es]

Gillam, E. H., and B. K. Montero. 2016. Influence of call structure on the jamming avoidance response of echolocating bats. Journal of Mammalogy, 97(1): 14–22. [Erin.Gillam@ndsu.edu]

Gilani, U. S., and R. Müller. 2016. An assessment of the direction-finding accuracy of bat biosonar beam pattern. Journal of the Acoustical Society of America, 139(2): 569–580. [Müller: rolf.mueller@vt.edu]

Rodenas-Cuadrado, P., X. Sylvia Chen, L. Wiegrebe, U. Firzlaff, and S. C. Vernes. 2015. A novel approach identifies the first transcriptome networks in bats: a new genetic model for vocal communication. BMC Genomics, 16: 1–18. [Vernes: Sonja.Vernes@mpi.nl]

ECOLOGY

Banskar, S., D. T. Mourya, and Y. S. Shouche. 2016. Bacterial diversity indicates dietary overlap among bats of different feeding habits. Microbiological Research, 182: 99–108. [Shouche : yogesh@nccs.res.in]

Dejean, A., S. Groc, B. Hérault, H. Rodriguez-Pérez, A. Touchard, R. Céréghino, R., J. H. C. Delabie, and B. Corbara. 2015. Bat aggregation mediates the functional structure of ant assemblages. Comptes Rendus Biologies, 338(10): 688–695. [alain.dejean@wanadoo.fr]

Goodman, S. M., S. V. Razakaratrimo, and L. D. Roland. 2016. An analysis of Bat Hawk *Macheiramphus alcinus* diet in the Melaky Region of lowland western Madagascar. Ostrich: The Journal of African Ornithology, 87(1): 77–80. [Goodman: sgoodman@fieldmuseum.org]

Hulgard, K., C. F. Moss, L. Jakobsen, and A. Surlykke. 2016. Big brown bats (*Eptesicus fuscus*) emit intense search calls and fly in stereotyped flight paths as they forage in the wild. Journal of Experimental Biology, 219(3): 334–340. [Hulgard: khulgard@biology.sdu.dk]

Milchev, B. 2015. Diet of Barn Owl *Tyto alba* in central south Bulgaria as influenced by landscape structure. Turkish Journal of Zoology, 39(5): 933–940. [boyan.m@abv.bg]

Stewart, A. B., and M. R. Dudash. 2016. Differential pollen placement on an Old World nectar bat increases pollination efficiency. Annals of Botany, 117(1): 145–152. [Stewart: aly55a@umd.edu]

EVOLUTION

Shi, H., J. Dong, D. M. Irwin, S. Zhang, and X. Mao. 2016. Repetitive transpositions of mitochondrial DNA sequences to the nucleus during the radiation of horseshoe bats (*Rhinolophus*, Chiroptera). Gene, 581(2): 161–169.

FLIGHT

Swartz, S., and N. Konow. 2015. Advances in the study of bat flight: the wing and the wind. Canadian Journal of Zoology, 93(12): 977–990. [Department of Ecology and Evolutionary Biology, Brown University, Providence, RI 02912, USA.]

GENETICS

Chattopadhyay, B., K. M. Garg, A. K. Vinoth Kumar, D. P. Swami Doss, F. E. Rheindt, S. Kandula, and U. Ramakrishnan. 2016. Genome-wide data reveal cryptic diversity and genetic introgression in an Oriental cynopterine fruit bat radiation. BMC Evolutionary Biology, 16: 1–15. [balaji.chattopadhyay@gmail.com]

Naidoo, T., M. C. Schoeman, S. M. Goodman, P. J. Taylor, and J. M. Lamb. 2016. Discordance between mitochondrial and nuclear genetic structure in the bat *Chaerephon pumilus* (Chiroptera: Molossidae) from southern Africa. Mammalian Biology, 81(2): 115–122. [Naidoo: theshnien@gmail.com]

PARASITOLOGY

Biazus, A., D. Dezen, L. Barros, J. Garcia, L. Portella., F. Vogel., D. Olsson, T. Bogoni, K. Prior, O. Bordignon, J. Favero, and A. Silva. 2016. Antibodies against *Toxoplasma gondii* in bats (*Desmodus rotundus*) captured near caves in cities from western region of Santa Catarina State, Brazil. Comparative Clinical Pathology, 25(2): 505–507. [Silva*:* aleksandro_ss@yahoo.com.br]

Dietrich, M., K. Mühldorfer, P. Tortosa, and W. Markotter. 2015. Leptospira and Bats: Story of an Emerging Friendship. Plos Pathogens, 11(10), 1–6. doi:10.1371/journal.ppat.1005176 [muriel.dietrich@gmail.com]

Leulmi, H., A. Aouadi, I. Bitam, A. Bessas, A. Benakhla, D. Raoult, and P. Parola. 2016. Detection of *Bartonella tamiae*, *Coxiella burnetii* and rickettsiae in arthropods and tissues from wild and domestic animals in northeastern Algeria. Parasites & Vectors, 9: 1–8. [Parola: philippe.parola@univ-amu.fr]

Lourenço, E. C., P. P. Patrício, and K. M. Famadas. 2016. Community components of spinturnicid mites (Acari: Mesostigmata) parasitizing bats (Chiroptera) in the Tinguá Biological Reserve of Atlantic Forest of Brazil. International Journal of Acarology, 42(2): 63–69. [Department of Ecology, University do Estado do Rio de Janeiro, Rio de Janeiro, Brazil]

Muñoz-Leal, S., A. Eriksson, C. F. Santos, E. Fischer, J. Cardoso de Almeida, H. R. Luz, and M. B. Labruna. 2016. Ticks infesting bats (Mammalia: Chiroptera) in the Brazilian Pantanal. Experimental and Applied Acarology, 68: 1–13.

Ramasindrazana, B., K. Dellagi, E. Lagadec, M. Randrianarivelojosia, S. M. Goodman, and P. Tortosa. 2016. Diversity, host specialization, and geographic structure of filarial nematodes infecting Malagasy bats. Plos ONE, 11(1): 1–18. [ramasindrazana@gmail.com]

PALEONTOLOGY

Hand, S., B. Sigé, M. Archer, G. Gunnell, and N. Simmons. 2015. A new Early Eocene (Ypresian) bat from Pourcy, Paris Basin, France, with comments on patterns of diversity in the earliest chiropterans. Journal of Mammalian Evolution, 22(3): 343–354. [s.hand@unsw.edu.au]

PHYSIOLOGY/ENERGETICS

Rodríguez-Herrera, B., L. Víquez-R., E. Cordero-Schmidt, J. M. Sandoval, and A. Rodríguez-Durán. 2016. Energetics of tent roosting in bats: the case of *Ectophylla alba* and *Uroderma bilobatum* (Chiroptera: Phyllostomidae). Journal of Mammalogy, 97(1): 246–252. [bernal.rodriguez@ucr.ac.cr]

PUBLIC HEALTH

Ben, H., G. Xingyi, W. Lin-Fa, and S. Zhengli. 2015. Bat origin of human coronaviruses. Virology Journal, 12: 1–10. [zlshi@wh.iov.cn]

Benedict, K., and R. K. Mody. 2016. Epidemiology of histoplasmosis outbreaks, United States, 1938–2013. Emerging Infectious Diseases, 22(3): 370–378. [Benedict: jsy8@cdc.gov]

REPRODUCTION

Hayes, M. A., and R. A. Adams. 2015. Maternity roost selection by Fringed Myotis in Colorado. Western North American Naturalist, 75(4): 460–473. [hayesm@usgs.gov]

Ramírez Hernández, G., and M. L. G. Herrera. 2016. Allocation of endogenous nutrients for reproduction in the lesser long-nosed bat (*Leptonycteris yerbabuenae*) in central Mexico. Journal of Mammalogy, 97(1): 23–31. [gherrera@ib.unam.mx]

TAXONOMY/SYSTEMATICS/ PHYLOGENETICS

Dool, S. E., S. J. Puechmaille, N. M. Foley, B. Allegrini, A. Bastian, G. L. Mutumi, T. G. Maluleke, L. J. Odendaal, E. C. Teeling, and D. S. Jacobs. 2016. Nuclear introns outperform mitochondrial DNA in inter-specific phylogenetic reconstruction: Lessons from horseshoe bats (Rhinolophidae: Chiroptera). Molecular Phylogenetics and Evolution, 97: 196–212.

Moras, L. M., A. M. e Gomes, and V. da Cunha Tavares. 2015. Distribution and taxonomy of the common big-eared bat *Micronycteris microtis* (Chiroptera: Phyllostomidae) in South America. Mammalia: International Journal of The Systematics, Biology & Ecology of Mammals, 79(4): 439–447. [ligimoras@yahoo.com.br]

TECHNIQUES FOR STUDY

Goodenough, A. E., L. Deans, L.Whiteley, and S. Pickering. 2015. Later is Better: Optimal Timing for Walked Activity Surveys for a European Bat Guild. Wildlife Biology, 21(6): 323–328. [aegoodenough@glos.ac.uk]

Pollock, T., C. R. Moreno, L. Sánchez, A. Ceballos-Vasquez, P. A. Faure, and E. C. Mora. 2016. Wound healing in the flight membranes of wild big brown bats. The Journal of Wildlife Management, 80(1): 19–26. [polloctj@mcmaster.ca]

Sánchez, C. A., and M. L. Baker. 2016. Disease risk perception and safety practices: A survey of Australian flying fox rehabilitators. Plos Neglected Tropical

Diseases, 10(2): 1–15. [cecilia.sanchez@aya.yale.edu]

VIROLOGY

De Thoisy, B., H. Bourhy, M. Delaval, D. Pontier, L. Dacheux, E. Darcissac, D. Donato, A. Guidez, F. Larrous, R. Lavenir, A. Salmier, V. Lacoste, and A. Lavergne. 2016. Bioecological drivers of rabies virus circulation in a Neotropical bat community. Plos Neglected Tropical Diseases, 10(1): 1–21. [bdethoisy@pasteur-cayenne.fr]

Goffard, A., C. Demanche, L. Arthur, C. Pinçon, J. Michaux, and J. Dubuisson, J. 2015. Alphacoronaviruses detected in French bats are phylogeographically linked to coronaviruses of European bats. Viruses, 7(12): 6279–6290. [anne.goffard@univ-lille2.fr]

Maruyama, J., N. Nao, H. Miyamoto, K. Maeda, H. Ogawa, R. Yoshida, M. Igarashi, and A. Takada. 2016. Characterization of the glycoproteins of bat-derived influenza viruses. Virology, 488: 43–50. [atakada@czc.hokudai.ac.jp]

Paweska, J. T., N. Storm, A. A. Grobbelaar, W. Markotter, A. Kemp, and P. J. van Vuren. 2016. Experimental inoculation of Egyptian fruit bats (*Rousettus aegyptiacus*) with Ebola virus. Viruses, 8(2): 1–11. [Paweska: januszp@nicd.ac.za]

WHITE-NOSE SYNDROME

Lučan, R. K., H. Bandouchova, T. Bartonička, J. Pikula, A. Zahradníková Jr., J. Zukal, and N. Martínková. 2016. Ectoparasites may serve as vectors for the white-nose syndrome fungus. Parasites & Vectors, 9: 1–5. [radek.lucan@natur.cuni.cz]

Vanderwolf, K. J., D. Malloch, and D. F. McAlpine. 2016. Fungi on white-nose infected bats (Myotis spp.) in Eastern Canada show no decline in diversity associated with *Pseudogymnoascus destructans* (Ascomycota: Pseudeurotiaceae). International Journal of Speleology, 45(1): 43–50. [kjvanderw@gmail.com]

Zukal, J., H. Berková, and J. Madaraszová,. 2016. Flying or sleeping: flight activity of bats in natural cave with confirmed WNS. Folia Zoologica, 65(1): 46–51. [zukal@ivb.cz]

ANNOUNCEMENTS

Reminder—Renewal Time!

Just a reminder that some of you have or will be receiving renewal information in the inbox of your e-mail soon. I hope you will continue to support *BRN* for the 2016 volume-year. Regardless, all of us at *Bat Research News* wish you a safe and happy 2016!

Request for News

Please consider submitting news from your lab group, your field work, or any bat-related news. Also please consider submitting short articles, notes, or letters on a bat-related topic (see below). Thank you in advance for considering us as a place for bat, bat worker, and bat lab news items.

Request for Manuscripts — *Bat Research News*

Original research/speculative review articles, short to moderate length, on a bat-related topic would be most welcomed. Please submit manuscripts as .rtf documents to Allen Kurta, Editor for Feature Articles (akurta@emich.edu). If you have questions, please contact Al. Thank you for considering submitting your work to *BRN*.

Change of Address Requested

Will you be moving in the near future? If so, please **send** your **new postal and e-mail addresses** to Margaret Griffiths (margaret.griffiths01@gmail.com), and include the date on which the change will become effective. Thank you in advance for helping us out!

FUTURE MEETINGS and EVENTS

2016

The Maine Bat Working Group (MEBWG) will be hosting Maine's first International Bat Research Symposium at Acadia National Park's Schoodic Institute in Winter Harbor, Maine, April 26–27, 2016. Please send questions to mainebatworkinggroup@gmail.com, and see: https://goo.gl/LA5dQP for registration information.

The 17th International Bat Research Conference will be held in Durban, South Africa, July 31–August 5th, 2016. Please see: http://www.eurobats.org/bat_news/17th_international_bat_research_conference_2016 for more information.

The 46th Annual NASBR will be held October 12–15, 2016, in San Antonio, Texas. See the NASBR website for future updates — http://www.nasbr.org/.

2017

The 47th Annual NASBR will be held in Knoxville, Tennessee, dates to be determined. Check the NASBR website for future updates — http://www.nasbr.org/.

BAT RESEARCH NEWS

VOLUME 57: NO. 2 SUMMER 2016

BAT RESEARCH NEWS

VOLUME 57: NUMBER 2 **SUMMER 2016**

Table of Contents

Front Cover

A hairy-legged vampire (*Diphylla ecaudata*) taking blood from the toe of a keel-billed toucan (*Ramphastos sulfuratus*)—see page 11 of this issue. Photo by G. Granados.

BAT RESEARCH NEWS

Volume 57: Number 2 Summer 2016

Publisher and Managing Editor: Dr. Margaret A. Griffiths, 8594 Berwick Circle, Bloomington, IL 61705; E-mail: margaret.griffiths01@gmail.com

Editor for Feature Articles: Dr. Allen Kurta, Dept. of Biology, Eastern Michigan University, Ypsilanti, MI 48197; E-mail: akurta@emich.edu

Editor for Recent Literature: Dr. Thomas A. Griffiths, 8594 Berwick Circle, Bloomington, IL 61705; E-mail: thomas.alan.griffiths@gmail.com

Emeritus Editor: Dr. G. Roy Horst

Bat Research News is published four times each year, consisting of one volume of four issues. *Bat Research News* publishes short feature articles and general interest notes that are reviewed by at least two scholars in that field. *Bat Research News* also includes abstracts of presentations at bat conferences around the world, letters to the editors, news submitted by our readers, notices and requests, and announcements of future bat conferences worldwide. In addition, *Bat Research News* provides a listing of recent bat-related articles that were published in English. *Bat Research News* is abstracted in several databases (e.g., BIOSIS).

Communications concerning feature articles and "Letters to the Editor" should be addressed to Dr. Al Kurta (akurta@emich.edu), recent literature items to Dr. Tom Griffiths (thomas.alan.griffiths@gmail.com), and all other correspondence (e.g., news, conservation, or education items; subscription information; cover art) to Dr. Margaret Griffiths (margaret.griffiths01@gmail.com).

The prices for one volume-year (4 issues within a single volume) are:

Institutional/Group subscriptions	US $50.00
Individual subscriptions:	
printed edition (U.S.A.)	US $25.00
printed edition (outside U.S.A)	US $35.00

Subscriptions may be paid by check or money order, payable to "***Bat Research News***." Please include both mailing (postal) and e-mail addresses with your payment, and send to Dr. Margaret Griffiths at the address listed above. To pay by credit card (Visa or MasterCard only) or for further information, please go to the *Bat Research News* website at http://www.batresearchnews.org/ and click on the "Subscription Information" link.

Back issues of *Bat Research News* are available for a small fee. Please contact Dr. Margaret Griffiths (margaret.griffiths01@gmail.com) for more information regarding back issues. Thank you!

Bat Research News is ISSN # 0005-6227.
Bat Research News is printed and mailed at Illinois Wesleyan University, Bloomington, Illinois, U.S.A.

This issue printed July 5, 2016.

Letters to the Editor

Editor's Note: Unlike technical articles, letters are not peer-reviewed, but they are edited for grammar, style, and clarity. Letters provide an outlet for opinions, speculations, anecdotes, and other interesting observations that, by themselves, may not be sufficient or appropriate for a technical article. Letters should be no longer than two manuscript pages and sent to the Feature Editor.

Field Observations of the Hairy-legged Vampire (*Diphylla ecaudata*) Feeding on a Native Bird in Costa Rica

Gabriel Granados-Madrigal[1] and David Villalobos-Chaves[2]

[1]*Manejo Forestal y Vida Silvestre, Universidad Técnica Nacional sede Atenas, Alajuela, PA 7-4013, Costa Rica, and*
[2]*Escuela de Biología, Universidad de Costa Rica, San José, PA 2060, Costa Rica*
E-mail: gabriel0149@hotmail.com

The hairy-legged vampire, *Diphylla ecaudata* is one of three species of sanguivorous bats in the Neotropics. Although this bat occasionally consumes mammalian blood (i.e., pigs, cattle, equines, humans—Ruschi, 1951, 1953), the hairy-legged vampire seems to prefer avian blood (Hoyt and Altenbach, 1981; Ruschi, 1951; Villa-R. et al., 1969) and has been observed feeding on chickens, turkeys, guinea fowl, ducks, and geese (Ruschi, 1951). Most observations of their feeding habits, though, have been performed in captivity or with domesticated animals, and virtually no information exists concerning the prey and behavior of the hairy-legged vampire in the wild.

On 11 August 2015, while watching nocturnal fauna with the help of a white light, one of the authors (GG) accidentally observed a hairy-legged vampire feeding on the blood of a keel-billed toucan (*Ramphastos sulfuratus*). The bird was sleeping on the branch of a tree (*Trichilia martiana*), 6 m above the ground (Fig. 1), on property located near Rincón de la Vieja National Park, Guanacaste, Costa Rica (10°45' N, 85°20' W).

The area is characterized by the presence of mature forests, forested pastures, and secondary forests and is classified as premontane wet forest (Holdridge, 1987). The bat-bird interaction was observed for about 18 min (2047–2105 h), during which two short videos (48 sec in total) and some still photos were taken; neither animal reacted to the light during the observations.

The vampire apparently used its forearms, thumbs, and hind legs to move on small branches and anchor itself close to its prey. Although this bat has been reported to bite birds in the cloacal region (Ruschi, 1951), the location of this bite was on the third digit of the right foot of the bird. While feeding, the bat was motionless, and only small repeated movements were noted in the abdominal area, perhaps as a result of the ingestion of blood. Three other keel-billed toucans were located in the same tree, but it was unknown whether more than one individual was attacked that night.

This is the first observation of blood consumption in the field by the hairy-legged vampire on a native bird. Large birds, such as a *R. sulfuratus* (ca. 500 g—Stiles and Skutch,

Figure 1. A hairy-legged vampire taking blood from the toe of a keel-billed toucan. (A) Close-up of the bat. (B) Broad view, showing details of the position of both animals. Photos by G. Granados.

2007), are expected to be prey of this vampire, because of the large volume of blood available and because large prey probably are easier to access than smaller ones. Until modern techniques, such as isolation of avian DNA from fecal samples (Carter et al., 2006), become reliable in the identification of birds to low taxonomic levels (e.g., genera or species), information about wild hosts of vampires must come from field observations like this one.

Acknowledgments.—We are grateful to J. Miranda, S. Ponce, and F. Castillo for their help during the field observations. We also appreciate the valuables comments of R. K. LaVal on early versions of this manuscript.

Literature Cited

Carter, G., C. E. Coen, L. M. Stenzler, and I. J. Lovette. 2006. Avian host DNA isolated from the feces of white-winged vampire bats (*Diaemus youngi*). Acta Chiropterologica, 8: 255–274.

Holdridge, L. 1987. Ecología basada en zonas de vida. Instituto Interamericano de Cooperación para la Agricultura, San José, Costa Rica.

Hoyt, R. A., and J. S. Altenbach. 1981. Observations on *Diphylla ecaudata* in captivity. Journal of Mammalogy, 62:215–216.

Ruschi, A. 1951. Morcegos do estado do Espirito Santo. Descripçáo de *Diphylla ecaudata* Spix e algumas observações a seu respeito. Boletim do Museu de Biologia Professor Mello Leitão, 3:1–7.

Ruschi, A. 1953. Dois casos de sanguivorismo de *Desmodus rotundus rotundus* (E. Geoffroy) e *Diphylla ecaudata* Spix, no homen, e óutras observações sobre os quirópteros hematófagos e acidentalmente hematófagos. Boletim do Museu de Biologia Professor Mello Leitão, 13:1–8.

Stiles, G. F., and A. F. Skutch. 2007. Guía de aves de Costa Rica. 4th ed. Instituto Nacional de Biodiversidad, Santo Domingo, Heredia, Costa Rica.

Villa-R., B., N. Morales da Silva, and B. Villa Cornejo. 1969. Estudio del contenido estomacal de los murciélagos hematófagos *Desmodus rotundus rotundus* (Geoffroy) y *Diphylla ecaudata*

ecaudata Spix (Phyllostomatidae: Desmodinae). Anales Instituto Biología Universidad National Autónoma de México, Série Zoología, 40:291–298.

Letters to the Editor

Editor's Note: Unlike technical articles, letters are not peer-reviewed, but they are edited for grammar, style, and clarity. Letters provide an outlet for opinions, speculations, anecdotes, and other interesting observations that, by themselves, may not be sufficient or appropriate for a technical article. Letters should be no longer than two manuscript pages and sent to the Feature Editor.

Roosting by Townsend's Big-eared Bats (*Corynorhinus townsendii*) and Yuma Myotis (*Myotis yumanensis*) inside a Metal Pipe

Greg Tatarian

Wildlife Research Associates, 1119 Burbank Ave., Santa Rosa, California 95407
E-mail: gregbat@wildliferesearchassoc.com

Townsend's big-eared bat (*Corynorhinus townsendii*) roosts primarily in open spaces within mines, buildings, bridges, tunnels, and hollow trees (Fellers and Pierson, 2002; Keeley and Tuttle, 1998; Pierson and Rainey, 1998; Kunz and Martin, 1982). Yuma myotis (*Myotis yumanensis*), in contrast, typically are found in crevices or small cavities but also use larger openings in caves, hollow trees, buildings, bridges, culverts, and bat houses (Adams, 2003; Barbour and Davis, 1969; Betts, 1997; Pierson and Rainey, 1998). However, the author recently detected both *C. townsendii* and *M. yumanensis* roosting inside a large, smooth-walled, metal pipe associated with the Hetch Hetchy Water System, in Tuolumne County, California (Fig. 1). The pipe began at the wall of a forebay and extended ca. 560 m, partially underground, to where it joined a smaller pipe that eventually exited below the surface of the reservoir.

On 23 July 2014, the author observed a single *C. townsendii* flying inside the 150-cm-diameter pipe, near the opening to the forebay. On 13 August 2014, 12 *C. townsendii* exited the pipe, and six of those were caught in a harp trap. The captured individuals included two lactating/ postlactating females, one post-reproductive adult male, and one juvenile non-reproductive male; the other two *C. townsendii*, however, were released immediately, without further data collection, due to restrictions established by the California Department of Fish and Wildlife. In addition to the *C. townsendii*, 14 Yuma myotis were trapped exiting the pipe—12 lactating/postlactating females, one post-reproductive adult male, and one juvenile male. An additional 10–12 *Myotis*, presumably *M. yumanensis*, were observed flying from the forebay into the pipe but were not caught.

Subsequent examination of the interior of the pipe showed that it was assembled in sections with telescoping ends, slipped together and riveted, and that several vertical standpipes intersected the ceiling and provided limited ventilation. Potential sites where bats might grasp the surface of the pipe included patches of rust, the edges of the joined sections, and the interior of the standpipes. Fecal pellets were observed in several locations within the pipe, with obvious concentrations below each visible joint. The capture of reproductive females of both *C. townsendii* and *M. yumanensis* indicates that this pipe was serving as a novel maternity roost for both species.

Figure 1. Top) Metal pipe joining wall of forebay. Bottom) Interior view of pipe used for roosting by reproductive *Corynorhinus townsendii* and *Myotis yumanensis*.

Literature Cited

Adams, R. A. 2003. Bats of the Rocky Mountain West: Natural history, ecology, and conservation. University Press of Colorado, Boulder, Colorado.

Barbour, R. W., and W. H. Davis. 1969. Bats of America. University Press of Kentucky, Lexington, Kentucky.

Betts, B. J. 1997. Microclimate in Hell's Canyon mines used by maternity colonies of *Myotis yumanensi*s. Journal of Mammalogy, 78:1240–1250.

Fellers, G., and E. Pierson. 2002. Habitat use and foraging behavior of Townsend's big-eared bat (*Corynorhinus townsendii*) in coastal California. Journal of Mammalogy, 83:167–177.

Keeley, B. W., and M. D. Tuttle. 1998. Bats in American bridges. Bat Conservation International, Resource Publication, 4:1–40.

Kunz, T. H., and R. A. Martin. 1982. *Plecotus townsendii*. Mammalian Species, 175:1–6.

Pierson, E. D., and W. E. Rainey. 1998. The distribution, status and management of Townsend's big-eared bat (*Corynorhinus townsendii*) in California. Unpublished report. California Department of Fish and Game, Bird and Mammal Conservation Program. URL: http://dfg.ca.gov/wildlife/nongame/publications/bm_research/docs/96_07.pdf (accessed 6 June, 2016).

RECENT LITERATURE

Authors are requested to send reprints (PDF files) of their published papers to the Editor for Recent Literature, **Dr. Thomas A. Griffiths**, (e-mail: **thomas.alan.griffiths@gmail.com**) for inclusion in this section. Receipt of reprints is preferred, as it will facilitate complete and correct citation. However, if reprints and/or PDF files are unavailable, please send a complete citation (including complete name of journal and corresponding author mailing address) by e-mail. The Recent Literature section is based on several bibliographic sources and for obvious reasons can never be up-to-date. Any error or omission is inadvertent. Voluntary contributions for this section, especially from researchers outside the United States, are most welcome and appreciated.

BEHAVIOR

Doss, D. P. S., V. Nagarajan-Radha, and S. Kandula. 2016. Daily and seasonal variation in non-acoustic communicative behaviors of male greater short-nosed fruit bats (*Cynopterus sphinx*). Acta Chiropterologica, 18(1): 199–207. [chiropteranethology@gmail.com]

Murphy, M., E. L. Clare, J. Rydell, Y. Yovel, Y. Bar-On, P. Oelbaum, and M. B. Fenton. 2016. Opportunistic use of banana flower bracts by *Glossophaga soricina*. Acta Chiropterologica, 18(1): 209–213. [mmurp5@uwo.ca]

CONSERVATION

Hammond, K. R., J. M. O'Keefe, S. P. Aldrich, and S. C. Loeb. 2016. A presence-only model of suitable roosting habitat for the endangered Indiana bat in the southern Appalachians. PLoS ONE, 11(4): e0154464. doi:10.1371/journal.pone.0154464 [joyokeefe@gmail.com]

Hooton, L.A., Y. A. Dzai, N. Veselka, and M. B. Fenton. 2016. Polychlorinated biphenyls (PCBs): impact on bat activity and foraging behaviour along the upper Hudson River, New York. Canadian Journal of Zoology, 94(3): 217–223. [lhooton@normandeau.com]

Jachowski, D. S., C. T. Rota, C. A. Dobony, W. M. Ford, and J. W. Edwards. 2016. Seeing the forest through the trees: considering roost-site selection at multiple spatial scales. PLoS ONE, 11(3): e0150011. doi:10.1371/journal.pone.0150011 [djachowski@gmail.com]

Rowse, E. G., S. Harris, and G. Jones. 2016. The switch from low-pressure sodium to light emitting diodes does not affect bat activity at street lights. PLoS ONE, 11(3): e0150884. doi:10.1371/journal.pone.0150884 [liz.rowse@bristol.ac.uk]

Rueegger, N. 2016. Bat boxes — a review of their use and application, past, present and future. Acta Chiropterogica, 18(1): 279–299. [niels_ruegger@hotmail.com]

DISTRIBUTION/FAUNAL STUDIES

Alurralde, S. G., M. F. L. Berrizbeltia, R. M. Barquez, and M. M. Diaz. 2016. Diversity and richness of small mammals at a well-conserved site of The Yungas in Jujuy Province Argentina. Mammalia, 80(3): 253–262. [santigamboaalurralde@gmail.com]

Beck, J. D., A. D. Loftis, J. L. Daly, W. K. Reeves, and M. V. Orlova. 2016. First record of *Chiroderma improvisum* Baker & Genoways, 1976 (Chiroptera: Phyllostomidae) from Saint Kitts, Lesser Antilles. The Journal of Biodiversity Data, (Luís Felipe Toledo) (1809-127X),

12(2), publication 1854:1–4. [will.reeves@us.af.mil]

Deshpande, K., M. Gangal, and N. Kelkar. 2016. First record of a bat from the Lakshadweep archipelago southwestern India. Mammalia, 80(2): 223–225. [kvd.novel@gmail.com]

Núñez-Novas, M. S., M. L.Yolanda, J. Mateo, and L. M. Dávalos. 2016. Records of the cave-dwelling bats (Mammalia: Chiroptera) of Hispaniola with an examination of seasonal variation in diversity. Acta Chiropterologica, 18(1): 269–278. [m.nunez@mnhn.gov.do]

Shapiro, J. T., and A. Monadjem. 2016. Two new bat species for Swaziland and a revised list for the country. Mammalia, 80(3): 353–357. [julie.teresa.shapiro@gmail.com]

Tsang, S. M., S. Wiantoro, and N. B. Simmons. 2015. New records of flying foxes (Chiroptera, Pteropus sp.) from Seram, Indonesia, with notes on ecology and conservation status. American Museum Novitates, No. 3842, 1–23. [All issues of *Novitates* and *Bulletin* are available on the web (http://digitallibrary.amnh.org/dspace).]

Varzinczak, L. H., I. P. Bernardi, and F. C. Passos. 2016. Null model analysis on bat species co-occurrence and nestedness patterns in a region of the Atlantic Rainforest, Brazil. Mammalia, 80 (2): 171–179. [luiz.varzinczak@gmail.com]

White, J. A., C. A. Lemen, and P. W. Freeman. 2016. Acoustic detection reveals fine-scale distributions of *Myotis lucifugus*, *Myotis septentrionalis*, and *Perimyotis subflavus* in eastern Nebraska. Western North American Naturalist, 76(1): 27–35. [jeremywhite@unomaha.edu]

ECHOLOCATION

Chen, Y., Q. Liu, Q. Su, Y. Sun, X. Peng, X. He, and L. Zhang. 2016. 'Compromise' in echolocation calls between different colonies of the intermediate leaf-nosed bat (*Hipposideros larvatus*). PLoS ONE, 11(3): e0151382. doi:10.1371/journal.pone.0151382 [zhanglb@gdei.gd.cn]

Fujita, K., and Y. Kashimori. 2016. Neural mechanism of corticofugal modulation of tuning property in frequency domain of bat's auditory system. Neural Processing Letters, 43(2): 537–551. [kazu@spikingneuron.net]

Luszcz, T. M. J., and R. M. R. Barclay. 2016. Influence of forest composition and age on habitat use by bats in southwestern British Columbia. Canadian Journal of Zoology, 94: 145–153. [tanya.luszcz@canada.ca OR tluszcz@yahoo.com]

Luszcz, T. M. J., J. M. K. Rip, K. J. Patriquin, L. M. Hollis, J. M. Wilson, H. D. M. Clarke, J. Zinck, and R. M. R. Barclay. 2016. A blind-test comparison of the reliability of using external morphology and echolocation-call structure to differentiate between the Little Brown Bat (*Myotis lucifugus*) and Yuma Myotis (*Myotis yumanensis*). Northwestern Naturalist: A Journal of Vertebrate Biology, 97(1): 13–23. [tanya.luszcz@canada.ca]

Warnecke, M., W. J. Lee, A. Krishnan, and C. F. Moss. 2016. Dynamic echo Information guides flight in the Big Brown Bat. Frontiers in Behavioral Neuroscience, 10 (81): 1–11. [warnecke@jhu.edu]

ECOLOGY

Bustamante, E., A. Burquez, E. Scheinvar, and L. E. Eguiarte. 2016. Population genetic structure of a widespread bat-pollinated columnar cactus. PLoS ONE, 11(3): e0152329. doi:10.1371/journal.pone.0152329

[ebustamante@ecologia.unam.mx]

De La Cruz, J. L., and R. L. Ward. 2016. Summer-habitat suitability modeling of *Myotis sodalist* (Indiana bat) in the eastern mountains of West Virginia. Northeastern Naturalist, 23(1): 100–117. [jesse@allstarecology.com]

Downs, N. C., W. J. Cresswell, P. Reason, G. Sutton, D. Wells, L. Williams, and S. Wray. 2016. Activity patterns and use of night roosts by lesser horseshoe bats *Rhinolophus hipposideros* (Borkhausen, 1797). Acta Chiropterologica, 18(1): 223–237. [nick.downs@arcadis.com]

Froidevaux, J. S. P., F. Zellweger, K. Bollmann, G. Jones, and M. K. Obrist. 2016. From field surveys to LiDAR: shining a light on how bats respond to forest structure. Remote Sensing of Environment, 175: 242–250. [jf14883@bristol.ac.uk]

Ganesh, A., M. Mukilan, G. Marimuthu, and K. E. Rajan. 2016. A novel food preference in the greater short-nosed fruit bat, *Cynopterus sphinx*: mother-pup interaction a strategy for learning. Acta Chiropterologica, 18(1): 193–198. [emmanuvel1972@yahoo.com]

Lučan, R. K., T. Bartonička, P. Jedlička, Š. Řeřucha, M. Šálek, M. Čížek, H. Nicolaou, and I. Horáček. 2016. Spatial activity and feeding ecology of the endangered northern population of the Egyptian fruit bat (*Rousettus aegyptiacus*). Journal of Mammalogy, 97(3): 815–822. [radek.lucan@natur.cuni.cz]

Maxinová, E., M. Kipson, L. Naďo, P. Hradická, and M. Uhrin. 2016. Foraging strategy of Kuhl's pipistrelle at the northern edge of the species distribution. Acta Chiropterologica, 18(1): 215–222. [edita.maxinova@gmail.com]

Nkrumah, E. E., P. Vallo, S. M. Klose, S. Ripperger, E. K. Badu, C. Drosten, E. K. V. Kalko, M. Tschapka, and S. K. Oppong. 2016. Home range of Noack's round-leaf bat (*Hipposideros* aff. *ruber*) in an agricultural landscape of central Ghana. Acta Chiropterologica, 18(1): 239–247. [kobbyoppong@yahoo.com]

Reuter, K. E., A. R. Wills, R. W. Lee, E. E. Cordes, and B. J. Sewall. 2016. Using stable isotopes to infer the impacts of habitat change on diets and vertical stratification of frugivorous bats in Madagascar. PLoS ONE, 11(4): e0153192. doi:10.1371/journal.pone.0153192 [kimeleanorreuter@gmail.com]

Segura-Trujillo, C. A., W. Z. Lidicker, Jr., and S. T. Álvarez-Castañeda. 2016. New perspectives on trophic guilds of arthropodivorous bats in North and Central America. Journal of Mammalogy 97(2): 644–654. [sticul@cibnor.mx]

Tillon, L., K. Bresso, and S. Aulagnier. 2016. Tree selection by roosting bats in a European temperate lowland sub-Atlantic forest. Mammalia, 80(3): 271–279. [laurent.tillon@onf.fr]

Van Den Bussche, R. A., D. N. Lee, M. E. Judkins, J. E. Dyer, D. M. Thompson, R. C. Stark, W. L. Puckette, and B. Fuller. 2016. Molecular dietary analysis of the endangered Ozark big-eared bat (*Corynorhinus townsendii ingens*). Acta Chiropterologica: 18(1): 181–191. [ron.van_den_bussche@okstate.edu]

Villalobos-Chaves, D., S. Padilla-Alvárez, and B. Rodríguez-Herrera. 2016. Seed predation by the wrinkle-faced bat *Centurio*

senex: a new case of this unusual feeding strategy in Chiroptera. Journal of Mammalogy, 97(3): 726-733. [david.villaloboschaves@ucr.ac.cr]

EVOLUTION

Flanders, J., M. Inque-Murayama, S. J. Rossiter, and D. A. Hill. 2016. Female philopatry and limited male-biased dispersal in the Ussuri tube-nosed bat, *Murina ussuriensis*. Journal of Mammalogy, 97(2): 545–553. [Jon.Flanders@bristol.ac.uk]

FLIGHT

Alexander, D. E. 2015. On the Wing: Insects, Pterosaurs, Birds, Bats and the Evolution of Animal Flight. Oxford University Press, Oxford, UK. 224 pages, 43 illustrations. [BOOK] ISBN: 978-0-1999-9677-3.

GENETICS

Eckalbar, W., S. A. Schlebusch, M. K. Mason, Z. Gill, A. V. Parker, B. M. Booker, S. Nishizaki, C. Muswamba-Nday, E. Terhune, K. A. Nevonen, N. Makki, T. Friedrich, J. E. VanderMeer, K. S. Pollard, L. Carbone, J. D. Wall, N. Illing, and N. Ahituv. 2016. Transcriptomic and epigenomic characterization of the developing bat wing. Nature Genetics, 48(5): 528–536. [Nicola.illing@uct.ac.za]

Jiang, J.-J., S.-Q. Wang, Y.-J. Li, W. Zhang, A.-G. Yin, and M. Hu. 2016. The complete mitochondrial genome of insect-eating Brandt's bat, *Myotis brandtii* (*Myotis*, Vespertilionidae). Mitochondrial DNA, 27(2): 1403–1404. [Hu: Humin999@aliyun.com]

Wang, S.-Q., Y.-J. Li, A.-G. Yin, W. Zhang, J.-J. Jiang, W.-L. Wang, and M. Hu. 2016. The complete mitochondrial genome of David's myotis, *Myotis davidii* (*Myotis*, Vespertilionidae). Mitochondrial DNA, 27(3): 1587–1588. [Hu: Humin999@aliyun.com]

MORPHOLOGY

Ospina-Garcés, S. M., E. De Luna, L. G. Herrera M., and J. J. Flores-Martínez. 2016. Cranial shape and diet variation in *Myotis* species (Chiroptera: Vespertilionidae): testing the relationship between form and function. Acta Chiropterologica, 18(1): 163–180. [ospinagarcess@gmail.com]

PARASITOLOGY

Hernandez-Arciga, U., L. G. Herrera M., and J. B. Morales-Malacara. 2016. Tracking host use by bat ectoparasites with stable isotope analysis. Canadian Journal of Zoology, 94(5): 353–360. [gherrera@ib.unam.mx]

Patrício, P. M. P., E. C. Lourenço, A. Q. de Freitas, and K. M. Famadas. 2016. Host morphophysiological conditions and environment abiotic factors correlate with bat flies (Streblidae) prevalence and intensity in *Artibeus* Leach, 1821 (Phyllostomidae). Ciência Rural, 46 (4): 648–653. [Priscilla: patricio@hotmail.com]

Shapiro, J. T., E. Barbier, and A. Monadjem. 2016. First record of Streblidae, *Raymondia alulata* Speiser, 1908 (Diptera: Streblidae), in Swaziland and a review of the genus *Raymondia* and their hosts in Africa. Acta Chiropterologica, 18(1): 249–268. [Julie.teresa.shapiro@gmail.com]

PALEONTOLOGY

Goodman, S. M., M. C. Schoeman, A. Rakotoarivelo, and S. Willows-Munro. 2016. How many species of *Hipposideros* have occurred on Madagascar since the Late Pleistocene? Zoological Journal of the Linnaean Society, 177(2): 428–449. [sgoodman@fieldmuseum.org]

Simmons, N.B., E. R. Seiffert, and G. F. Gunnell. 2016. A new family of large omnivorous bats (Mammalia, Chiroptera) from the late Eocene of the Fayum Depression, Egypt, with comments on use of the name "Eochiroptera." American Museum Novitates, No. 3857, 1–43. [All issues of *Novitates* and *Bulletin* are available on the web (http://digitallibrary.amnh.org/dspace).]

Ziegler, A. C., F. G. Howarth, and N. B. Simmons. 2016. A second endemic land mammal for the Hawaiian Islands: a new genus and species of fossil bat (Chiroptera, Vespertilionidae). American Museum Novitates, 3854: 1–52. [All issues of *Novitates* and *Bulletin* are available on the web (http://digitallibrary.amnh.org/dspace).]

PHYSIOLOGY/ENERGETICS

Yin, Q., H. Ge, C.-C. Liao, D. Liu, S. Zhang, and Y.-H. Pan. 2016. Antioxidant defenses in the brains of bats during hibernation. PloS ONE, 11(3): e0152135. doi:10.1371/journal.pone.0152135 [yihsuanp@gmail.com]

PUBLIC HEALTH

Liu, H., K. A. McComas, D. E. Buttke, S. Roh, M. A. Wild. 2016. A one-health message about bats increases intentions to follow public health guidance on bat rabies. PLoS ONE, 11(5): e0156205. doi: 10.1371/journal.pone.0156205 [hl896@cornell.edu]

TAXONOMY/SYSTEMATICS/ PHYLOGENETICS

Almeida, F. C., N. P. Giannini, and N. B. Simmons. 2016. The evolutionary history of the African fruit bats (Chiroptera: Pteropodidae). Acta Chiropterologica, 18(2): 73–90. [falmeida@nyu.edu]

Baker, R. J., S. Solari, A. Ciranello, and N. B. Simmons. 2016. Higher level classification of phyllostomid bats with a summary of DNA synapomorphies. Acta Chiropterologica, 18(1): 1–38. [sergio.solari@udea.edu.co]

Cirranello, A., N. B. Simmons, S. Solari, and R. J. Baker. 2016. Morphological diagnoses of higher-level phyllostomid taxa (Chiroptera: Phyllostomidae). Acta Chiropterologica, 16(1): 39–71. [andreacirranello@gmail.com]

Decher, J., A. Hoffmann, J. Schaer, R. Norris, B. Kadjo, J. J. Astrin, A. Monadjem, and R. Hutterer. 2015. Bat diversity in the Simandou Mountain Range of Guinea, with the description of a new white-winged vespertilionid. Acta Chiropterologica, 17(2): 255–282. [JDecher@zfmk.de]

Gager, Y., E. Tarland, D. Lieckfeldt, M. Ménage, F. Botero-Castro, S. J. Rossiter, R. H. S. Kraus, A. Ludwig, and D. K. N. Dechmann. 2016. The value of molecular vs. morphometric and acoustic information for species identification using sympatric molossid bats. PLoS ONE, 11(3): e0150780. doi:10.1371/journal.pone.0150780 [yann.gager@gmail.com]

Gomes, A. J. B., C. Y. Nagamachi, L. R. R. Rodriguez, T. C. M. Benathar, T. F. A. Ribas, P. C. M. O'Brien, F. Yang, M. A. Ferguson-Smith, and J. C. Pieczarka. 2016. Chromosomal phylogeny of vampyressine bats (Chiroptera, Phyllostomidae) with description of two new sex chromosome systems. BMC Evolutionary Biology, 16(1): 1–11. doi: 10.1186/s12862-016-0689-x [juliopieczarka@gmail.com]

Haynie, M. L., M. T. N. Tsuchiya, S. M. Ospina-Garcés, J. Arroyo-Cabrales, R. A. Medellin, O. J. Polaco, and J. E. Maldonado. 2016. Placement of the rediscovered *Myotis planiceps* (Chiroptera: Vespertilionidae)

within the *Myotis* phylogeny. Journal of Mammalogy, 97(3): 701–712. [mhaynie@uco.edu]

López-Wilchis, R., M. Flores-Romero, L. M. Guevara-Chumacero, A. Serrato-Díaz, J. Díaz-Larrea, F. Salgado-Mejia, C. Ibañez, L. O. Salles, and J. Juste. 2016. Evolutionary scenarios associated with the *Pteronotus parnellii* cryptic species-complex (Chiroptera: Mormoopidae). Acta Chiropterologica, 18(1): 91–116. [rlw@xanum.uam.mx]

Ith, S., S. Bumrungsri, N. M. Thomas, P. J. J. Bates, D. A. Willette, F. A. A. Khan, M. Wonglapsuwan, P. Soisook, I. Maryanto, J. C.-C. Huang, and N. M. Furey. 2016. Geographical variation of *Rhinolophus affinis* (Chiroptera: Rhinolophidae) in the Sundaic subregion of Southeast Asia, including the Malay Peninsula, Borneo and Sumatra. Acta Chiropterologica, 18(1): 141–161. [pheaveng@gmail.com]

Soisook, P., S. Karapan, M. Srikrachang, A. Dejtaradol, K. Nualcharoen, S. Bumrungsri, S. S. L. Oo, M. M. Aung, P. J. J. Bates, M. Harutyunyan, M. M. Buś, and W. Bogdanowicz. 2016. Hill forest dweller: a new cryptic species of *Rhinolophus* in the '*pusillus* group' (Chiroptera: Rhinolophidae) from Thailand and Lao PDR. Acta Chiropterologica: 18(1): 117–139. [pipat66@gmail.com]

TECHNIQUES FOR STUDY

Dressler, F., M. Mutschlechner, B. Li, R. Kapitza, S. Ripperger, C. Eibel, B. Herzog, T. Hönig, and W. Schröder-Preikschat 2016. Monitoring bats in the wild: on using erasure codes for energy-efficient wireless sensor networks. ACM Transactions on Sensor Networks, 12(1): doi:10.1145/2875426. [fd@acm.org]

VIROLOGY

Davis, A. D., S. M. D. Morgan, M. Dupuis, C. E. Poulliott, J. A. Jarvis, R. Franchini, A. Clobridge, and R. J. Rudd. 2016. Overwintering of rabies virus in silver-haired bats (*Lasionycteris noctivagans*). PLoS ONE, 11(5): e0155542. doi:10.137/journal.pone.0155542. [april.davis@health.ny.gov]

Hoffmann, M., N. Krüger, P. Zmora, F. Wrensch, G. Herrier, and S. Pöhlmann. 2016. The hemagglutinin of bat-associated Influenza viruses is activated by TMPRSS2 for pH-dependent entry into bat but not human cells. PloS ONE, 11(3): e0152134. doi:10.1371/journal.pone.0152134 [mhoffmann@dpz.eu]

Islam, M. S., H. M. S. Sazzad, S. M. Satter, S. Sultana, M. J. Hossain, M. Hasan, M. Rahman, S. Campbell, D. L. Cannon, U. Stroher, P. Daszak, S. P. Luby, and E. S. Gurly. 2016. Nipah virus transmission from bats to humans associated with drinking traditional liquor made from date palm sap, Bangladesh, 2011-2014. Emerging Infectious Diseases, 22 (4): 664–670. [saiful@icddrb.org]

Katoh, H., T. Kubota, T. Ihara, K. Maeda, M. Takeda, and M. Kidokoro. 2016. Cross-neutralization between human and African bat mumps viruses. Emerging Infectious Diseases, 22(4): 703–706. [mtakeda@nih.go.jp]

Van Vuren, P. J., M. Wiley, G. Palacios, N. Storm, S. McCulloch, W. Markotter, M. Birkhead, A. Kemp, and J. T. Paweska. 2016. Isolation of a novel fusogenic orthoreovirus from *Eucampsipoda africana* bat flies in South Africa. Viruses (1999-4950), 8(3): 1–25. [petrusv@nicd.ac.za]

WHITE-NOSE SYNDROME

Frank, C. L., M. R. Ingala, R. E. Ravenelle, K. Dougherty-Howard, S. O. Wicks, C. Herzog, and R. J. Rudd. 2016. The effects of cutaneous fatty acids on the growth of *Pseudogymnoascus destructans*, the etiological agent of white-nose syndrome (WNS). PLoS ONE, 11(4): e0153535. doi:10.1371/journal.pone.0153635 [frank@fordham.edu]

Lilley, T. M., J. S. Johnson, L. Ruokolainen, E. J. Rogers, C. A. Wilson, S. M. Schell, K. A. Field, and D. M. Reeder. 2016. White-nose syndrome survivors do not exhibit frequent arousals associated with *Pseudogymnoascus destructans* infection. Frontiers in Zoology, 13(12): doi: 10.1186/s12983-016-0143-3. [deeann.reeder@bucknell.edu]

ANNOUNCEMENTS

Reminder—Renewal Payment Due!

Just a reminder that subscription renewals are due. I hope you will continue to support *BRN* for the 2016 volume-year. Regardless, all of us at *Bat Research News* wish you a successful 2016 field season!

Request for News

Please consider submitting news from your lab group, your field work, or any bat-related news. Also please consider submitting short articles, notes, or letters on a bat-related topic (see below). Thank you in advance for considering us as a place for bat, bat worker, and bat lab news items.

Request for Manuscripts — *Bat Research News*

Original research/speculative review articles, short to moderate length, on a bat-related topic would be most welcomed. Please submit manuscripts as .rtf documents to Allen Kurta, Editor for Feature Articles (akurta@emich.edu). If you have questions, please contact Al. Thank you for considering submitting your work to *BRN*.

Change of Address Requested

Will you be moving in the near future? If so, please **send** your **new postal and e-mail addresses** to Margaret Griffiths (margaret.griffiths01@gmail.com), and include the date on which the change will become effective. Thank you in advance for helping us out!

FUTURE MEETINGS and EVENTS

2016

The 17th International Bat Research Conference will be held in Durban, South Africa, July 31–August 5th, 2016. Please see:
http://www.eurobats.org/bat_news/17th_international_bat_research_conference_2016
for more information.

The 46th Annual NASBR will be held October 12–15, 2016, in San Antonio, Texas. See the NASBR website for future updates — http://www.nasbr.org/.

2017

The 47th Annual NASBR will be held in Knoxville, Tennessee, dates to be determined. Check the NASBR website for future updates — http://www.nasbr.org/.

BAT RESEARCH NEWS

VOLUME 57: NO. 3 FALL 2016

BAT RESEARCH NEWS

VOLUME 57: NUMBER 3 **FALL 2016**

Table of Contents

Front Cover

Although not handled and verified, these appear to be a pair of common tent-making bats (*Uroderma bilobatum*) roosting in a modified coconut palm leaf at the Firestone Center for Restoration Ecology in southwestern Costa Rica. Photo by Keith Christenson. Thank you for sharing your photos once again, Keith!

BAT RESEARCH NEWS

Volume 57: Number 3 Fall 2016

Publisher and Managing Editor: Dr. Margaret A. Griffiths, 8594 Berwick Circle, Bloomington, IL 61705; E-mail: margaret.griffiths01@gmail.com

Editor for Feature Articles: Dr. Allen Kurta, Dept. of Biology, Eastern Michigan University, Ypsilanti MI 48197; E-mail: akurta@emich.edu

Editor for Recent Literature: Dr. Thomas A. Griffiths, 8594 Berwick Circle, Bloomington, IL 61705; E-mail: thomas.alan.griffiths@gmail.com

Emeritus Editor: Dr. G. Roy Horst

Bat Research News is published four times each year, consisting of one volume of four issues. *Bat Research News* publishes short feature articles and general interest notes that are reviewed by at least two scholars in that field. *Bat Research News* also includes abstracts of presentations at bat conferences around the world, letters to the editors, news submitted by our readers, notices and requests, and announcements of future bat conferences worldwide. In addition, *Bat Research News* provides a listing of recent bat-related articles that were published in English. *Bat Research News* is abstracted in several databases (e.g., BIOSIS).

Communications concerning feature articles and "Letters to the Editor" should be addressed to Dr. Al Kurta (akurta@emich.edu), recent literature items to Dr. Tom Griffiths (thomas.alan.griffiths@gmail.com), and all other correspondence (e.g., news, conservation, or education items; subscription information; cover art) to Dr. Margaret Griffiths (margaret.griffiths01@gmail.com).

The prices for one volume-year (4 issues within a single volume) are:

Institutional/Group subscriptions	US $50.00
Individual subscriptions:	
printed edition (U.S.A.)	US $25.00
printed edition (outside U.S.A)	US $35.00

Subscriptions may be paid by check or money order, payable to "***Bat Research News***." Please include both mailing (postal) and e-mail addresses with your payment, and send to Dr. Margaret Griffiths at the address listed above. To pay by credit card (Visa or MasterCard only) or for further information, please go to the *Bat Research News* website at http://www.batresearchnews.org/ and click on the "Subscription Information" link.

Back issues of *Bat Research News* are available for a small fee. Please contact Dr. Margaret Griffiths (margaret.griffiths01@gmail.com) for more information regarding back issues. Thank you!

Bat Research News is ISSN # 0005-6227.
Bat Research News is printed and mailed at Illinois Wesleyan University, Bloomington, Illinois, U.S.A.

This issue printed October 3, 2016.

Letters to the Editor

Editor's Note: Unlike technical articles, letters are not peer-reviewed, but they are edited for grammar, style, and clarity. Letters provide an outlet for opinions, speculations, anecdotes, and other interesting observations that, by themselves, may not be sufficient or appropriate for a technical article. Letters should be no longer than two manuscript pages and sent to the Feature Editor.

Aggressive Interaction between a Hoary Bat (*Lasiurus cinereus*) and Silver-haired Bat (*Lasionycteris noctivagans*) in the Ouachita Mountains of Arkansas

David A. Saugey[1], Susan Weinstein[2], and Dale Paulson[2]

[1]*Nightwing Consulting, P.O. Box 52, Jessieville, AR 71949, and* [2]*Arkansas Department of Health, 4815 West Markham Street, Slot 42, Little Rock, AR 72205*
E-mail: dasnightwing@gmail.com

Interspecific aggression among insectivorous bats in North America has been documented a few times, most recently by Krynak and Reibe (2013), Sasse et al. (2014), and Brokaw et al. (2016), and has often involved members of the genus *Lasiurus*. On 28 April 2014 at 2100 hours (CDT) at a house in Jessieville, Garland County, Arkansas (NAD83: N34.69789° W-93.07083°), two residents were sitting on their porch when they heard "faint squeals" coming from an area in their front yard. Upon investigation they observed, on the ground, a larger, silvery-white bat wrapped around a smaller, dark-colored bat. After a few moments, the larger bat, perhaps aware of their presence, flew away leaving behind the smaller bat that the residents immediately covered with a flower pot to prevent escape.

After one of us (DAS) arrived on the scene, he identified the animal as a male, silver-haired bat, *Lasionycteris noctivagans* (length of forearm = 39.2 mm; weight = 10g). Blood was apparent on the bat's face, and the left lower canine was missing; however, there was no obvious damage to the wing membranes or bones. The bat was retained overnight, but on the following day, the animal was unable to launch itself or remain airborne, possibly due to wounds received during the incident. The bat was subsequently submitted to the Arkansas Department of Health Rabies Laboratory where it tested negative for rabies.

While showing the witnesses the silver-haired bat, both indicated that the aggressive, silvery-white bat was 2–3 times larger in size. To establish the identity of the larger bat, DAS returned the next day with eight photographs removed from *Bats of the United States* (Harvey et al., 1999). These photographs depicted various species including, but not limited to, members of the genus *Lasiurus*. He asked each witness to examine independently the photographs, to see if they recognized the bat in question, and requested that they not reveal their choice until the second person had made a selection. Both witnesses identified the hoary bat. He then showed them a photograph of the dorsal aspect of a hoary bat with wings spread, an aspect they most likely had observed, and both indicated the hoary bat was definitely the animal that they had seen. Eyewitness accounts are often unreliable, but in this case, the hoary bat was adequately described by both color and size and later positively identified from photographs. Considering

past documentation of aggressive behavior of hoary bats toward other species, we believe this identification is correct.

Literature Cited

Brokaw, A. F., J. Clerc, and T. J. Weller. 2016. Another account of interspecific aggression involving a hoary bat (*Lasiurus cinereus*). Northwestern Naturalist, 97:130–134.

Harvey, M. J., J. S. Altenbach, and T. L. Best. 1999. Bats of the United States. Arkansas Game and Fish Commission, Little Rock, Arkansas.

Krynak, T. J., and J. A. Reibe. 2013. An apparent attack on a tricolored bat (*Perimyotis subflavus*) by a hoary bat (*Lasiurus cinereus*) in northern Ohio. Bat Research News, 54:1–2.

Sasse, D. B., S. Weinstein, and D. A. Saugey. 2014. Interspecific aggression by a rabid eastern red bat (*Lasiurus borealis*). Journal of Wildlife Diseases, 50:694–695.

Using Harp Traps at Caves with Belligerent Bats: A Cautionary Note

Ashley K. Wilson

School of Biological Sciences, University of Northern Colorado, Greeley, CO 80639
Email: arolfe121@gmail.com

Harp traps are ideal tools for capturing a large number of bats in a short period of time (Kunz and Kurta, 1988). Recently, I used a collapsible harp trap (Palmeirim and Rodrigues, 1993) to obtain mormoopid bats for dietary analyses (Rolfe and Kurta, 2012; Rolfe et al., 2014). Sampling occurred ca. 7 km SW of Arecibo, Puerto Rico, at Culebrones Cave, a site that housed ca. 300,000 bats from six different species (Rodríguez-Durán and Lewis, 1987). Each night these bats emerged through the same small exit of this cave, and it was common to have 20–100 individuals from multiple species in the bag of the trap at any particular moment.

At ca. 0130 hours on 31 May 2009, ca. 50 sooty mustached bats (*Pteronotus quadridens*) were in the bag of my harp trap, along with a single Antillean fruit bat (*Brachyphylla cavernarum*). I removed each *P. quadridens* as quickly as possible and placed single individuals in separate cloth bags to gather fecal pellets. After bagging each *P. quadridens*, I extracted the *B. cavernarum* from the trap and released it unharmed within ca. 10 min of its capture.

Later, while processing the bagged mormoopids, I discovered that five *P. quadridens* had broken forearms—a phenomenon that had not yet occurred while using the same trap on more than 10 previous nights. Upon examining the wings of the injured bats, I noticed that each *P. quadride*ns had two puncture wounds near the break, with one hole on either side of the injured area. Furthermore, the distance between the two puncture wounds was ca. 6 mm—the same as that between the canines of a *B. cavernarum*.

Pteronotus quadridens is a tiny mormoopid (≤ 7 g), whereas *B. cavernarum* is a large phyllostomid (≤ 53 g) that has been described as belligerent, petulant, and pugnacious (Anthony, 1918; Gannon et al., 2005; Swanepoel and Genoways, 1983). *B. cavernarum* has shown aggression toward the similar-sized Jamaican fruit bat (*Artibeus jamaicensis*) while foraging, and Nellis and Ehle (1977) even documented *B. cavernarum* quarrelling with conspecifics and heterospecifics in the field to such an extent that the wings of multiple individuals were broken. Therefore, it seems probable that the one *B. cavernarum* bit the forearms of five *P. quadridens* that were simultaneously stuck in the bag of my harp trap. After this event, I quickly removed any *B. cavernarum* from the trap, and no additional injuries to any species of bat were observed during the remainder of my year-long investigation. Therefore, I recommend that researchers using harp traps at locations where multiple species reside immediately remove belligerent species, such as *B. cavernarum*, from the bag of the trap to reduce the likelihood of injury to other individuals.

Literature Cited

Anthony, H. E. 1918. Indigenous land mammals of Porto Rico, living and extinct. Memoirs of the American Museum of Natural History, 2:331–435.

Gannon, M. R., A. Kurta, A. Rodríguez-Durán, and M. R. Willig. 2005. Bats of Puerto Rico: an island focus and a Caribbean perspective. Texas Tech University Press, Lubbock, Texas.

Kunz, T. H., and A. Kurta. 1988. Capture methods and holding devices. Pp. 1–29, *in* Ecological and behavioral methods for the study of bats (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, D.C.

Nellis, D. W., and C. P. Ehle. 1977. Observations on the behavior of *Brachyphylla cavernarum* (Chiroptera) in the Virgin Islands. Mammalia, 41:403–409.

Palmeirim, J. M., and L. Rodrigues. 1993. The 2-minute harp trap for bats. Bat Research News, 34: 60–64.

Rodríguez-Durán, A., and A. R. Lewis. 1987. Patterns of population size, diet, and activity time for a multispecies assemblage of bats at a cave in Puerto Rico. Caribbean Journal of Science, 23:352–360.

Rolfe, A. K., and A. Kurta. 2012. Diet of mormoopid bats on the Caribbean island of Puerto Rico. Acta Chiropterologica, 14:369–377.

Rolfe, A. K., A. Kurta, and D. L. Clemans. 2014. Species-level analysis of diets of two mormoopid bats from Puerto Rico. Journal of Mammalogy, 95:587–596.

Swanepoel, P., and H. H. Genoways. 1983. *Brachyphylla cavernarum*. Mammalian Species, 205:1–6.

BOOK REVIEW

Sánchez-Hernández, C., M. d. L. Romeo-Almaraz, G. D. Schnell, M. L. Kennedy, T. L. Best, R. D. Owen, and **S. B. González-Pérez.** 2016. **BATS OF COLIMA, MEXICO**. University of Oklahoma Press, Norman OK, xvi + 321 pp. [ISBN 978-0-8061-5216-5] Price: $45.00 (paper).

Bats of Colima, Mexico is the fourteenth volume in the Animal Natural History Series issued by the University of Oklahoma Press. In keeping with earlier volumes in the series, it is a superbly crafted, high-quality book—high quality in both physical appearance and in content. It is printed on durable, heavy duty paper. The layout, fonts, and editing are first-rate. The illustrations, most printed in full color, are uniformly superb. The University of Oklahoma Press has produced a volume in which the high quality of production complements and augments the equally high quality of the contents. In this Age of Electronic Media, this is a treat for those of us who still treasure the printed, bound volume.

Following prefacing material, the book begins with Chapter One—an "Introduction to the Study of Colima Bats"—a section which briefly recounts the history of scientific study of bats from the earliest field work of the 1890's through to the present. We learn that the Mexican State of Colima is a center of biodiversity for vertebrates, mammals, and bats. Though Colima is the fourth smallest Mexican state in terms of area, the authors tell us it is home to 66 bat species, nearly half of the bat species known from Mexico. Until the early 1950's, the authors report that the study of bats in Colima was primarily by individuals and groups of collectors working directly or indirectly for the American Museum of Natural History, the National Museum of Natural History, and the Field Museum of Natural History. The first dedicated efforts at collection began in the late 1950's by personnel associated with the Natural History Museum of Los Angeles, and continued with work performed by teams from other institutions up through major collecting trips sponsored by the University of Memphis, Auburn University, Texas Tech, and by the Sam Noble Oklahoma Museum of Natural History at the University of Oklahoma.

There has been relatively little prior published work of a nature similar to what this volume covers. Villa-R (1966) included bats from Colima in his seminal volume *Los Murcielagos de Mexico*, recognizing 37 species of bats from Colima. He provided measurements; diagnostic characters; printed distributions and range maps; taxonomic synonymies; dichotomous keys to families, genera, and species; and black and white drawings and photographs of most of the species he included. Hall (1981) recognized about 60 bat species from Colima (there is some imprecision in a few range maps as to whether they include Colima, strictly speaking). Hall also included keys, skull drawings, range maps, synonymies, and limited descriptions and data of some taxa.

The present volume represents a great leap forward in the scientific study of Colima bats. Chapter Two, titled "Study Area," consists of a thorough review of the political boundaries of municipalities and cities and towns within the State of Colima; physiography; geology; climate; vegetation; and precipitation and temperatures, with full-color maps and photographs illustrating each topic. Chapter Three, "Methods," describes the techniques used to study and measure specimens taken in the field, and introduces the reader to the extremely well-done Gazetteer (found as Appendix A at the end of

the book). Chapter Four is an interesting and useful summary of specimens deposited in museums and documented in the scientific literature, as well as limited accounts of observed diets and of reproductive data on each species. There are also short sections entitled "Zoogeographic Associations," "Conservation of Endemic Species," and a very useful brief account of "Misidentified Species from Colima."

The heart of the book begins with Chapter Five, which consists of a dichotomous key (one of the best I have ever seen) to the families, subfamilies, genera, and species of bats found in Colima. Terms used are well-defined and well-illustrated. I can find no imprecision or ambiguity in any of the key couplets. It is always perfectly clear what is meant. Even a relative novice to the practice of using dichotomous keys can see exactly what is meant by terms such as "tragus" or "uropatagium" or "second phalanx" by consulting Figure 5.1 at the start of the chapter. The key leads the reader to the appropriate species account, found in Chapter Six entitled "Accounts."

Each of the species accounts begins with the common English name followed by the species name with author information appended (e.g., "Commissaris's Long-tongued Bat *Glossophaga commissarisi* Gardner, 1962"). The type locality of the species and the etiology of the scientific name—both genus and species—follow. Each species account continues with a precise Description of the species, Distribution within Colima (accompanied by a full-color map), Conservation Status, and Habitats (where the species has been found). Short sections on Diet, Reproduction, and diurnal Activity provide useful natural history information. A section entitled "Other observations" provide a potpourri of interesting information on the species. Each species account concludes with a section on "Measurements" (data are found in the appendices), "Specimens examined," "Localities" found in the Gazetteer, and "Records in literature." I would be remiss in failing to mention the full-color pictures of the head and neck, face, or full body of each species. They would be considered very well-done if taken by professional photographers, but it appears that most of these photos were taken in the field by researchers, including a number taken by the authors of this book.

I have one very minor quibble with the book, not of great import. My quibble is not so much with the book itself, but rather with the advertising copy about the book. Although it is not *specifically* stated that Colima is one of the "three most biodiverse hot spots in the world" for bats, it is strongly implied by the advertising copy. I initially bristled when I read this assentation. Although Colima is quite clearly part of the meeting point of the temperate and tropical fauna, it is situated closer to the northern end of that zone for bats. Many South American chiropteran species that have successfully entered Panama, Costa Rica, and points north have not yet entered Mexico (though global warming may yet facilitate those range extensions). Thus I would guess that Panama and a number of localities in Neotropical South America possess greater chiropteran biodiversity than Colima. I would also be quite surprised if sub-Saharan Africa and Southeastern Asia do not surpass Colima in Chiropteran biodiversity (though I admit that I've not actually counted the number of bat species in either locality).

Having been involved several times in producing similar accounts (of South American Glossophaginae and Lonchophyllinae), I know exactly how much work was involved in the production of *Bats of Colima, Mexico*. Hiding within the attractive façade of the book is a Herculean mountain of effort in field work, library research, measurement, writing, photography, and artistry. I can state unequivocally that the effort has paid off handsomely. This is quite simply a superb

book. It belongs in the library of every natural history institution and in the personal libraries of any scientist working on the natural history, taxonomy, systematics, zoogeography, or ecology of bats. I recommend it with enthusiasm to my colleagues in chriopterology.

—Thomas A. Griffiths, *Department of Biology, Illinois Central College, 1 College Drive, East Peoria, IL 61635-001, USA; e-mail: thomas.alan.griffiths@gmail.com*.

LITERATURE CITED

Hall, E. R. 1981. The Mammals of North America. Vol. 1. 2nd Edition. John Wiley and Sons, New York, xv + 90 pp.

Villa-R., B. 1966. Los Murcielagos de Mexico—Su importancia en la economía y la salubridad—Su clasificación sistemática. Universidad Nacional Autonoma de Mexico, Instituto de Biologia, Mexico, xvi + 491 pp.

RECENT LITERATURE

Authors are requested to send reprints (PDF files) of their published papers to the Editor for Recent Literature, **Dr. Thomas A. Griffiths**, (e-mail: **thomas.alan.griffiths@gmail.com**) for inclusion in this section. Receipt of reprints is preferred, as it will facilitate complete and correct citation. However, if reprints and/or PDF files are unavailable, please send a complete citation (including complete name of journal and corresponding author mailing address) by e-mail. The Recent Literature section is based on several bibliographic sources and for obvious reasons can never be up-to-date. Any error or omission is inadvertent. Voluntary contributions for this section, especially from researchers outside the United States, are most welcome and appreciated.

ANATOMY/HISTOLOGY/ ULTRASTRUCTURE

Chavhan, P. R., and A. Dhamani. 2016. Ultrastructural characterization of gonadotrophs in the wild caught female bat *Taphozous nudiventris kachhensis* (Dobson). Journal of Microscopy and Ultrastructure, 4(2): 108–114. [panksphd@gmail.com]

Martins, F. F., M. R. Beguelini, C. C. I. Puga, E. Morielle-Versute, P. S. L. Vilamaior, and S. R. Taboga. 2016. Morphophysiology and ultrastructure of the male reproductive accessory glands of the bats *Carollia perspicillata*, *Glossophaga soricina* and *Phyllostomus discolor* (Chiroptera: Phyllostomidae). Acta Histochemica, 118: 640–651. [mateus.beguelini@ufob.edu.br]

Nerkar, A. A., M. P. Gujar, and M. M. Gadegone. 2016. Ultrastructure of the secretory epithelial cells of the Cowper's gland in the Indian fruit bat, *Rousettus leschenaulti* (Desmarest) during the reproductive cycle. Journal of Microscopy and Ultrastructure, 4: 156–161. [archnerkar@gmail.com]

BEHAVIOR

Nassar, J. M., R. Galicia, A. Ibarra, and R. A. Medellin. 2016. Tracking the origin of the smearing behavior in long-nosed bats (*Leptonycteris* spp.). Mammalian Biology, 81:623–627. [jnassar@ivic.gob.ve]

Ramakers, J. J. C., D. K. N. Dechmann, R. A. Page, and M. T. O'Mara. 2016. Frugivorous bats prefer information from novel social partners. Animal Behaviour, 116: 83–87. [tomara@orn.mpg.de]

BIOGEOGRAPHY

Cuadrado-Ríos, S., and H. Mantilla-Meluk. 2016. Timing the evolutionary history of tent-making bats, genus *Uroderma* (Phyllostomidae): A biogeographic context. Mammalian Biology, 81: 579–586. [sacuadrador@uqvirtual.edu.co]

Stoetzel, E., A. Royer, D. Cochard, and A. Lenoble. 2016. Late Quaternary changes in bat palaeobiodiversity and palaeobiogeography under climatic and anthropogenic pressure: new insights from Marie-Galante, Lesser Antilles. Quaternary Science Reviews, 143: 150–174. [emma_stoetzel@hotmail.com]

CONSERVATION

Afonso, E., P. Tournant, J.-C. Foltête, P. Giraudoux, P.-E. Baurand, S. Roué, V. Canella, D. Vey, and R. Scheifler. 2016. Is the lesser horseshoe bat (*Rhinolophus hipposideros*) exposed to causes that may have contributed to its decline? A non-invasive approach. Global Ecology and Conservation, 8: 123–137. [eve.afonso@univ-fcompte.fr]

Bolívar-Cimé, B., A. Bolívar-Cimé, S. A. Cabrera-Cruz, Ó. Muñoz-Jiménez, and R. Villegas-Patraca. 2016. Bats in a tropical wind farm: species composition and importance of the spatial attributes of vegetation cover on bat fatalities. Journal of Mammalogy, 97(4): 1197–1208. [Rafael.villegas@inecol.mx]

Clarke-Wood, B. K., K. M. Jenkins, B. S. Law, and R. V. Blakey. 2016. The ecological response of insectivorous bats to coastal lagoon degradation. Biological Conservation, 202: 10–19. [b.clarke.wood@gmail.com]

Hall, L. K., C. T. Lambert, R. T. Larsen, R. N. Knight, and B. R. McMillan. 2016. Will climate change leave some desert bat species thirstier than others? Biological Conservation, 201: 284–292. [lucashall@byu.edu]

Heima, O., A. Schrödera, J. Eccard, K. Jung, and C. C. Voigt. 2016. Seasonal activity patterns of European bats above intensively used farmland. Agriculture, Ecosystems, and Environment, 233: 130–139. [heim@izw-berlin.de]

Hernout, B. V., K. E. Arnold, C. J. McClean, M. Walls, M. Baxter, and A. B.A. Boxall. 2016. A national level assessment of metal contamination in bats. Environmental Pollution, 214: 847–858. [beatrice.hernout@gmail.com]

Mehl, C., G. Marsden, M. C. Schoeman, and D. Vosloo. 2016. Coping with environmental stress: The effects of wastewater pollutants on energy stores and leptin levels in insectivorous bats. Mammalian Biology, 81: 527–533. [voslood@ukzn.ac.za]

Phelps, K., R. Jose, M. Labonite, and T. Kingston. 2016. Correlates of cave-roosting bat diversity as an effective tool to identify priority caves. Biological Conservation, 201: 201–209. [kendra.phelps@ttu.edu]

Rydell, J., W. Bogdanowicz, A. Boonman, S. Pettersson, E. Suchecka, and J. J. Pomorski. 2016. Bats may eat diurnal flies that rest on wind turbines. Mammalian Biology, 81: 331–339. [jens.rydell@telia.com]

Smith, A., M. C. Schoeman, M. Keith, B. F. N. Erasmus, A. Monadjem, A. Moilanen, and E. D. Minin. 2016. Synergistic effects of climate and land-use change on representation of African bats in priority conservation areas. Ecological Indicators, 69: 276–283. [alainsmith46@gmail.com]

Threlfall, C. G., N. S. G. Williams, A. K. Hahs, and S. J. Livesley. 2016. Approaches to urban vegetation management and the impacts on urban bird and bat assemblages. Landscape and Urban Planning, 153: 28–39. [caragh.threlfall@unimelb.edu.au]

Welch, J. N., J. A. Fordyce, D. S. Simberloff. 2016. Indirect impacts of invaders: A case study of the Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*). Biological Conservation, 201: 146–151. [jwelch14@utk.edu]

DEVELOPMENT

Ball, H. C., F. M. Moussa, T. Mbimba, R. Orman, F. F. Safadi, and L. N. Cooper. 2016. Methods and insights from the characterization of osteoprogenitor cells of bats (Mammalia: Chiroptera). Stem Cell Research, 17: 54–61. [hcball08@gmail.com]

DISTRIBUTION/FAUNAL STUDIES

Morni, M. A., N. F. D. A. Tahir, Q. S. Rosli, J. W. Dee, I. Azhar, A. Roslan, M. A. Zahidin, M. T. Abdullah, and F. A. A. Khan.

2016. New record of *Rhinolophus chiewkweeae* (Chiroptera: Rhinolophidae) from the east coast of Peninsular Malaysia with new information on their echolocation calls, genetics and their taxonomy. Raffles Bulletin of Zoology, 64: 242–249. [amsyari.morni92@gmail.com]

Jargalsaikhan, A. 2016. Bat study in the Kharaa region, Mongolia. Journal of Asia-Pacific Biodiversity, 9: 107–115. [j_ariunbold@yahoo.com]

Kraker-Castãneda, C., S. G. Pérez, J. O. Cajas-Castillo, and J. L. Echeverría-Tello. 2016. Lista actualizada de los murciélagos (Mammalia, Chiroptera) de Guatemala (Updated list of the bats (Mammalia, Chiroptera) of Guatemala). Revista Mexicana de Biodiversidad, 87:409–416. [ckraker@ecosur.edu.mx]

Sánchez-Hernández, C., M. d. L. Romeo-Almaraz, G. D. Schnell, M. L. Kennedy, T. L. Best, R. D. Owen, and S. B. González-Pérez. 2016. Bats of Colima, Mexico. University of Oklahoma Press, Norman OK, xvi + 321 pp. [ISBN 978-0-8061-5216-5] [LCCN 2016001067]

Tu, V. T., P. Estók, G. Csorba, N. T. Son, H. T. Thanh, L. Q. Tuan, and T. Görföl. 2016. Recent remarkable records reveal that Phia Oac-Phia Den Nature Reserve is a priority area for bat conservation in Northern Vietnam. Journal of Asia-Pacific Biodiversity, 9: 312–322. [vttu@iebr.ac.vn]

Zahidin, M. A., A. Roslan, W. Marni, M. Kombi, M. T. Abdullah, and Consortium of Bako Researchers. 2016. Biodiversity Assessment and updated checklist of faunal diversity in Bako National Park, Sarawak, Malaysian Borneo. Journal of Sustainability Science and Management, 11(1): 53–72. [aiditarsier@gmail.com]

ECHOLOCATION

Miller, K. E., K. Barr, M. Krawczyk, and E. Covey. 2016. Seasonal variations in auditory processing in the inferior colliculus of *Eptesicus fuscus*. Hearing Research, 341: 91–99. [kimiline@uw.edu]

Razak, K. A. 2016. Functional segregation of monaural and binaural selectivity in the pallid bat auditory cortex. Hearing Research, 337: 35–45. [khaleel@ucr.edu]

Wohlgemuth, M. J., J. Luo, and C. F. Moss. 2016. Three-dimensional auditory localization in the echolocating bat. Current Opinion in Neurobiology, 41: 78–86. [cynthia.moss@jhu.edu]

ECOLOGY

Abedi-Lartey, M., D. K. N. Dechmann, M. Wikelski, A. K. Scharf, and J. Fahr. 2016. Long-distance seed dispersal by straw-coloured fruit bats varies by season and landscape. Global Ecology and Conservation, 7: 12–24. [wikelski@orn.mpg.de]

Bilgin, R., K. Gürün, H. Rebelo, S. J. Puechmaille, Ö. Maracı, P. Presetnik, P. Benda, P. Hulva, C. Ibáñez, D. Hamidovic, N. Fressel, I. Horáček, A. Karatas, A. Karatas, B. Allegrini, P. Georgiakakis, S. Gazaryan, Z. L. Nagy, M. Abi-Said, R. K. Lučan, T. Bartonička, H. Nicolaou, D. Scaravelli, B. Karapandza, M. Uhrin, M. Paunović, and J. Juste. 2016. Circum-Mediterranean phylogeography of a bat coupled with past environmental niche modeling: A new paradigm for the recolonization of Europe? Molecular Phylogenetics and Evolution, 99: 323–336. [rasit.bilgin@boun.edu.tr]

Cassano, C. R., R. M. Dilva, E. Mariano-Neto, G. Schroth, and D. Faria. 2016. Bat and bird exclusion but not shade cover influence arthropod abundance and cocoa leaf consumption in agroforestry landscape in

northeast Brazil. Agriculture, Ecosystems & Environment, 232: 247–253. [crc.uesc@gmail.com]

Hayman, D. T. S., and A. J. Peel. 2016. Can survival analyses detect hunting pressure in a highly connected species? Lessons from straw-coloured fruit bats. Biological Conservation, 200: 131–139. [davidshayman@gmail.com]

León-Tapia, M. Á., and Y. Hortelano-Moncada. 2016. Richness of insectivorous bats in a chaparral area in the municipality of Tecate, Baja California, Mexico. Revista Mexicana de Biodiversidad, 87: 1055–1061. [yolahm@ib.unam.mx]

EVOLUTION

Zalapa, S. S., S. Guerrero, M de Lourdes Romero-Almaraz, and C. Sánchez-Hernández. 2016. Coloración atípica en murciélagos: frecuencia y fenotipos en Norte y Centroamérica e islas del Caribe y nuevos casos para México y Costa Rica. Revista Mexicana de Biodiversidad, 87: 474–482. [sszalapah@gmail.com]

IMMUNOLOGY

Lee, W. T., D. D. Jones, J. L. Yates, G. M. Winslow, A. D. Davis, R. J. Rudd, C. T. Barron, and C. Cowan. 2016. Identification of secreted and membrane-bound bat immunoglobulin using a Microchiropteran-specific mouse monoclonal antibody. Developmental and Comparative Immunology, 65: 114–123. [William.lee@health.ny.gov]

PARASITOLOGY

Lutz, H. L., B. D. Patterson, J. C. K. Peterhans, W. T. Stanley, P. W. Webala, T. P. Gnoske, S. J. Hackett, and M. J. Stanhope. 2016. Diverse sampling of East African haemosporidians reveals chiropteran origin of malaria parasites in primates and rodents. Molecular Phylogenetics and Evolution, 99: 7–15. [hl147@cornell.edu]

McKee, C. D., D. T. S. Hayman, M. Y. Kosoy, and C. T. Webb. 2016. Phylogenetic and geographic patterns of *Bartonella* host shifts among bat species. Infection, Genetics, and Evolution, 44: 382–394. [clifton.mckee@colostate.edu]

Schiller, S. E., K. N. Webster, and M. Power. 2016. Detection of *Cryptosporidium hominis* and novel *Cryptosporidium* bat genotypes in wild and captive *Pteropus* hosts in Australia. Infection, Genetics and Evolution, 44: 254–260. [sabine.schiller@students.mq.edu.au]

PALEONTOLOGY

Galán, J., G. Cuenca-Bescós, and J. M. López-Garcia. 2016. The fossil bat assemblage of Sima del Elefante Lower Red Unit (Atapuerca, Spain): First results and contribution to the palaeoenvironmental approach to the site. Comptes Rendus Palevol, 15(6): 647–657. [galanj@unizar.es]

PHYSIOLOGY/ENERGETICS

Menzies, A. K., Q. M. R. Webber, D. E. Baloun, L. P. McGuire, K. A. Muise, D. Coté, S. Tinkler, and C. K. R. Willis. 2016. Metabolic rate, latitude and thermal stability of roosts, but not phylogeny, affect rewarming rates of bats. Physiology & Behavior, 164: 361–368. [allysonmenzies@gmail.com]

REPRODUCTION

Edith, A.-R., R. G. Adolfo, C.-B. Edith, K. Mina, A.-S. Marcela, R.-T. Ahiezer, F.-M. Gisela, and L.-G. M. Angel. 2016. Reactive oxygen species production and antioxidant enzyme activity during epididymal sperm maturation in *Corynorhinus mexicanus* bats. Reproductive Biology, 16: 78–86. [editharenas2000@yahoo.com]

Puga, C. C. I., M. R. Beguelini, E. Morielle-Versute, P. S. L. Vilamaior, and S. R. Taboga. 2016. The effects of castration followed testosterone supplementation in prostatic complex of *Artibeus planirostris* (Chiroptera: Phyllostomidae). Tissue and Cell, 48: 252–264. [taboga@ibilce.unesp.br]

TAXONOMY/SYSTEMATICS/ PHYLOGENETICS

Catzeflis, F., Y. Gager, M. Ruedi, and B. de Thoisy. 2016. The French Guianan endemic *Molossus barnesi* (Chiroptera: Molossidae) is a junior synonym for *M. coibensis*. Mammalian Biology, 81: 431–438. [francois.catzeflis@univ-montp2.fr]

Dietz, C., A. Gazaryan, G. Papov, H. Dundarova, and F. Mayer. 2016. *Myotis hajastanicus* is a local vicariant of a widespread species rather than a critically endangered endemic of the Sevan lake basin (Armenia). Zeitschrift für Säugetierkunde, 81(5): 518–522. [frieder.mayer@mfn-berlin.de]

Gregorin, R., L. M. Moras, L. H. Acosta, K. L. Vasconcellos, J. L. Poma, F. R. dos Santos, and R. C. Paca. 2016. A new species of *Eumops* (Chiroptera: Molossidae) from southeastern Brazil and Bolivia. Mammalian Biology, 81: 235–246. [rgregorin@dbi.ufla.br]

Pavan, A. C., and G. Marroig. 2016. Integrating multiple evidences in taxonomy: species diversity and phylogeny of mustached bats (Mormoopidae: *Pteronotus*). Molecular Phylogenetics and Evolution, 103: 184–198. [nanpavan@usp.br]

VIROLOGY

Arai, S., S. Taniguchi, K. Aoki, Y. Yoshikawa, S. Kyuwa, K. Tanaka-Taya, J. S. Masangkay, T. Omatsu, R. Puentespina Jr., S. Watanabe, P. Alviola, J. Alvarez, E. Eres, E. Cosico, M. N. R. M. Quibod, S. Morikawa, R. Yanagihara, and K. Oishi. 2016. Molecular phylogeny of a genetically divergent hantavirus harbored by the Geoffroy's rousette (*Rousettus amplexicaudatus*), a frugivorous bat species in the Philippines. Infection, Genetics, and Evolution, 45: 26–32. [arais@nih.go.jp]

Banerjee, A., N. Rapin, M. Miller, P. Griebel, Y. Zhou, V. Munster, and V. Misra. 2016. Generation and Characterization of *Eptesicus fuscus* (Big brown bat) kidney cell lines immortalized using the *Myotis polyomavirus* large T-antigen. Journal of Virological Methods, 237: 166–173. [vicram.misra@usask.ca]

Kemenesi, G., Á. Gellért, B. Dallos, T. Görföl, S. Boldogh, P. Estók, S. Marton, M. Oldal, V. Martella, K. Bányai, and F. Jakab. 2016**.** Sequencing and molecular modeling identifies candidate members of Caliciviridae family in bats. Infection, Genetics, and Evolution, 41: 227–232. [jakabf@gamma.ttk.pte.hu]

Li, Z., D. Liu, X. Ran, C. Liu, D. Guo, X. Hu, J. Tian, X. Zhang, Y. Shao, S. Liu, and L. Qu. 2016. Characterization and pathogenicity of a novel mammalian orthoreovirus from wild short-nosed fruit bats. Infection, Genetics, and Evolution, 43: 347–353. [SWLIU@hvri.ac.cn]

Yadav, P., P. Sarkale, D. Patil, A. Shete, P. Kokate, V. Kumar, R. Jain, S. Jadhav, A. Basu, S. Pawar, A. Sudeep, M. Gokhale, R. Lakra, and D. Mourya. 2016. Isolation of Tioman virus from *Pteropus giganteus* bat in North-East region of India. Infection, Genetics, and Evolution, 45: 224–229. [dtmourya@gmail.com]

Yinda, C. K., A. Rector, M. Zeller, N. Conceição-Neto, E. Heylen, P. Maes, S. M.

Ghogomu, M. Van Ranst, and J. Matthijnssens. 2016. A single bat species in Cameroon harbors multiple highly divergent papillomaviruses in stool identified by metagenomics analysis. Virology Reports, 6: 74–80. [kweclaude.yinda@kuleuven.be]

WHITE-NOSE SYNDROME

Meyer, A. D., D. F. Stevens, and J. C. Blackwood. 2016. Predicting bat colony survival under controls targeting multiple transmission routes of white-nose syndrome. Journal of Theoretical Biology, 409: 60–69. [jcb5@williams.edu]

ANNOUNCEMENTS

Request for News

Please consider submitting news from your lab group, your field work, or any bat-related news. Also please consider submitting short articles, notes, or letters on a bat-related topic (see below). Thank you in advance for considering us as a place for bat, bat worker, and bat lab news items.

Request for Manuscripts — *Bat Research News*

Original research/speculative review articles, short to moderate length, on a bat-related topic would be most welcomed. Please submit manuscripts as .rtf documents to Allen Kurta, Editor for Feature Articles (akurta@emich.edu). If you have questions, please contact Al. Thank you for considering submitting your work to *BRN*.

Change of Address Requested

Will you be moving in the near future? If so, please **send** your **new postal and e-mail addresses** to Margaret Griffiths (margaret.griffiths01@gmail.com), and include the date on which the change will become effective. Thank you in advance for helping us out!

FUTURE MEETINGS and EVENTS

2016

The 46th Annual NASBR will be held October 12–15, 2016, in San Antonio, Texas. See the NASBR website for future updates — http://www.nasbr.org/.

2017

The 14th European Bat Research Symposium will be held 1–5 August 2017, in Donostia – The Basque Country. Please see http://ebrs2017.eus/ for more information.

The 47th Annual NASBR will be held October 18–21, 2017, in Knoxville, Tennessee. Check the NASBR website for future updates — http://www.nasbr.org/.

2018

The 48th Annual NASBR will be held October 24–27, 2018, in Puerto Vallarta, Mexico. Check the NASBR website for future updates — http://www.nasbr.org/.

Australian Bat Conference 2018 venue and dates to be announced.

BAT RESEARCH NEWS

VOLUME 57: NO. 4 WINTER 2016

BAT RESEARCH NEWS

VOLUME 57: NUMBER 4 **WINTER 2016**

Table of Contents

Front Cover

The photograph from the first Symposium on Bat Research in the Southwest held in Tucson, Arizona, 27–28 November 1970, was submitted by Ken Geluso. Roy Horst and Jim Findley can be seen having a conversation in the foreground, but can you help identify other individuals in the photo from the first meeting? If so let us know (margaret.griffiths01@gmail.com). Many thanks to Ken for sharing this bit of nostalgia!

BAT RESEARCH NEWS

Volume 57: Number 4 Winter 2016

Publisher and Managing Editor: Dr. Margaret A. Griffiths, 8594 Berwicke Circle, Bloomington, IL 61705; E-mail: margaret.griffiths01@gmail.com

Editor for Feature Articles: Dr. Allen Kurta, Dept. of Biology, Eastern Michigan University, Ypsilanti MI 48197; E-mail: akurta@emich.edu

Editor for Recent Literature: Dr. Thomas A. Griffiths, 8594 Berwicke Circle, Bloomington, IL 61705; E-mail: thomas.alan.griffiths@gmail.com

Emeritus Editor: Dr. G. Roy Horst

Bat Research News is published four times each year, consisting of one volume of four issues. *Bat Research News* publishes short feature articles and general interest notes that are reviewed by at least two scholars in that field. *Bat Research News* also includes abstracts of presentations at bat conferences around the world, letters to the editors, news submitted by our readers, notices and requests, and announcements of future bat conferences worldwide. In addition, *Bat Research News* provides a listing of recent bat-related articles that were published in English. *Bat Research News* is abstracted in several databases (e.g., BIOSIS).

Communications concerning feature articles and "Letters to the Editor" should be addressed to Dr. Al Kurta (akurta@emich.edu), recent literature items to Dr. Tom Griffiths (thomas.alan.griffiths@gmail.com), and all other correspondence (e.g., news, conservation, or education items; subscription information; cover art) to Dr. Margaret Griffiths (margaret.griffiths01@gmail.com).

The prices for one volume-year (4 issues within a single volume) are:

Institutional/Group subscriptions	US $50.00
Individual subscriptions:	
printed edition (U.S.A.)	US $25.00
printed edition (outside U.S.A)	US $35.00

Subscriptions may be paid by check or money order, payable to "***Bat Research News***." Please include both mailing (postal) and e-mail addresses with your payment, and send to Dr. Margaret Griffiths at the address listed above. To pay by credit card (Visa or MasterCard only) or for further information, please go to the *Bat Research News* website at http://www.batresearchnews.org/ and click on the "Subscription Information" link.

Back issues of *Bat Research News* are available for a small fee. Please contact Dr. Margaret Griffiths (margaret.griffiths01@gmail.com) for more information regarding back issues. Thank you!

Bat Research News is ISSN # 0005-6227.
Bat Research News is printed and mailed at Illinois Wesleyan University, Bloomington, Illinois, U.S.A.

This issue printed January 3, 2017.

Abstracts of Papers Presented at the 46th Annual Symposium of the North American Society for Bat Research San Antonio, TX, USA October 12th–15th, 2016

The following abstracts are from papers presented at the 46th Annual Symposium of the North American Society for Bat Research (NASBR). The local hosts for the meeting were Rebecca Patterson and Mylea Bayless. Meeting abstracts were submitted by Gary Kwiecinski, Shahroukh Mistry, Riley Bernard, and Luis Viquez-R., Program Directors for NASBR. Abstracts are arranged in alphabetical order by first author and, except for minor formatting changes, are published as received. Abstracts are considered the property of the authors and we request that you please contact the author to request further information about their work. **Student award recipients** are indicated by an asterisk (*****) next to the title of their paper. E-mail contact information for authors is not available.

In Your Face: Influence of Signal Direction on Sonar Interference
Amanda M. Adams and Michael Smotherman
Department of Biology, Texas A&M University, College Station, USA

How bats mitigate mutual interference is a longstanding question that has both ecological and technological implications as biosonar systems continue to outperform man-made sonar systems in noisy, cluttered environments. Echolocating bats use mutual suppression, slowing their pulse emission rates, when flying in groups to reduce interference and improve sonar performance. Greater interference results in lower emission rates, but what interference matters? We tested the hypothesis that the directionality of a signal, and its returning echoes, plays a role in the amount of interference a bat experiences. We predicted that a signal emitted in the same direction as the bat is emitting will interfere more than a signal emitted towards the bat. We tested whether flying free-tailed bats (*Tadarida brasiliensis*) changed their emission rates depending on the playback direction of an artificial stimulus. We also recorded emission rates when bats were flown in pairs, either flown towards each other or in the same direction. Lastly, we investigated if pairs of bats flying together behaviorally mitigated interference in combination with reduced emission rates. Mutual suppression improves sonar efficiency and supports social cohesion; characterizing this behavior will help elucidate the context-dependent variation prevalent in bat echolocation.

Climbing and Walking in Bats: Are There Two Evolutionary Pathways?
Rick A. Adams
School of Biological Sciences, University of Northern Colorado, Greeley, USA

Most locomotor analyses of bats have focused on flight mechanics and behaviors. However, analysis of nonflight locomotion may give better insight into evolutionary histories. There are some limited published data on walking in bats, but none on climbing. Using high-speed video (300 Hz), I compared walking and climbing in several species of megachiropterans (Pteropodidae) and microchiropterans. Fundamentally, pteropodids readily took to climbing, but resisted walking, whereas microchiropterans resisted climbing, but exhibited good walking skills. Limb mechanics showed no significant differences ($P = 0.19$) in maximum extension of the elbow joint when climbing between groups, but there was significantly greater ability of pteropodids to extend the humerus past the shoulder plane ($P = 0.0001$), thereby extending forelimb reach. In addition, pteropodids had a significantly greater ability to abduct their rear legs than did microchiropterans ($P = 0.0001$) resulting in placement of the rear feet next to, or even ahead of, the rostrum during climbing. Climbing footfall patterns in pteropodids were diverse, but usually involved ipsilateral limb movements and sometimes fore- and hind limbs were even in motion simultaneously. When climbing, microchiropterans used a less-efficient, but highly stable, contralateral gait by diagonally alternating limb movements in a manner very similar to how they walked. Pteropodids showed little ability to coordinate their limbs for walking and movements on the ground were awkward and, at times, appeared to lack competent orientation. These data, as well as specific morphological attributes, evoke an arboreal ancestry for pteropodids, whereas microchiropterans manifest a more generalized, terrestrially-based, ancestry.

Heart-rate Telemetry Reveals an Unusual Response to Stress in the Brazilian Free-tailed Bat
Louise C. Allen[1], Isabelle A. Bisson[2], Nickolay I. Hristov[1], Taylor K. Jones[3] and Jennifer A. Riley[1]
1 *Winston-Salem State University, Winston-Salem, USA;* ***2*** *Smithsonian Migratory Bird Center, Washington DC, USA;* ***3*** *Wake Forest University, Winston-Salem, USA*

As human populations expand, increased encroachment on wildlife habitat is likely. Organisms able to adapt or acclimate to human-altered habitats will have a selective advantage over those unable to do so. One example of this is the increasing use of highway bridges by bats. Evidence from previous research suggests that bridge-roosting bats (*Tadarida brasiliensis*) actually experience lower stress levels (measured as baseline cortisol) and are in better overall health than their cave-roosting counterparts (parasite loads and body score). This unexpected result suggests that this species does not perceive or is able to rapidly acclimate to the potential stressors observed at highway bridges. Heart rate telemetry allows direct and continuous monitoring of an acute response to a stressor and, thus is ideal for perception to stimuli and assessing acclimation to repeated stimuli. To measure heart rate, a small (0.6g) custom-made heart rate transmitter was affixed to each bat (~12g) and the signal was recorded on an MP3 recorder while the bat was in the roost. Bats (n=4) were subjected to several novel disturbance events, including restraint and a simulated predator, over the course of the experiment. Other potentially disturbing events that bats regularly experience, including trains, were also noted. Preliminary results indicate that bats did not perceive routine noxious events, such as passing trains, as stressful. Bats did respond to restraint and the disturbance protocol, but notably, they exhibited pronounced bradycardia (retardation of heart rate), the first such report in bats; this physiological response matches the species' behavioral response to restraint.

Roosting Behaviors of Western Red Bats in Southwestern New Mexico
Brett R. Andersen and Keith Geluso
Department of Biology, University of Nebraska-Kearney, Kearney, USA

In the 1990s, separation of the red bat into two distinct species, eastern (*Lasiurus borealis*) and western (*L. blossevillii*), resulted in the need for an understanding of roosting behaviors for western red bats. However, minimal research has been emphasized on the western species, as many have seemed to assume that western red bats would exhibit the same roosting behaviors as the well-studied eastern species. In this study, roost characteristics and novel roosting behaviors were identified for western red bats along the Mimbres River in southwestern New Mexico, a state where the species is listed as one of greatest conservation need. After identifying several behaviors seemingly unique to western reds, it may be important to further investigate the roosting behaviors of eastern reds, particularly in the state of New Mexico, to evaluate whether or not these novel behaviors are exclusive to the western species. Specific roost characteristics identified by this study can also be used to implement proper mitigation plans for the long-term persistence of the species in areas where many deciduous riparian corridors are imperiled.

Winter Activity of Big Brown Bats in Western Indiana
Robert J. Arndt and Steven L. Lima
Biology Department, Indiana State University, Terre Haute, USA

Bats are known to periodically leave hibernacula for multiple reasons, including finding more suitable roosts, winter mating and replenishing lost water. However, the general activity of wintering bats remains poorly characterized. We thus recorded winter bat activity (using Anabat acoustic detectors) over three years (2012 – 2014) at 21 sites (2,905 detector-nights) in western Indiana, with the goal of relating activity to key environmental variables. Most of the bats detected were big brown bats (*Eptesicus fuscus*), based on the structure and frequency of calls. We thus focused our analysis on this species. To avoid confounding results from fall and spring hibernation transition periods we focused on the coldest winter months (December – February). During these months, the majority of recorded activity occurred within 2 - 3 hours post-sunset, with post-midnight activity occurring rarely. Overall activity was clearly correlated with temperature on the day of observation, rather than temperatures of previous days. Big brown bats hibernate mainly in buildings, and thus are likely to quickly register temperature changes and take advantage of relatively warm periods. Most activity occurred on evenings above 0°C with especially high activity on rare evenings above 10°C, but activity was recorded as low as -4°C. However, overall recorded bat activity levels were generally low, even on warmer nights (maximum of 23 – 76 calls). In winter, insects (mainly moths) remain active at low levels, but only during the warmest nights, however we found no evidence of winter feeding in this population, as indicated by the lack of feeding buzzes.

Echolocation Diversity of Cave Roosting Bats in Western Cuba: Implications for an Acoustic Monitoring Program

Bryan D. Arnold, Kara A. Fulkerson and Taylor R. Duffy
Department of Biology, Illinois College, Jacksonville, USA

Cave systems in Cuba support a diverse assemblage of bat species. For example, La Barca Cave, a "hot cave" so named because it maintains consistently high temperatures as a result of body heat produced by the abundance of bats present, is home to at least 13 species including one endemic. However, capture based surveys to monitor population trends are difficult given that many areas in caves are inaccessible. Thus, the goal of our initial study was to obtain species voucher recordings from bats captured at two caves in Guanahacabibes National Park, La Barca and French Cave, analyze the recordings to determine species specificity, and examine the use of automated recorders to monitor bat populations. Captured bats were identified to species and recorded after being released in a large, open cavern. After selecting high signal to noise ratio recordings, we measured temporal and spectral characteristics from 5-10 echolocation pulses from each recording. While we did not obtain enough recordings from La Barca for a detailed analysis, we conducted a factor analysis on measured recordings from two species in French Cave (*Artibeus jamaicensis* and *Erophylla sezekorni*). After extracting two factors which explained 70% of the variance in the data and plotting calls as a function of the extracted factors we found that the two species emit acoustically distinct echolocation calls. Future work will include adding more species to the call library and analyzing calls obtained from automated recorders placed outside cave entrances as preliminary steps toward developing a bioacoustics monitoring protocol.

Roost Selection by the Eastern Red Bat during Migration

Giorgianna Gene Auteri[1,2], Allen Kurta[1] and L. Lacey Knowles[2]
1 *Department of Biology, Eastern Michigan University, Ypsilanti, USA;* ***2*** *Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, USA*

Understanding migratory strategies of tree bats is important for protecting habitat along migratory routes. We examined how one long-distance migrant, the eastern red bat, uses roosts during periods of summer residency versus fall migration. We predicted that trees selected during migration would have a smaller diameter and be shorter, due to unfamiliarity with the area. We also hypothesized there would be differences in canopy coverage and number of nights that roosts were used. We mist-netted and radio-tracked bats in a coastal area of Lake Huron, Michigan in July 2013 and 2014, as well as August 2014. We tagged seven bats (three during migration and four during residency) and identified a total of 19 associated roost trees—seven trees of three species during migration, and 12 trees of seven species during residency. One-directional t-tests showed no significant difference in diameters of roosts, but trees used by migrants were significantly shorter. Roosts used during migration had significantly more open canopy near the tree trunk in each of the four cardinal directions, but 5-m from the trunk there was significantly less canopy coverage to the south. We found no apparent difference in number of nights that a roost was occupied during migration (mean 1.29 nights, SD ± 0.700) versus residency (1.45 ± 0.89 nights). Given the windy nature of our coastal study site, we suggest that migrating bats may be selecting short, sturdy trees with high solar exposure.

Do Fatalities at Wind Turbines Threaten the Population Viability of Hoary Bats?

Erin F. Baerwald
American Wind Wildlife Institute, Washington DC, USA

Wind energy is increasingly popular, however, large numbers of bats are killed at some wind energy facilities, which raises concerns about cumulative impacts on bat populations. An estimated 0.84 and 1.7 million bats have been killed in the U.S. and Canada from 2000-2011, and this increases by over 450,000 individuals annually, 38% of which are hoary bats (*Lasiurus cinereus*). Given this, our objective was to determine whether fatalities threaten the North American populations of hoary bats. We investigated this by using repeated measures analyses to examine how fatality rates change through time at wind facilities with two-years of post-construction monitoring. If fatalities consistently decline, then this may indicate declines in population sizes. We also used parameters derived from expert elicitation to model population trends of hoary bats. Both of our analyses suggest that fatalities at wind energy facilities may be negatively affecting hoary bat populations. Fatality rates declined over time at 63.5% of sites examined and the mean fatality rate was significantly lower overall in the second year of studies. Population modelling suggests that current fatality levels could cause a 91% decrease in the NA population of hoary bats within

50 years. Only in the scenario of an initial population greater than 4 million and baseline growth of at least 3% per year ($\lambda = 1.03$) did mortality from wind turbines have no impact on hoary bat populations. Our analyses highlight the need for effective policy and mitigation strategies that embrace adaptive and flexible management and address cumulative impacts.

The Genetic Diversity of *Molossus molossus,* Between Populations on St. John and St. Thomas

Hema Balkaran[1], Alice Stanford[2], Eric Hoffman[3] and Renata Platenberg[4]
1 *Department of Biology, University of the Virgin Islands, St. Croix, USA;* ***2*** *Department of Biology, University of the Virgin Islands, St. Thomas, USA;* ***3*** *Department of Biology, University of Central Florida, Orlando, USA;* ***4*** *Department of Natural Resource Management, University of the Virgin Island, St. Thomas, USA*

Bats are the only native terrestrial mammals in the United States Virgin Islands and they serve major ecological and economical roles in ecosystems. The velvety free-tailed bat, the only insect eating bat of the five bats species in the USVI, was sampled for tissue samples from two populations on St. Thomas and from one population on St. John. Polymerase chain reactions (PCRs) were carried out with their DNA extractions using different primers and the PCR products are being analyzed. In the results, I expect to see a genetic structure difference between St. Thomas and St. John. I also expect to find a little variation in the genetic structure from the two populations within St Thomas. This study will help explain whether these two islands represent two different populations or if they are one interbreeding population. This information is critical for the informed management of this endemic mammal of the Virgin Islands. We will not want to lose any populations with unique genetic structure and therefore this study will help to inform us of the extent of the varying genetic structure of *M. molossus*.

Hematology and Blood Chemistry Differences in Greater Mouse-eared and Noctule Bats during Hibernation and Lactation

Hana Bandouchova[1], Petr Linhart[1], Veronika Kovacova[1], Vladimir Piacek[1], Ehdaa E. Abdelsalam[1], Tomas Bartonicka[2], Hana Berkova[3], Jiri Brichta[1], Tomasz Kokurewicz[4], Jan Zukal[3] and Jiri Pikula[1]
1 *Department of Ecology and Diseases of Game, Fish and Bees, University of Veterinary and Pharmaceutical Sciences Brno, CZE;* ***2*** *Department of Botany and Zoology, Masaryk University, Brno, CZE;* ***3*** *Institute of Vertebrate Biology, Academy of Sciences of the Czech Republic, Brno, CZE;* ***4*** *Department of Vertebrate Ecology and Paleontology, Institute of Biology, Wroclaw University of Environmental and Life Sciences, Wroclaw, POL*

Insectivorous bats from the temperate zone of the northern hemisphere are a specific group of mammals with enormous differences in metabolic activity during the year and numerous adaptations of very special life strategies. Their metabolic status shifts from considerable reduction during hibernation to high extremes in females during lactation. Both hibernation and lactation represent extremes in the metabolic status. Considering the growth rate of juvenile bats, females are not able to provide nutrition solely based on their feed without use of their stored resources. These extreme metabolic changes are likely to be reflected in hematological and blood chemistry parameters. Since analytical methods in hematology and blood chemistry are improving and sample volumes necessary for analysis are low enough for use in larger European bat species, we were able to describe changes in blood parameters in greater mouse-eared and noctule bats during different life stages. We collected blood samples from a total of 130 greater mouse-eared bat (*Myotis myotis*) and 80 noctule bat (*Nyctalus noctula*) specimens during the whole year and measured blood parameters using VetScan VS2 and i-STAT analyzers. While significant differences in hibernating bats were related to the hydration status and ion imbalance, lactating females showed the most significant alteration in calcium and albumin levels apparently due to milk production. Our results show the importance of protection of bats in hibernacula and maternity roosts as animals in these stages of life are very vulnerable.

Multimodal Aposematism in the Bat-Moth Arms Race

Jesse R. Barber
Department of Biological Sciences, Boise State University, Boise, USA

Darwin was perplexed by the colors of caterpillars, an impasse that Wallace surmounted by suggesting that animals warn of unpalatability. Aposematism has since been revealed to be widespread in animals. Surprisingly, multimodal aposematic signaling is an almost unknown area of animal communication even though signaling in two or more modalities is more common than one alone. Why do so many species invest in additional modalities? Until very recently, tiger moths were thought to be unique among moths in their ultrasonic warning of bad taste in reply to

bat attack. We have recently discovered that several additional chemically protected moth groups produce ultrasonic clicks when they hear the approaching cries of echolocating bats. Most of these moth sounds are unlikely to jam bat sonar. This finding underscores the efficacy of acoustic aposematism as an anti-bat strategy. Many chemically protected moths are also white or otherwise high contrast against the night sky. Bats have specializations for dim light vision and while echolocation is superior to vision for detecting small insects in dim light, these predators should be able to see a medium sized moth at a few meters away, approximately the distance from attacking bats that ultrasound-producing moths begin emitting their warning sounds. Here I present data testing the hypothesis that naive bats can learn to associate bad taste with high contrast visual signals from moths. Further I examine the question of whether the combined presence of visual and acoustic warning signals is synergistic, enhancing learning rates, or are redundant signals.

Paramyxoviruses in Bat Species: The Usefulness of a Bat Disease Database

Lisa A. Beltz
Department of Natural Sciences, Malone University, Canton, USA

Many studies have focused on microbes infecting bats, especially viruses with potential for zoonotic transmission of diseases. I developed a database containing the majority of published reports of the following types of microbes infecting bat species/genera and linked them to the bat species, family, feeding habit, and location: Baltimore Classification I-VII viruses, bacteria, fungi, and Apicomplexan and flagellate protozoan parasites. In order to demonstrate the dataset's usefulness, this study examines published reports of bat species and paramyxoviruses with which they are associated, including Hendra and Nipah viruses. While both Old and New World frugivorous and insectivorous bats are infected by paramyxoviruses, different patterns of infection are detectable. For frugivorous bats, 15 different paramyxoviruses infected 30 bat species, representing 9 genera and 2 families: Phyllostomidae with 4 bat/microbe combinations and Pterpodidae with 27 combinations. *Eidolon helvum* was infected by 6 different microbial species and *Rousettus leschenaultii* with 7. For insectivorous bats, 8 paramyxovirus species infected 54 bat species, representing 24 bat genera and 6 families: Vespertilionoidea (22 bat/microbe combinations), Rhinolophidae (11 combinations), Miniopteridae (8 combinations), Molossidae (4 combinations), Emballonuroidea (4 combinations), Mormoopidae (2 combinations). *Hipposideros*, *Myotis,* and *Miniopterus* genera had the highest number of bat/paramyxovirus combinations. Morbilliviruses were the primary type of paramyxovirus found in insectivorous bats while Henipaviruses were the primary type for frugivores. This database may similarly be used to examine other links between bats and microbes.

***Myotis sodalis* Thermoregulatory Flexibility**

Scott M. Bergeson[1], Joy M. O'Keefe[1] and R. Mark Brigham[2]
1 *Center for Bat Research, Outreach, and Conservation, Indiana State University, Terre Haute, USA;* ***2*** *Department of Biology, University of Regina, Regina, CAN*

Due to increasing temperatures, the Midwestern U.S. may become climatically unsuitable for the federally endangered *Myotis sodalis* between 2030 and 2050. However, bats may be able to buffer the impacts of climate change via thermoregulation. Our objective was to investigate how flexible Midwestern *Myotis sodalis* are in roost and torpor use in response to varying weather patterns. We tagged 26 adult female and juvenile bats from 2013–2015 with temperature sensitive transmitters, which we used to measure skin temperature and track bats to roosts. We compared models testing the fixed effects of weather and roost characteristics (38 individual roosts) on daily torpor patterns (120 full bat days), with reproductive period and individual bats as random effects. Weather and roost characteristic models were the most plausible for explaining torpor duration and depth. On cool days, bats opted for heterothermy (one long or several short deep torpor bouts, >32% of day torpid) and used heavily shaded secondary roosts. On warm days, bats remained normothermic, using torpor for < 5% of the day, and used solar-exposed maternity roosts. Bats responded to weather fluctuations by using different types of roosts and different thermoregulatory strategies. This flexible response likely allowed bats to maintain a balance between energy savings and reproductive effort with varying weather. Because bats used warm solar-exposed roosts on hot days throughout the reproductive season, they may not be overly stressed by warm weather. Future predictions of the impact of climate change on this species may benefit from the inclusion of this information.

Timing and Emergence of Bats on the Landscape: Using Acoustics to Inform Land Management Decisions
Riley F. Bernard[1,2], Emma V. Willcox[1], John M. Zobel[1] and William H. Stiver[2]
1 *Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, USA;* ***2*** *Great Smoky Mountains National Park, Gatlinburg, USA*

Regional United States Fish and Wildlife Service (USFWS) offices and state resource agencies have put forth restrictions on when many land management activities, such as hazard tree removal and prescribed fire, are allowed to occur. In the Southeast, spring restrictions range from April 1st (Tennessee), April 15th (Kentucky and North Carolina) to May 1st (Alabama and Georgia). Although these dates have been set to protect bats while they prepare for spring migration, we have found no evidence to suggest these dates are based on data and limit the amount of habitat management that can be conducted prior to the May 15th – August 15th maternity season for Threatened and Endangered bat species. Recent studies have shown that regular prescribed fires have many long-term benefits for bats and other wildlife. We examined acoustic data collected year round at six cave hibernacula and seven landscape sites to try and identify a range of dates for when bats are most likely to be emerging from and returning to cave hibernacula. Data were collected continuously from January 2011 to May 2016 in middle and eastern Tennessee, USA. We recorded over 43,000 hours of bat activity, which equated to 1,071,000 bat calls. Bats were most active at caves during spring emergence (March through May) and fall swarming (October). The peak in activity at our study sites occurred at the beginning of May, suggesting the current restrictions imposed by USFWS may be overly conservative, leading to a decrease in habitat management activities.

Energetic Implications of Roost Selection in Reproductive Silver-haired Bats
Shelby J. Bohn and R. Mark Brigham
Department of Biology, University of Regina, Regina, CAN

Mammalian reproduction is energetically expensive, and pregnant and lactating females must budget for this extra seasonal expense. Reducing energetic expenditure is an important part of energy budgeting, and high quality habitat can play a role. If the habitat microclimate is stable and favourable, animals can devote more energy to reproduction instead. A well-insulated, stable microclimate is also especially important for animals that are capable of using torpor to save energy, despite possibly slowed offspring development. We used radio telemetry to track reproductive silver-haired bats to their daytime roost trees in Cypress Hills, SK. We quantified characteristics like tree size, cavity temperature and humidity, and cavity aspect, and compared these with random available trees to better understand the potential energetic benefits of the chosen roosts.

Developing Sustainable Citizen Science Projects: A Case Study of the Colorado Bats/Inactive Mines Project
Lea' R. Bonewell[1] and Mark A. Hayes[2]
1 *U.S. Geological Survey, Fort Collins, USA;* ***2*** *Cherokee Nation Technologies, U.S. Geological Survey, Fort Collins, USA*

Citizen science programs can help achieve conservation goals that may not otherwise be possible. However, maintaining citizen science programs can present substantial challenges, such as large investments of time to recruit and train volunteers and to coordinate group activities. We take a qualitative inquiry perspective to consider the characteristics of a successful and long-running citizen science program aimed at helping biologists conserve important bat roosts. The Colorado Bats/Inactive Mines Project (BIMP) utilized volunteer citizen scientists to identify bat roosts at abandoned mines throughout Colorado and was coordinated by Colorado's wildlife management agency. The BIMP utilized citizen scientists over 19 years (1991-2009) and grew into the State's leading citizen science program in terms of volunteer hours donated (>50,000 hours by >1,000 volunteers) and conservation outcomes (>2,500 mine surveys), which saved the State of Colorado > $500,000. We also consider the elements of the BIMP that helped lead to its dissolution in recent years. The data in this case study draws on multiple sources of information, such as interviews, retrospective observations, evaluation of documents, and consideration of other materials from the project. We identify 4 key themes in maintaining the BIMP: support from senior managers; and opportunities for volunteers to develop social connections, develop wildlife observation skills, and engage with applied conservation. We conclude that the BIMP remained sustainable while managers supported BIMP goals and BIMP staff provided volunteers with opportunities for social interactions with peers.

Pathogen Transmission and Torpor Expression in *Myotis lucifugus*
Ana M. Breit and Craig K.R. Willis
Department of Biology, University of Winnipeg, Winnipeg, CAN

Pathogen transmission can be influenced by host traits and environmental characteristics. Temperate bats often select warm roosts or huddle with conspecifics to help reduce thermoregulatory energy expenditure. Alternatively, bats may also enter torpor, a state of reduced body temperature and metabolic rate, to save energy. In addition to providing energy savings, torpor may reduce predation risk by allowing individuals to reduce time spent foraging. Torpor expression could also reduce an individual's risk of contracting pathogens from infected conspecifics or substrates. We tested the hypothesis that torpor expression and huddling influence pathogen transmission for communally roosting *Myotis lucifugus*. We predicted that bats relying most heavily on torpor would be least likely to transmit or acquire contact pathogens. We housed bats in outdoor flight cages and experimentally manipulated energy balance by providing either heated or unheated bat houses. We then quantified the influence of torpor expression, social aggregation and overall activity on transmission of a harmless proxy for a contact pathogen (i.e., ultraviolet fluorescent powder). We dusted a focal individual with UV powder and released it into the flight cage. We assessed frequency and duration of torpor bouts, based on skin temperature, using modified iButtons attached to each individual. After 24 hours all bats were re-captured and photographed, and prevalence and intensity of infection with UV powder were later quantified from digitized photographs. This study has implications for understanding pathogen transmission in temperate-zone bats in the context of zoonotic pathogens relevant to human health and conservation pathogens impacting bat populations.

Roosting Habits, Home Range and Echolocation Call Characteristics of *Sturnira parvidens*
Alyson F Brokaw[1,2] and Michael Smotherman[2]
1 *Department of Ecology and Evolutionary Biology, Texas A&M University, College Station, USA;* ***2*** *Department of Biology, Texas A&M University, College Station, USA*

The New World leaf-nosed bats (Phyllostomidae) are one of the most morphologically, ecologically and behaviorally diverse bat families. Despite their high diversity, behavior studies have focused on only a few specific species. The yellow-shouldered bats (Genus: *Sturnira*) are among the most widespread and abundant fruit eating Phyllostomids and are important seed dispersers in tropical forests, yet little is known about their natural history. In this preliminary study, we used radio telemetry to locate roosts of *S. parvidens (*formerly *S. lilium parvidens)* at El Centro de Investigaciones Costeras de La Mancha (CICOLMA), Veracruz, Mexico. A total of four adult bats (3 males and 1 female) were tagged and tracked over a total of 9 days. Echolocation calls were recorded from two adult males and two juveniles in an outdoor flight tent. Results from this study provide insight on multiple aspects of the natural history, including foraging ecology, movement patterns and social behavior of *Sturnira*.

Effects of Artificial Lighting on Bat Activity in Forested and Agricultural Habitats
Christopher A.C. Brooks[1], Liam P. McGuire[2] and Justin G. Boyles[1]
1 *Department of Zoology, Southern Illinois University, Carbondale, USA;* ***2*** *Department of Biological Sciences, Texas Tech University, Lubbock, USA*

Bats are economically important predators of agricultural pests and excluding them from agricultural areas can have devastating effects on crop production. Artificial lighting is a growing conservation concern and is known to disrupt many aspects of bat behavior including commuting and foraging, forcing bats to avoid areas they normally occupy or use them in different ways. Further, artificial light likely modifies more effects of natural moonlight on bat behavior. Light emitting diodes (LED) are becoming more common as a light source because they are energy efficient and LEDs have been found to have effects on bat behavior comparable to other lighting types. In this study, we assessed bat activity levels as they relate to artificially lit and unlit conditions across several lunar cycles. We used bat detectors (Anabat) to compare foraging activity of two bat communities in different habitats (agriculture and forest) in the presence and absence of artificial light (accomplished with 30W LED lights 3.5 m off the ground). Bat activity was generally higher in the agricultural habitat. The interaction between artificial light and moonlight was also stronger at agricultural sites. Further, activity often increased around lighted areas after lights were automatically turned off at 2 AM. Our results indicate LED lighting does affect bat activity but this effect is variable. The extent and direction of this influence is dependent upon the local habitat. Artificial lighting around agricultural fields could alter bat activity resulting in a change in crop quality, subsequently influencing their economic value.

Effect of Forest Opening Characteristics, Prey Abundance, and Environment on Bat Activity in the Southern Appalachians

Jonathan D. Brooks[1], Patrick D. Gerard[2] and Susan C. Loeb[3]
1 *Department of Forestry and Environmental Conservation, Clemson University, Clemson, USA;* ***2*** *Department of Mathematical Sciences, Clemson University, Clemson, USA;* ***3*** *USDA Forest Service, Southern Research Station, Clemson, USA*

Early successional habitat (ESH) is important for many wildlife species. In the eastern U.S., land use changes over the past century have caused declines in ESH and in many ESH dependent wildlife species. Understanding how ESH restoration will affect forest ecosystems, including bats, is a priority for many land managers. Our objective was to determine how opening size, presence of edge, prey abundance, vegetation structure, and environmental factors affect bat activity in forest openings. In June-August 2014 and May-August 2015, we placed Anabat SD2 bat detectors, Townes-style Malaise insect traps, and iButton temperature loggers at the interior and edge of small (0.2-1.6 ha), medium (2.1-5.6 ha), and large (6.2-18.5 ha) forest openings in the Nantahala National Forest, NC. Calls were identified to species and insects were identified to Order. Mean nightly temperature was determined using iButton temperature loggers and vegetation surveys were conducted to quantify vegetation structure. Difference in insect abundance, bat activity, and bat species richness were tested using mixed effects general linear models. Overall bat activity was significantly higher at opening edges compared to opening interiors and was positively related to mean nightly temperature and negatively related to vegetation structure. Activity of open-adapted species was also negatively related to vegetation structure and elevation. When creating ESH, land managers should maintain an open vegetation structure to benefit open-adapted bat species, focus on creating openings at lower elevations, and configure openings to maximize edge relative to opening area.

***What Explains the Unique Shape of the Turbinal Bones Hidden Inside Horseshoe Bat Noses?**

Alexis Brown[1], Abigail A. Curtis[1,2], and Nancy B. Simmons[1]
1 *Department of Mammalogy, American Museum of Natural History, New York, USA;* ***2*** *Department of Biology, University of Washington, Seattle, USA*
*** Alexis Brown** received the **Titley Electronics Award**.

Inside mammal noses are a set of paper-thin, often architecturally complex bones called turbinals. Turbinals and associated epithelia function in preventing respiratory heat and water loss and increase surface area for olfactory tissue. Turbinals typically range in form from simple plates to scrolls and branches. In Rhinolophidae, the maxilloturbinals and a portion of ethmoturbinal I form a pair of strand-like bony structures on each side of the nasal chamber, which are unique among mammals and represent a synapomorphy of this family. These structures project anteriorly from the transverse lamina and complete a hairpin turn to project posteriorly down the nasopharyngeal duct. Rhinolophids have highly modified nasolaryngeal tracts associated with emission of high duty cycle echolocation calls via the nostrils. We hypothesize that the unique turbinals of rhinolophids are also related to transmission of echolocation calls since they are located directly along the path that sound travels during call emission. We used high-resolution micro-CT scans to image the skulls of 31 rhinolophid species from which we collected 4 linear measurements and 24 landmarks to capture turbinal and cranial dimensions. These data were used to explore correlations between turbinal morphology and features of cranial morphology associated with echolocation and body size, all within a phylogenetic context. When shared evolutionary history was accounted for, maxilloturbinal size and shape were most strongly correlated with echolocation frequency and structures thought to function in call transmission, suggesting rhinolophid maxilloturbinal morphology is more strongly shaped by echolocation than need to prevent respiratory heat and moisture loss.

Nocturnal Airplane and Ground Telemetry to Determine Foraging Habitat of *Macrotus californicus*

Patricia E. Brown[1], William E. Rainey[2] and Allen W. Calvert[3]
1 *Brown-Berry Biological Consulting, Bishop, USA;* ***2*** *Department of Integrative Biology, University of California, Berkeley, USA;* ***3*** *National Park Service, Mojave Desert Network, Inventory and Monitoring Program, Boulder City, USA*

California leaf-nosed bats (*Macrotus californicus*) captured at mine roosts in California near the now predominantly agricultural Lower Colorado River (LCR) floodplain were tracked using aircraft and ground-based telemetry for sessions of 2-3 weeks in summer 2015 and winter 2015 and 2016. Individual bats demonstrated fidelity to certain foraging areas and some travelled distances of at least 70 km in a single night. The bats foraged in

relatively undisturbed native desert vegetation as well as over agricultural areas, within which they concentrated activity in remnant riparian vegetation, some in incised channels of the historic LCR floodplain. Bats captured in mist nets in California and Arizona while foraging in Bureau of Reclamation habitat creation areas planted with native cottonwood and willows were tracked to diurnal roosts in mines and caves (some inaccessible to ground trackers) and to an interstate highway bridge over the LCR.

Database for Identifying Guano to Bat Species in the Southeastern United States

Veronica A. Brown[1], Emma V. Willcox[2], Kirstin E. Fagan[2] and Riley F. Bernard[2,3]
1 *Division of Biology, University of Tennessee, Knoxville, USA;* ***2*** *Department of Forestry, Wildlife, and Fisheries, University of Tennessee, Knoxville, USA;* ***3*** *Great Smoky Mountains National Park, National Park Service, Gatlinburg, USA*

As white-nose syndrome (WNS) spreads throughout North America, altering the species composition of bat communities, wildlife managers increasingly need to identify the species of bats present in an area. Guano is often the only indication to the presence of bats. During the first year of a multi-year survey in the Great Smoky Mountains National Park in Tennessee and North Carolina, where the bat fauna has changed dramatically since WNS was confirmed in the park in 2010, we created a sequence database for 10 bat species found throughout the southeastern United States. We first extracted and sequenced DNA from tissue of opportunistically collected bats. From those samples, we were able to distinguish all 10 species using a single set of primers that were previously published to create a similar database for bats in the Northwest. We then confirmed that the primers work on fecal samples using guano collected from known species of bats. This database has broader use outside this project and outside the southeastern US as more land managers need to identify bat species based solely on the guano.

Following the Flames? Bat Occupancy in Cumberland Plateau Forests Managed by Fire

Leanne K.L. Burns[1], Susan C. Loeb[2], William C. Bridges[3] and Patrick G. Jodice[4]
1 *Department of Forestry and Environmental Conservation, Clemson University, Clemson, USA;* ***2*** *USDA Forest Service, Southern Research Station, Clemson, USA;* ***3*** *Department of Mathematical Sciences, Clemson University, Clemson, USA;* ***4*** *U.S. Geological Survey South Carolina Cooperative Fish and Wildlife Research Unit, Clemson University, Clemson, USA*

As the practice of prescribed burning becomes more common for the management of eastern forests, understanding if, and how, foraging bats respond to structural changes generated by fire is of increasing importance. Our objective was to investigate the effects of post-fire landscape conditions on the occurrence of foraging bats in mixed forests of the Cumberland Plateau physiographic region. We paired Anabat II bat detectors between 164 burned and unburned forest sites of similar stand type and elevation, and deployed detectors for ≥ 2 nights from May through August, 2014 and 2015. We collected meteorological data and conducted vegetation surveys to quantify site-specific environmental and structural characteristics. We recorded 9,209 bat passes and identified 5 species/species groups. We detected bats at 88% of surveyed sites, with detections at more burned (94%) than unburned sites (83%). Analysis of Variance indicated measures of structure (e.g., tree density and basal area) were significantly lower in burned than unburned sites. We used occupancy modeling to test *a priori* hypotheses of probability of detection and bat occupancy related to weather, burn history, and site and landscape characteristics. Detection and occupancy varied by species/species group. Detection was affected by nighttime temperature, barometric pressure, year, vegetative structure, and burn history. Occupancy was most strongly associated with lower vegetative structure, higher elevation, and a history of burning in open stand types. Our results suggest that the lower vegetative structure associated with prescribed fire may increase the suitability of forests for foraging bats in mixed forests of the Cumberland Plateau.

The Relationship between Bat Activity and Salamander Size Structure

Nancy Buschhaus[1], Russell Milam[1], Adrianne Smith[1], Cy Mott[2], Robin Baker[3] and Howard Whiteman[3,4]
1 *Department of Biological Sciences, University of Tennessee at Martin, Martin, USA;* ***2*** *Department of Biological Sciences, Eastern Kentucky University, Richmond, USA;* ***3*** *Department of Biological Sciences, Murray State University, Murray, USA;* ***4*** *High Lonesome Institute, DeBeque, USA*

Trophic cascades in aquatic systems have been shown to influence terrestrial communities via inter-ecosystem subsidies. Size variation in aquatic predators (e.g., salamander larvae) can potentially influence the availability of emergent insects that are then consumed by terrestrial bats. To explore these interactions, we hypothesized that

salamander size structure in ponds in the Land Between the Lakes National Recreation Area in western Kentucky (N = 3) and in the Kimball Creek Watershed at the High Lonesome Ranch on the western slope of the Colorado Rocky Mountains (N = 3) would be related to bat activity. We quantified bat activity and bat species richness with a Wildlife Acoustics SM2BAT+ detector and used SonoBat 3.1 with visual vetting to assign species identification. We captured salamander larvae, *Ambystoma talpoideum* (KY) and *Ambystoma tigrinum nebulosum* (CO), via seines and analyzed their size variation using ImageJ. Subsequently, salamander size structure data were used to categorize each pond as having high, medium, or low size variation. We collected emerging aquatic invertebrates by placing emergence traps on each pond and identifying captured insects to order. We found a statistically significant relationship between bat activity and size variation among salamanders in CO, but the relationship in KY, while statistically significant, was not as clear and may have been confounded by vegetative structure surrounding the ponds.

***Amino Acid Nitrogen Isotopes Reveal the Trophic Position and Dietary Strategies of Bats**

Caitlin J. Campbell[1,2], David M. Nelson[1], Nanako O. Ogawa[3], Yoshito Chikaraishi[3] and Naohiko Okhouchi[3]
1 *University of Maryland Center for Environmental Science Appalachian Laboratory, Frostburg, USA;*
2 *Department of Biology, Frostburg State University, Frostburg, USA;* ***3*** *Department of Biogeochemistry, Japanese Agency for Marine Science and Technology, Yokosuka, JPN*

*** Caitlin J. Campbell** received the **Speleobooks Award**.

Understanding the dietary strategies of animals is central to identifying the ecological and evolutionary processes that shape communities, and because the dietary flexibility of a species influences its susceptibility to habitat disturbance and extinction, is key to conservation and management efforts. However, knowledge of diets of many species is limited by difficulty in identifying and quantifying food sources. Bats, in particular, are difficult to study due to their high degree of mobility, use of diverse habitats, and the inherent challenge of observation or capture of small, volant, nocturnal creatures. Compound-specific amino acid nitrogen isotope ($\delta^{15}N$) analysis offers a novel and noninvasive method to estimate trophic position of many species, but its applicability to bats remains unknown. Here, we present preliminary $\delta^{15}N$ data of amino acids obtained from the hair of five highly-specialized bat species (carnivorous *Vampyrum spectrum*, piscivorous *Myotis vivesi*, sanguivorous *Desmodus rotundus*, and frugivorous/nectivorous *Artebius jamaicensis* and *Glossophaga soricina*). Individual trophic positions calculated from amino acid $\delta^{15}N$ values ranged from 1.9±0.3 (purely vegetarian) to 3.8±0.3 (carnivorous, high on the food chain). The trophic positions calculated for each species were within the range of those based on *a priori* estimates from the known dietary strategies of these species. Thus, these results validate the application of amino acid $\delta^{15}N$ data for assessing the dietary complexity of bats feeding in marine and terrestrial environments. In ongoing work, we are applying this tool to quantify the trophic positions for bat species about which dietary preferences are uncertain.

***Paternity and Parentage Genetic Analysis of the White Honduras Bat, *Ectophylla alba* (Chiroptera: Phyllostomidae), Using Microsatellites**

Daniela Carmona[1], Jorge Ortega[1] and Bernal Rodríguez-Herrera[2]
1 *Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Ciudad de México, MEX;* ***2*** *Escuela de Biología, Universidad de Costa Rica, San José, CRI*

*** Daniela Carmona** received the **Bernardo Villa Award**.

So far, genetic analysis in bat group composition has not documented. The genetic processes that influence the conformation of bat social groups are unknown. Like most Neotropical bats, *Ectophylla alba* build shelters or tents, where more than two individuals are involved, been in many cases females. Our goal was to analyze the genetic identity of the individuals present in different hanger groups, to test the hypothesis of kin selection as a major force to structure group composition. We used thirteen microsatellites, designed for *E. alba*, to demonstrate the genetic identity of individuals and parentage. We analyze parenting and kinship using the ML-Relate, GenAlex, CERVUS, PARENTE, and several specialized software. We observed a clear paternity relationship among adults and offspring in the obtained probabilities (0.5) with allele compatibility. We achieved a low level of relatedness within hanger groups (0.2), for groups at different locations the half-sib relationship probabilities was rated among 0.2-0.25, and for full siblings we observed a probability between 0.25-0.5. We explained the relationship among individuals in hanger group, due the paternity bounds between pups and mothers. Adult individuals are not genetically related and kin selection evolutionary force did not explain the group composition.

Status and Roost Selection of Male Tri-colored Bats in the Great Smoky Mountains National Park
Grace M. Carpenter[1], Emma V. Willcox[1], Riley F. Bernard[1,2] and William H. Stiver[2]
1 *Department of Forestry Wildlife and Fisheries, University of Tennessee, Knoxville, USA;* ***2*** *National Parks Service, Great Smoky Mountains National Park, Gatlinburg, USA*

The tri-colored bat was once common across the eastern U.S. However, populations have been severely impacted by white-nose syndrome (WNS) and the species has been petitioned for federal listing. During the summers of 2015 and 2016, we determined the status of tri-colored bats in Great Smoky Mountains National Park (GRSM), and examined summer roost tree use and selection by the species to better inform management strategies and aid in species recovery. We captured bats at 24 locations across GRSM over 68 net-nights. We compared our data with results from a study conducted at the same sites during the summers of 2000-2004, prior to the WNS outbreak. Pre-WNS, 10 bat species were captured, while, post WNS, we captured 12 bat species. From 2004 to 2016 total bat captures declined by 65%. Over the same time period, capture rates of tri-colored bats declined by 78%, suggesting populations of the species have declined dramatically since the arrival of the disease. To investigate roost site selection, we used radio telemetry to locate day roosts used by individual bats. To date, we have tracked 15 male bats (no females have been captured) to 35 roost trees. Of the roost trees used, 42.9% were oaks (*Quercus* spp.), 28.6% were maples (*Acer* spp.), and 28.6% were other hardwood species. We are in the process of conducting analyses to characterize roost tree selection.

Reinforcement of the Lower Respiratory Tract in Response to Flight Development in Jamaican Fruit Bats (Phyllostomidae)
Richard T. Carter
Department of Biology, University of Dayton, Dayton, USA

The production of echolocation in bats along with forces produced by contraction of abdominal wall musculature and thoracic musculature used in flight presumably puts relatively high mechanical loads on the lower respiratory tract (LRT). Thus, there are likely adaptations to prevent collapse, or distortion of the bronchial tree and trachea during flight in echolocating bats. By clearing and staining (alcian blue and alizarin red) LRTs removed from nonvolant neonates, semivolant juveniles, volant subadults, and adult Jamaican fruit bats (*Artibeus jamaicensis*), I found that calcification of the tracheal, primary bronchial, and secondary bronchial (lobar) cartilage rings occurs over the span of about three days and coincides with later developmental stages of flight and the increased use of echolocation. Tracheal rings that are immediately adjacent to the larynx calcified first followed by more caudal tracheal rings and then the rings of the primary and secondary bronchi. I suggest that calcification of LRT cartilage rings in echolocating bats provides increased rigidity to counter the thoracic compressions incurred during flight. Calcification of the LRT rings is an adaptation allowing for the use of laryngeal echolocation during flight.

Social Roles in Contact-calling Communication Networks of the Spix's Disc-winged Bat
Gloriana Chaverri[1] and Maria Sagot[2]
1 *Universidad de Costa Rica, Alamedas, Golfito, CRI;* ***2*** *Department of Biological Sciences, State University of New York at Oswego, Oswego, USA*

Group formation is known to increase fitness, as individuals in larger and more cohesive groups face reduced rates of predation, and may engage more often in cooperative interactions such as grooming and sharing resources. Bats effectively maintain group cohesion through contact calls, forming communication networks. These networks might be composed of individuals that differ in a specific set of behaviors or social roles. No studies to date however, have evaluated differences in contact calling rates among individuals within groups. In this study, we measured differences in contact calling rates within groups, to determine if social roles exist in communication networks of the Spix's disc-winged bat (*Thyroptera tricolor*). To do this, we estimated variation in contact calling rates within and among groups. We also calculated assortativity, or homophily within social networks. We found that most groups were composed of individuals that produced a different amount of social calls. There was more variation in the number of inquiry calls produced within groups, than there is in the entire population. Moreover, as group size increased, more social calls were emitted as a result of presence of a larger number of more vocal bats, combined with other less vocal individuals, but not as a result of a greater number of calls emitted per group member. Identifying social roles in communication networks, will allow us to understand behavioral mechanisms used to establish and maintain cohesion in social groups.

Bats Roosting in Bridges: Details and Results from a New England Project

Scott A. Civjan[1], Angela Berthaume[1], Alyssa Bennett[2] and Elisabeth Dumont[3]
1 *Department of Civil and Environmental Engineering, University of Massachusetts, Amherst, USA;* ***2*** *Vermont Fish and Wildlife Department, Rutland, USA;* ***3*** *Department of Biology, University of Massachusetts, Amherst, USA*

A research project was undertaken to assess bats' use of bridges for roosting in New England. The project included rapid visual assessments of 191 bridges and more extensive evaluation of eighteen of these bridges. Full evaluations included acoustic monitoring, detailed inspections, and emergence studies during early, mid, and late summer roosting seasons in summer 2015 and/or 2016. Through this project, eleven documented bridges have been positively identified as bat roosting sites (five monitored in project, six notified of by state Departments of Transportation), with possible roosting at several other sites. The project evaluated monitoring technologies including: acoustic methods, infrared imaging, borescope inspection, and visual inspection. To identify bat species both full-spectrum (SonoBat) and zero-crossing (EchoClass) acoustic monitoring software were used. These programs' results differed significantly in species identification of identical call sequences, which agrees with wide discrepancies between automated acoustic bat identification software program results previously reported in the literature. Further evaluation of differences is ongoing. A new bridge inspection survey has been developed for the project to supplement the joint Federal Highway Administration and Federal Railroad Administration (FHWA/FRA) survey forms. Recommendations for bridge surveys, training of inspection personnel, interpretation of data, and information to request from consultants have been developed through the project. Final project findings can be used as guidance for Transportation Agencies developing protocol for construction at potential roosting sites, which will be especially useful if Federal listing of bat species and associated 4(d) rulings are modified in the future.

Bat Bone Mineral Analyses: Challenges and Requests for Bones to Analyze

Carson Clabeaux[1], Samual Andrews[1], David Rusak[2] and Gary Kwiecinski[1]
1 *Department of Biology, University of Scranton, Scranton, USA;* ***2*** *Department of Chemistry, University of Scranton, Scranton, USA*

Gross and microscopic morphological arrangements of adult long and flat bones of bats are typically mammalian. Unlike bird bones, bat bones do not contain pneumatic air sacs, instead, the cortical and trabecular bone are reduced. Yet, bat bone appearance is similar to any other terrestrial mammal. How does bat bone structural reduction by cortical and trabecular thinning remain supportive and not compromise strength? We hypothesize that the mineral composition of bone may vary allowing for increased strength and decreased weight (e.g., an increase in magnesium content). We also predict disease will alter bone mineral composition and bats with white-nose syndrome (WNS) will have reduced bone mineral composition. Previous studies provided bones from bats of both sexes, and bats with and without WNS. We analyzed their mineral composition by standard protocols utilizing flame atomization atomic absorption spectrophotometry (AAS) after acid hydrolysis of dried bone mass, 5-30 mg. Bones included either single or pooled femurs, tibias, radii, and phalanges (humeri not available) from individual *Myotis lucifugus*. Preliminary analyses found the amount of bone available per bat was inadequate for establishing validity for individual minerals within the working part of standard curves for trace minerals (e.g., Pb, Mg, Zn, Fe). Either more bone mass is required (ideally 100 mg) or a technique needs to be developed that allows for small sample sizes. We believe a furnace atomization AAS method will reduce required sample size, and increased bone mass will allow for determination of mineral composition. Do you have bat bones we can atomize?

Considerations of Heterothermy in Optimal Migration Theory: Optimizing Time and Energy during Migration

Jeff Clerc and Liam P. McGuire
Department of Biological Sciences, Texas Tech University, Lubbock, USA

Optimal migration theory is a predictive framework used to understand migratory decisions and strategies. Under optimal migration theory, individuals face tradeoffs when optimizing one of three currencies: time, energy, and predation risk. As currently considered, optimal migration theory assumes strict homeothermy, and thus does not accurately describe bats using torpor. Heterothermic migrants can minimize both time and energy expenditure by using torpor, and therefore avoid tradeoffs as typically considered. We hypothesized that heterotherms (1) optimize the fat mass accumulation to consumption ratio to reduce energy expenditure and (2) use torpor to increase net fuel deposition rate (FDR) independent of the daily FDR to reduce time expenditure. During spring migration we compared heterothermic male and presumed homeothermic (due to pregnancy) female *Lasionycteris noctivagans* to

test our predictions that (1) heterotherms have lower variance in fat mass in response to fluctuating prey availability and environmental conditions and (2) the proportion of foraging males would be less than or equal to that of females in response to fluctuating prey availability. We used quantitative magnetic resonance to measure fat mass of individuals and carbon isotope ratios from breath samples to quantify foraging. As predicted males had a lower variance in fat mass compared to females. Analysis of breath samples is ongoing. Our results suggest that heterothermic migrants reduce trade-offs between time and energy by minimizing the expenditure of both currencies during migration. Our study sheds new light on heterothermic migration, and expands the usefulness of optimal migration theory by incorporation of alternative thermoregulatory capacities.

The White-nose Syndrome National Response in 2016

Jeremy T.H. Coleman[1], Jonathan D. Reichard[1], Christina Kocer[1], Catherine Hibbard[1], Ann Froschauer[2], Jennifer Smith-Castro[3], Richard Geboy[4], Pete Pattavina[5], Bronwyn Hogan[6], Drew Crane[7] and Jordi Segers[8]
1 *U.S. Fish & Wildlife Service, Hadley, USA;* ***2*** *U.S. Fish & Wildlife Service, Lacey, USA;* ***3*** *U.S. Fish & Wildlife Service, Houston, USA;* ***4*** *U.S. Fish & Wildlife Service, Bloomington, USA;* ***5*** *U.S. Fish & Wildlife Service, Athens, USA;* ***6*** *U.S. Fish & Wildlife Service, Sacramento, USA;* ***7*** *U.S. Fish & Wildlife Service, Anchorage, USA;*
8 *Canadian Wildlife Health Cooperative, Atlantic, CAN*

In 2016, white-nose syndrome (WNS) was detected in western Washington State, marking the westernmost detection of the disease in North America and a significant change in the disease's range. WNS or the causative fungus, *Pseudogymnoascus destructans,* is now documented in 32 states and 5 provinces. Effects of WNS have varied among hibernating bat species and the national network of scientists working on the issue continue to advance our understanding of this major threat to bats. Sister national plans in the United States and Canada provide the framework for a comprehensive North American response, and establish topic-focused working groups to address research, management and communication needs for WNS. The U.S. Fish and Wildlife Service is the lead federal agency coordinating the response in the U.S., and since 2008 the agency has provided $27 million to researchers, conservation organizations, and state and federal agencies to address WNS. Scientists are investigating WNS from all angles, including the life history and ecology of this newly described fungus, the dynamics of fungal infection and transmission, and bat hibernation physiology and immunology in their search for a way to control *P. destructans* and conserve our native bats. Through the combined efforts of our community, we are making great advances in science and management of bats and wildlife diseases.

Monitoring of an Undisturbed Cave Bat Population at Multiple Time Scales

Angela Como[1], Frex D. Dimaculangan[2], Phillip Alviola[2], James Alvarez[2,3] and Jodi Sedlock[1]
1 *Department of Biology, Lawrence University, Appleton, USA;* ***2*** *Department of Biological Sciences, University of the Philippines, Los Baños, PHL;* ***3*** *Los Baños Museum of Natural History, University of the Philippines, Los Baños, PHL*

Cave bat populations worldwide are threatened by human disturbances, including mining, hunting, and ecotourism. An understanding of background population dynamics is essential to effectively managing caves for bat conservation. In this study, we monitored an undisturbed cave population comprised of four *Rhinolophus* spp. in the Mt. Makiling Forest Reserve in Laguna, Philippines. Evening emergences were filmed one night in August for three years, and individual bats were counted from the video footage. Additionally, evening emergences were filmed and individuals counted for five consecutive nights during the months of December-March during the third year. Bat call and capture data were compared with emergence footage to determine species compositions of the emergences. August wet season counts differed by 59% between years (range = 9316-5500 individuals), and monthly differences were as high as 76% between August and March. Moreover, the dramatic decline in population size between wet and dry seasons corresponded with a shift in the species composition from a *R. arcuatus*-dominated to a *R. macrotis*-dominated colony. These changes in population dynamics on a daily, seasonal, and annual scale in the absence of human disturbance highlight the importance of long-term monitoring to accurately assess population dynamics of cave bats. These findings suggest that cave use guidelines based upon one-time population censuses may not adequately account for the full scope of bat usage of the cave habitat.

Structure of Mutualistic Networks between Nectar-feeding Bats and Plants in a Semiarid Caatinga Forest of Brazil

Eugenia Cordero-Schmidt[1], Juan Carlos Vargas-Mena[1], Bruna Carvalho[1], Paulino Oliveira[2], Francisco de Assis R. Santos[2], Rodrigo A. Medellín[3], Bernal Rodriguez-Herrera[4] and Eduardo M. Venticinque[1]

***1** Departamento de Ecologia, Universidade Federal do Rio Grande do Norte, Natal, BRA; **2** Laboratorio de Micromorfologia Vegetal, Universidade Estadual de Feira de Santana, Novo Horizonte, BRA; **3** Instituto de Ecologia, Universidad Nacional Autónoma de México, México D. F., MEX; **4** Escuela de Biologia, Universidad de Costa Rica, San José, CRI*

Biodiversity encloses not just different species but also the interactions among them. Ecological networks seek for patterns with strong representation of the interactions between species highlighting their global interdependence. The study of these networks represents a conceptual and methodological challenge in highly diversified communities with several interactions. Bats exhibit high degrees of functional, compositional and structural diversity. Sixteen of the total 181 bat species occurring in Brazil are nectar-feeding bats and at least eight of these species co-occur in the semiarid Caatinga. Mutualistic networks between nectar-feeding bats and plants in semiarid environments have not been broadly studied. Our main objective was to describe the network of mutualistic interactions between nectar-feeding bats and plants in a semiarid forest in Caatinga of Rio Grande do Norte, to understand how these interactions varied according to resource use between bat species and resources availabilities temporally. As expected this network presented a pattern of nestedness and asymmetry. Showing this is a cohesive and resilient system where differences between the plants species used by bats varied among the bat species and among the sampled months. Finally, the columnar cactus *Pilosocereus pachycladus* and the bromeliad *Encholirium spectabile* were identified as central keystone species for the maintenance of the nectar-feeding bat community present in this Caatinga area.

Burn, Baby, Burn: Effects of Wildfire on Bat Species Occupancy Probability in the Sierra Nevada Mountains

Derek Corcoran[1], Dylan C. Kesler[2], Elisabeth Webb[1,3] and Matthew Johnson[4]

***1** Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia, USA; **2** Institute for Bird Populations, Point Reyes, USA; **3** U.S. Geological Survey, Missouri Cooperative Fish and Wildlife Research Unit, Columbia, USA; **4** USDA Forest Service, Plumas National Forest, Quincy, USA*

Increasing wildfire frequency and severity in the Western United States emphasizes the importance of understanding how fire-mediated habitat changes affect biodiversity. We evaluated wildfire effects on occupancy probability for 17 bat species in recently burned areas in the Sierra Nevada Mountains. Pettersson D500X passive detectors were used to record bat presence for three consecutive nights, at 120 sites in the Plumas National Forest during 2015-2016. We used k-means to classify the forest environment into five habitat types based on altitude, distance to water, distance to road, and vegetation type, and randomly sampled at 12 sites in each habitat type in areas impacted by wildfire and in areas not impacted by wildfire. Occupancy models were structured with all possible linear combinations of five variables associated with fire intensity and ranked using an information theoretic approach. Our results indicate that 15 of the 17 species had higher probability of occupancy in areas that experienced wildfire during the past 20 years, including three bat species of conservation concern (Forest Service Sensitive Species). Results indicate a positive relationship between fire intensity and bat species occupancy.

Usage of Major North Dakota Rivers as Corridors by Migratory Bats

Kevin Cortes and Erin Gillam

Department of Biological Sciences, North Dakota State University, Fargo, USA

The devastating spread of white-nose syndrome has led to an increasing body of work on hibernating bats; yet, we still lack basic information about the migratory ecology of most species, such as the specific corridors or land features used during migration. North Dakota is a state not abundantly equipped with natural hibernacula; hence, most summer residents presumably migrate to southerly sites for the winter months. Previous work suggests that rivers may be important migratory corridors for bats, but this has rarely been quantified or studied in detail. The goal of this work was to assess the importance of major river corridors in western and central ND as migratory corridors for bats. In Summer 2016, ultrasonic detectors with two microphones each were placed along the southward-flowing Missouri River in central ND. Microphones at each site were arranged parallel to the river and positioned 10m apart. Directionality (northward/southward flight) or nondirectionality of recorded bats was determined by analysis of the resulting stereo files in which calls were sequentially detected by both microphones. Proportional

directionality in the spring, summer, and fall months varied; additional analysis is ongoing. The frequency of directional vs. nondirectional flight varied between species, likely due to species-specific migratory patterns and behaviors. The results of this study will help us better understand the migratory ecology of bats in the Northern Great Plains.

Survey for Northern Long-eared Bats at Naval Installations in Virginia and North Carolina

Katelin K. Craven[1], David E. Yates[2], Derek W. Hengstenberg[1], Morgan Ingalls[2], Mandy M. Bailey[2], Caroline M. Byrne[2] and Blake Waller[3]
1 *Tetra Tech Inc., Portland, USA;* ***2*** *Biodiversity Research Institute, Portland, USA;* ***3*** *US Navy, Arlington, USA*

Surveys are necessary to provide important baseline information regarding the presence and health of bat species following the spread of white-nose syndrome. Multi-faceted, multi-year and large scale surveys covering several sites in a given area can provide that information. Nine U.S. Naval installations within approximately 1,000 mi^2 of southeastern Virginia and northeastern North Carolina, were surveyed for bats—the federally threatened northern long-eared bat (*Myotis septentrionalis;* NLEB) in particular—during the summer maternity season of 2014, 2015, and 2016. A compilation of mist-netting, day roost radio telemetry, emergence counts, and full-spectrum acoustic monitoring were used for the baseline and NLEB presence/absence surveys. Ten species were detected through acoustic monitoring (2,581 detector nights) at six installations. Eight species of bats were captured during 42 net night presence absence surveys at seven installations (294 total net nights). Twenty-five NLEB (83% female) were captured at three of the seven installations, of which nine NLEB were successfully tracked to roosting sites. A preference was shown for roosts in red maple trees with on average 61% canopy cover and bats showed high variability in roost switching. We looked at patterns and distances travelled from capture site and between roosts during the maternity season. Emergence counts revealed a maternity colony of 26 bats in one red maple. A concern identified during the surveys stems from the capture of only two juvenile bats at all installations combined, suggesting that while some adults seem to survive white-nose syndrome, the survival rate of their pups is still in question.

Changes in Bat Species Composition along a Forest/Agriculture Gradient

Zachary M. Cravens and Justin G. Boyles
Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, USA

A long held assumption in basic ecology is that abundance is greatest at the center of a species' range and declines toward range edges because habitat suitability may deteriorate toward the periphery while vulnerability to extirpation increases. Recent evidence, however, suggests this may not be the case in all species. We used mist-net captures and recordings of echolocations as a proxy for abundance along a forest/agriculture gradient in western Missouri. The eastern half of our study area is within the heavily forested Ozark Highlands physiographic region, and the western half is in the Osage Plains, an agricultural region with limited forest and woodlands. Taxon-specific requirements may determine how such a habitat gradient impacts a particular bat species' distribution. For example, northern long-eared bats seem to have a stronger affinity for interior forest than Indiana bats, who often roost in open savannah and agricultural landscapes. We documented the change in bat species abundance along this habitat gradient for four bat species using mist-nets and acoustic bat detectors with automated classification software to determine changes in species composition and relative abundance. Our results show that Indiana and northern long-eared bats decrease in abundance moving away from the Ozark region while little brown bats increase. There was no clear pattern in abundance of tri-colored bats. Understanding these differences has implications for the factors limiting distribution (e.g., food resource vs. environmental condition) and species vulnerability near the edge.

Summer Roosting Ecology of *Myotis septentrionalis* in the North Atlantic Coastal Plain

R. Bronson Curry and Shannon L. Farrell
Department of Environmental & Forest Biology, State University of New York College of Environmental Science & Forestry (SUNY-ESF), Syracuse, USA

As resource managers are faced with the task of conserving remnant populations of species impacted by white-nose syndrome, it is important to continue expanding our knowledge of habitat selection by bats across a diverse variety of landscapes. Cape Cod, located in eastern Massachusetts, provides an interesting example of roost selection in a coastal environment. In 2015, the National Park Service and SUNY-ESF initiated the first major study of bats at Cape Cod National Seashore (CCNS), using a combination of acoustic surveys and radio telemetry. Our

primary objective is to provide baseline information on occupancy and habitat use by bats at CCNS, with an emphasis on listed species. Over a two-year period, we captured 17 of the federally-threatened *M. septentrionalis* during 48 nights of mist netting in June and July. Nine adult female *M. septentrionalis* were fitted with radio transmitters and tracked to 22 roosts in the vicinity of the park, 77% of which were located in man-made structures. The high proportion of building roosts suggests that in this peninsular landscape characterized by mixed suburban residential and forest patches, man-made structures may provide an alternative to naturally-occurring cavities during the latter part of maternity period.

Unique Maxilloturbinal Bone Morphology in Horseshoe Bat Noses

Abigail A. Curtis[1,2] and Nancy B. Simmons[2]
1 *Department of Biology, University of Washington, Seattle, USA;* ***2*** *Department of Mammalogy, American Museum of Natural History, New York, USA*

Mammal noses contain a set of delicate bones called turbinals that range from plate-shaped, to scrolled or branched in form. Turbinals and the epithelia they support function in regulating respiratory heat and moisture loss, and increase surface area for olfactory tissue. Turbinal morphology in bats is poorly understood, but may reflect phylogenetic relationships, as well as ecological and behavioral adaptations. We used high-resolution microCT scanning to investigate turbinal morphology in 37 species from family Rhinolophidae, which we compared with those of Hipposideridae, *Megaderma lyra*, and *Pteropus lylei*. Rhinolophids have one of the most highly derived echolocation systems among bats, and show numerous modifications along the nasolaryngeal tract associated with nasal emission of high duty cycle echolocation calls. In Rhinolophidae, we found that the maxilloturbinals and a portion of ethmoturbinal I form a pair of strand-like bony structures on each side of the nasal chamber. These structures project anteriorly from the transverse lamina and complete a hairpin turn to project posteriorly down the nasopharyngeal duct, and varied in length among the species in our sample. The strand-like maxilloturbinals found in Rhinolophidae are unique in form among mammals and represent a synapomorphy for this family. Maxilloturbinal strand length and cross-sectional shape variation within Rhinolophidae were correlated with phylogeny, with some traits limited to specific clades. The position of these distinctive maxilloturbinals directly within the path that echolocation calls travel between the larynx and nostrils during call emission suggests they could play a role in sound transmission of echolocation calls.

Do Hot Bats Go Cold? Torpor in Neotropical Bats

Zenon J. Czenze[1] and Miranda B. Dunbar[2]
1 *School of Biological Sciences, University of Auckland, Auckland, NZL;* ***2*** *Biology Department, Southern Connecticut State University, New Haven, USA*

While torpor is common in bats, it has historically been viewed as an energy-saving technique reserved for temperate climates with less adaptive function in the tropics. This is understandable since the tropics do not present the same thermal challenges as temperate zones. However, this paradigm is shifting as researchers have discovered relatively common occurrences of torpor across several tropical bats families from Australia and Africa. Central America hosts a great diversity of bats with approximately 150 species, yet data from this area are lacking. Therefore, our goal was to investigate thermoregulatory responses of bats living in neotropical Belize. Adult bats were captured using mist-nets and harp traps set in tropical forests in the Lamanai Archeological Reserve in Belize. After a 12h acclamatory period, we recorded rectal temperature before and after exposing bats to 7°C for up to 60min. All 11 species across 4 families employed torpor upon exposure to cool temperatures. Individuals from Vespertilionidae defended lowest normothermic body temperature and exhibited the greatest drop in body temperature. Our data not only help to establish a new spectrum of physiological ability for this group of animals, but also shed light on the evolution of torpor. We show that contrary to wide belief, energy conservation is still of great importance even in warm and energetically stable environmental conditions. Expanding our view of torpor to also include how and why it is used in warm climates will help to better define paradigms in physiological ecology.

A Randomized and Repeatable Method for Monitoring Rock-roosting Bats at their Summer Sites

Mitch P. Dannon and Paul R. Moosman, Jr.
Department of Biology, Virginia Military Institute, Lexington, USA

Surveys of hibernacula have been the primary method used to monitor bat populations in North America, but this is of limited use in some situations. The eastern small-footed bat is one such example. Attempts at documenting

population trends for this species using hibernacula data have been frustrated by low abundance and high inter-annual variation in abundance at most sites. We developed and tested a method to assess populations of this species at their summer roost sites, on emergent rock-formations. We surveyed 6 talus sites in Virginia and 1 rip-rap covered dam in New Hampshire from 2013 to 2016 with randomized quadrats to estimate abundance, and assessed feasibility of the method. Average density (±SE) across sites was 70±14 bats per ha of rocky habitat. Estimated abundance ranged from 5 bats at the smallest site to >200 bats at the largest sites surveyed. Probability of encountering bats was similar for 3 observers who had varying levels of experience but differed based on quadrat size and seasonal changes in female roosting behavior. Simulations suggest 154-m^2 quadrats were optimal until females clustered into maternity colonies in mid-June, at which point ≥314-m^2 quadrats were warranted. Abundance estimates from quadrat-surveys had substantially lower variance than published hibernacula data. We argue surveys of rock-formations should be used in conjunction with other methods to monitor range-wide status of eastern small-footed bats. Surveying using this method also is likely to be useful for monitoring other species of rock-roosting bats.

Quantifying Species Richness and Activity of Bats in South Texas Using Ultrasonic Detectors

Helen T. Davis[1], Jeremy A. Baumgardt[2], Michael L. Morrison[1], Leonard A. Brennan[3] and Tyler A. Campbell[4]
1 *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, USA;* ***2*** *Texas A&M Institute of Renewable Natural Resources, College Station, USA;* ***3*** *Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, USA;* ***4*** *East Foundation, San Antonio, USA*

Southern Texas is an important region for bats providing species with breeding, wintering, foraging, and roosting sites. This region is also a crucial migration route for several species. However, little is known about the bat species occurring in this region and the degree to which they occupy and utilize various vegetation types. Between the months of June and September of 2015, we recorded bat calls using Pettersson D500X bat detectors on San Antonio Viejo Ranch (SAV) and El Sauz Ranch (ELS) operated by the East Foundation. We used a stratified random sampling study design to determine the placement of bat detectors within 9 vegetation types occurring on these ranches. We sampled a total of 216 nights at 35 sampling locations at SAV and 20 nights at 6 sampling locations at ELS. We classified bat calls to species using SonoBat 3.3.1 software. We detected 703 bat calls of 9 species at SAV and 163 calls of 6 species at ELS. At SAV, the most frequently detected species was *Myotis velifer* which accounted for 25% of all detections. At ELS, the most frequently detected species was *Lasiurus borealis* which accounted for 69% of all detections. We will continue sampling efforts in 2016 to monitor bat species occurring in south Texas. We will also use these data to determine if vegetation structure influences activity and richness of bat species in this region.

Habitat Characteristics Influencing Summer Occupancy of *Myotis* Species in Bottomland Hardwood Ecosystems

Jacquelyn A. Dearborn[1], Derek Corcoran[1], Elisabeth Webb[2], Sybill Amelon[3] and Shauna Marquardt[4]
1 *Department of Fisheries and Wildlife, University of Missouri, Columbia, USA;* ***2*** *U.S. Geological Survey, Missouri Cooperative Fisheries and Wildlife Research Unit, University of Missouri, Columbia, USA;* ***3*** *USDA Forest Service, University of Missouri, Columbia, USA;* ***4*** *U.S. Fish & Wildlife Service, Missouri Ecological Services Field Office, Columbia, USA*

Wide-scale anthropogenic land use changes in the Mississippi Alluvial Valley have resulted in the loss of approximately 96% of bottomland hardwood forests in the region. Mingo and Cypress Creek National Wildlife Refuges contain some of the last remaining tracts of this ecotype. Due to the characterization of bottomland hardwoods as prime roosting habitat for *Myotis* species, including *Myotis sodalis,* it is important to determine which habitat types within the refuges are utilized by *Myotis* species. During summer 2015, nine sites were randomly selected in habitats characterized as cropland, herbaceous wetland, and wooded wetland on each refuge. In each habitat type, we placed three Anabat II detectors that were deployed for three consecutive nights, and then moved to the next site in each habitat type. Throughout summer 2015, all nine sites per habitat type per refuge were surveyed for three detector nights. Habitat characteristics including stand density, water depth, distance to water and distance to road, were measured at each site. All calls were analyzed manually using Analook software, and *Myotis* calls were identified. We evaluated *Myotis* species detection and occupancy probabilities in relation to habitat covariates in a single-season occupancy modeling framework using program DiversityOccupancy in R. The top model included stand density, showing a positive relationship between stand density and occupancy by *Myotis* species. Our results

indicate that wooded wetlands are more likely to provide useful foraging habitat for *Myotis* species, suggesting that managing for more bottomland hardwood forests would be beneficial for Indiana bats and other *Myotis* species.

Bioaccumulation of the Liver Toxin Microcystin in *Eptesicus fuscus* from Southern Michigan

Kaity M. Denney[1], Devin N. Jones[2], M. Megan Woller-Skar[1] and Amy L. Russell[1]
1 *Department of Biology, Grand Valley State University, Allendale, USA;* ***2*** *Department of Microbiology and Immunology, Montana State University, Bozeman, USA.*

Harmful algal blooms have been increasing in severity due to human alterations such as eutrophication from urban and agricultural pollution, increased temperatures due to climate change, and selective filter feeding by invasive zebra mussels. These algal blooms can produce a hepatotoxin, microcystin (MC), that causes acute and chronic damage, necrosis, and cancer of the liver in humans and other animals. The bioaccumulation of MC in bats may pose a threat to species already facing multiple conservation pressures, such as wind turbines and white-nose syndrome. We used enzyme-linked immunosorbent assay (ELISA) to measure MC concentrations in the livers of 20 big brown bats (*Eptesicus fuscus*) from 13 counties in southern Michigan. Preliminary results indicate that *E. fuscus* livers contain low MC concentrations, with 15 samples containing concentrations of MC below the detectable limit of ELISA and 5 samples containing low, but detectable, levels of MC. These results are similar to MC concentrations detected in the livers of little brown bats (*Myotis lucifugus*) from a population in the northern Lower Peninsula of Michigan. Although MC concentrations in the livers of these bats are low, continuous or repeated exposure to this hepatotoxin could have negative long-term effects. Further work to monitor MC bioaccumulation in bats is crucial.

Is Dietary Overlap Between Indiana Bats and Northern Long-eared Bats Habitat Dependent?

Timothy J. Divoll[1], Joy M. O'Keefe[1], Veronica A. Brown[2] and Gary F. McCracken[3]
1 *Center for Bat Research, Outreach, and Conservation, Indiana State University, Terre Haute, USA;* ***2*** *Division of Biology, University of Tennessee, Knoxville, USA;* ***3*** *Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, USA*

The northern long-eared bat (*Myotis septentrionalis*) and the Indiana bat (*M. sodalis*) are considered generalist predators and occur together in various landscape contexts. These two *Myotis* differ in roost preferences and foraging space use, but we do not know if dietary differences also facilitate their coexistence. Furthermore, differences between the two species may be habitat dependent. We used next-generation sequencing of fecal DNA to identify prey consumed during the 2014 and 2015 maternity seasons at two central Indiana sites, the heavily forested Hardwood Ecosystem Experiment and the highly fragmented Indianapolis Airport mitigation area. Unique representative DNA sequences were matched to reference sequences in BOLD and GenBank at 98.5% and to the lowest taxonomic level. We confirmed matches (i.e., presumed prey items) with local moth and beetle specialists. Preliminary data indicate that northern long-eared bats have greater dietary breadth. Northern long-eared bats (n=60) consumed ≥106 prey items from 9 orders, including many microlepidoptera, whereas Indiana bats (n=27) consumed ≥11 different prey items from 3 different orders. Combining high resolution diet data with ecomorphology and foraging space use should lead to improved forest management practices that provide optimal foraging habitat for these two endangered *Myotis*.

***The Use of Habituation-discrimination Tests in Bat Behavioral Ecology**

M. May Dixon[1,2], Katrine Hulgard[3], Rachel A. Page[2] and John M. Ratcliffe[4]
1 *Department of Integrative Biology, University of Texas at Austin, Austin, USA;* ***2*** *Smithsonian Tropical Research Institute, Gamboa, PAN;* ***3*** *Department of Biology, University of Southern Denmark, Odense, DNK;* ***4*** *Department of Ecology and Evolutionary Biology, University of Toronto, CAN*
*** M. May Dixon** received the **Luis F. Bacardi Bat Conservation Award**.

Habituation-discrimination paradigms provide a powerful way to test whether animals can discriminate between stimuli, without requiring extensive training. This paradigm relies on the fact that habituation is stimulus specific. If an animal habituates to a stimulus, and dishabituates in response to a change in that stimulus, then it can be said that the animal can distinguish between the two stimuli. The slope of habituation may also indicate interest in or preferences between stimuli. This method has been used extensively in psychology, but has recently become popular for understanding how animals discriminate in behavioral and sensory ecology. In this study, we used this classical paradigm to test the discrimination capabilities of frog-eating bats to differently preferred frog calls. Here, we

confirmed that frog-eating bats can discriminate between tungara frogs and other species of frog by their calls. Further, they are able to discriminate between simple and complex tungara calls. We also discuss limitations, alternate explanations, and potential drawbacks of this method, and discuss the use of this paradigm to answer other questions in bat behavioral ecology.

***The Role of Torpor in Bats in a Post-fire Environment**

Anna C. Doty[1], Clare Stawski[1], Shannon E. Currie[2], Brad Law[3] and Fritz Geiser[1]
1 *Centre for Behavioural and Physiological Ecology, Zoology, University of New England, Armidale, AUS****;*** ***2*** *Department of Zoology, Tel-Aviv University, Tel-Aviv, ISR;* ***3*** *Forest Science Unit, New South Wales Department of Primary Industries, Parramatta, AUS*

*** Anna C. Doty** received the ***Bat Research News*** **Award**.

A changing global climate has increased the occurrence of fires and the need to know how bats respond both ecologically and physiologically to alterations in their foraging and roosting habitats. Therefore, we quantified how torpor expression changed in response to (i) a wildfire-altered habitat in the lesser long-eared bat (*Nyctophilus geoffroyi*) and (ii) roost choice according to color in the Gould's long-eared bat (*N. gouldi*). *Nyctophilus geoffroyi* used shorter torpor and longer normothemia/activity four months after the wildfire compared to two years later, when vegetative cover had increased. Insect abundance was 20-fold greater four months after the wildfire than two years later, likely encouraging longer foraging and activity. An abundance of burnt, black, peeling bark providing roosting sites for bats after the wildfire, potentially also facilitating normothermia. When offered black or white roost boxes, *N. gouldi* chose to roost in black boxes 92.9% of bat-nights when fed ad libitum and 100% of bat-nights when food restricted. Periods of torpor were longer and normothermia shorter when bats roosted in white boxes and when food-restricted. Bats were able to passively rewarm more often and to a higher skin temperature when roosting in black than in white boxes, demonstrating the physiological significance of roost choice and microclimate. Our results show the importance of understanding how both large- and small-scale changes in the environment mitigate the thermal biology and energy use of insectivorous bats.

Emergence Density and Stream Frequency Spectra of *Tadarida brasiliensis*

Stephanie G. Dreessen and Laura N. Kloepper
Department of Biology, Saint Mary's College, Notre Dame, USA

Bats depend on echolocation to maneuver through their environment. Mexican Free-Tailed bats (*Tadarida brasiliensis*) form large maternal colony roosts and emerge in large, dense groups. Previous work found that the *T. brasiliensis* bats adjust their call structure during emergence, which may help the bats avoid flight collisions. The limited physical space between bats in the emerging stream is not only problematic with flight collisions, but also with echolocation interference. In this study, we tested how the density of emergence affects echolocation. Specifically, we tested the hypothesis that the density of flying bats affects echolocation characteristics of the entire stream. We determined six emergence density categories from thermal imagery, and randomly selected 20, 500ms audio samples corresponding to each density. For each audio sample, we calculated the frequency spectrum, and analyzed how the stream frequency spectrum changed according to population density. Across densities, the stream frequency spectra all have the same shape and peak frequencies, but the variance for certain frequencies differs. This change in variance suggests that these bats are attempting to avoid jamming in dense emerging streams by altering their frequencies from bat-to-bat, irrespective of density.

Influence of Prescribed Fire on Endangered Bats in the Southern Appalachians

Andrew Edelman[1], Kaitlyn Rountree[1], Joseph Johnson[2] and Jonathan Stober[3]
1 *Department of Biology, University of West Georgia, Carrollton, USA;* ***2*** *Department of Biological Sciences, Ohio University, Athens, USA;* ***3*** *Shoal Creek Ranger District, Talladega National Forest, U.S. Forest Service, Heflin, USA*

Longleaf pine (*Pinus palustris*) forests of the southeastern U.S. are a disturbance-adapted ecosystem requiring frequent low-intensity fires to maintain an open, park-like savanna. Regionally, significant efforts are being implemented to restore this once widespread ecosystem through use of prescribed fire. These forest restoration activities, however, have the potential to negatively impact endangered species such as Indiana bats (*Myotis sodalis*) and northern long-eared bats (*Myotis septentrionalis*) that are known to forage in areas with greater forest canopy cover and lower forest gap size. Our research objective is to examine how Indiana bats and northern long-eared bats

respond to large-scale habitat changes from fire-based restoration activities in longleaf forests. Our study area (ca. 125,000 acres) is located on the Shoal Creek Ranger District of the Talladega National Forest in northeastern Alabama. Large-scale management efforts on the Talladega National Forest are aimed at improving longleaf pine forests for the endangered red-cockaded woodpecker (*Picoides borealis*) by using prescribed fire and mechanical thinning to create open canopy pine stands. During summer 2016 at the Talladega National Forest, we radio-tagged 6 Indiana bats and 13 northern long-eared bats. For each radio-tagged bat we attempted to monitor roost use and nighttime foraging movements. We will present preliminary data on roost and space use of these bats in relation to prescribed fire treatments. These early results suggest that careful prescribed fire management may be compatible with the habitat needs of endangered bats during the maternity season.

Occupancy of Bat Species in North Missouri prior to Wind Energy Development: Preliminary Results

Anthony G. Elliott[1], Ivan W. Vining[2], Jason T. Layne[1,3] and Ashley M. Matteson[1]
1 *Agricultural Systems Field Station, Missouri Department of Conservation, Kirksville, USA;* ***2*** *Resource Science Center, Missouri Department of Conservation, Columbia, USA;* ***3*** *Stantec, Overland Park, USA*

Bats throughout the Midwestern United States are confronted with an uncertain future. Though North Missouri poses the potential for wind farm development, there have been few constructed. Further, the full impact of white-nose syndrome on cave hibernating bats in Missouri is still uncertain. These potential impacts emphasize the importance of assessing the current status of bat communities in Missouri for better precision when evaluating future effects of these stressors. We initiated a multi-year (2013–2017) acoustic-monitoring, occupancy-modeling project across 21 northern Missouri counties to document occupancy while incorporating detection probabilities by bat species. Sample locations (n=120) were randomly positioned throughout state and federal lands in areas of high (n=60) and low (n=60) potential for wind farm development. Within categories, we selected sites for high (n=40) and low (n=20) potential bat use based on a combination of linear geographic features and onsite confirmation by trained bat specialists. Sites are sampled from March – November within defined bat activity seasons (Spring migration, Summer maternity, and Fall migration) with three sample nights per season. Each sample location is monitored with a Wildlife Acoustics SM2Bat+^{TM} echolocation detector using two microphones, one 2m and one 12m above ground level. High and low microphones recorded similar numbers of calls, but species composition varied. We estimated detection probabilities, local extinction and colonization probabilities, as well as occupancy estimates using robust occupancy estimation in MARK, for the hoary bat, red bat, Indiana bat, and northern myotis. Detection probabilities and occupancy varied extensively depending on season, area, species, and year.

Roost Selection by Synanthropic Bats in Buildings of Great Smoky Mountains National Park

Kirstin E. Fagan[1], Emma V. Willcox[1], Riley F. Bernard[1, 2] and William H. Stiver[2]
1 *Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, USA;* ***2*** *Great Smoky Mountains National Park, National Park Service, Gatlinburg, USA*

In Great Smoky Mountains National Park (GRSM), bats are regularly reported roosting in buildings during summer, resulting in concerns for public health, historic building preservation, and bat conservation, particularly in light of white-nose syndrome. GRSM managers want to make decisions regarding building maintenance and visitor access that minimize impacts on bats, but lack information on synanthropic species in the region. We assessed bat presence, based on observation of bats or guano, and building characteristics at 143 buildings in GRSM during summer 2015, and compared the characteristics of buildings used and unused by bats with a series of G-tests. We found bats roosting in 21 buildings, including big brown bat (*Eptesicus fuscus*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), and eastern small-footed bat (*Myotis leibii*). Genetic analysis of guano from 23 buildings indicated the presence of little brown bat (*Myotis lucifugus*), in addition to species observed directly at roost sites during daytime. Roosts were found more frequently in older buildings ($P \leq 0.001$), wooden buildings ($P = 0.01$) with interior and exterior structural complexity ($P \leq 0.001$), and buildings with access points to the interior ($P = 0.01$), as well as an attic ($P \leq 0.001$), porch ($P = 0.01$), or chimney ($P \leq 0.001$), suggesting that these features may be important roost selection criteria. Bat presence, microclimate, and landscape data from summer 2016 will be incorporated into additional analyses that examine interacting factors affecting roost selection by synanthropic species in GRSM.

Going Beyond a Leap of Faith When Choosing Between Active and Passive Bat Monitoring Methods
Julie Faure-Lacroix[1], André Desrochers[1], Louis Imbeau[2] and Anouk Simard[3]
1 *Centre d'Étude de la Forêt, Université Laval, Québec, CAN; 2 Centre d'Étude de la Forêt, UQAT, Québec, CAN;* ***3*** *Ministère des Forêts, de la Faune et des Parcs du Québec, Centre de la Science de la Biodiversité, Québec, CAN*

Acoustic detection plays a central role in the assessment of bat activity patterns and their association with landscape features. However, there is a trade-off between large-scale but overly superficial sampling, and very accurate sampling with a small sample size. One solution to maximize the area sampled per unit of time is active sampling via transect protocol. When human resources are limited, passive sampling via fixed recording points allows the monitoring of fewer locations, but for a longer continuous period of time. We compared the outcomes of active and passive acoustic bat surveys. We tested whether both methods could yield similar recording quality, and if temporal, environmental and spatial variation in bat activity were concordant between the two approaches. Active and passive methods yielded similar call quality, but active sampling often missed species considered rare, which were detected by passive sampling. Both methods detected similar peaks of activity during the night and over the summer. Both methods were little affected by weather and landscape attributes. We conclude that active sampling is suitable to assess the presence of common species, but that it is less appropriate for monitoring declining or rare species.

The Habitat Effect: Echolocation Call Variation in Three *Myotis* Species Affects Identification Accuracy
Stephanie V. Findlay
Department of Biological Sciences, University of Calgary, Calgary, CAN

Passive monitoring of bat species via acoustics is a growing field within bat biology and as a result there are a multitude of software programs available which allow for species identification. However, accuracy of these programs is variable and creating a local call library is essential when trying to identify acoustically-similar species. In Dinosaur Provincial Park, Alberta, three *Myotis* species are difficult to distinguish acoustically. I created a call library of the three species in various environmental types to test whether or not recording in the bats' local habitat could improve call library quality and model performance. Bat calls recorded within the coulees differed significantly from those recorded along the tree edges in two of the three species. Model accuracy for species identification also increased when I recorded bat calls in conditions similar to their primary habitat. By recording in various environmental habitats within a study site, I was able to improve identification accuracy and maximise model performance.

How do you Track Crevice-hibernating Bats to their Hibernacula?
Stephanie V. Findlay[1] and Nicole K. Besler[2]
1 *Department of Biological Sciences, University of Calgary, Calgary, CAN;* ***2*** *Department of Biology, Saint Mary's University, Halifax, CAN*

Understanding the winter roosting ecology for North American bat species has become increasingly important since the arrival of white-nose syndrome (WNS) in 2006. Smaller bats tend to experience increased fatalities than larger species with mortality rates as high as 99%. Understanding the winter roosting ecology for these small species prior to infection could lead to more effective management strategies. Bats in Dinosaur Provincial Park, Alberta, lack conventional cave structures and over-wintering bats must use other endemic features such as rock crevices to hibernate in the area. I attached transmitters to 4 *Myotis ciliolabrum* from October to November in 2014 and 2015 in an attempt to locate and monitor internal microclimatic conditions of crevice hibernacula used by these small bats. I was unable to successfully track any of these individuals to their roost sites using conventional tracking methods. Night tracking to obtain emergence bearings proved to be the most successful method for locating roost sites but it still failed to pinpoint which crevice in the coulee face the bat was using to over-winter. Issues with tracking bats to crevice hibernacula included the inability to obtain a signal while they were inside the crevice, the number of emergence nights required to pinpoint a location, and lack of a final emergence after the hibernacula was located. I am hoping to discuss the issues and possible solutions with other researchers who may have experience with this problem.

Feeling the Burn: Bat Use of Burned and Unburned Coastal Pitch Pine-Oak-Heath Woodlands
Michael S. Fishman[1], Timothy Green[2], Jennifer Higbie[2] and Kathy Schwager[2]
1 *ERM, Biological Field Services, Syracuse, NY, USA;* ***2*** *Brookhaven National Laboratory, Natural & Cultural Resources, Upton, NY, USA*

Pitch-pine-oak-heath forests in the northeastern American coastal plain historically relied on fire to maintain their species assemblage and structure. Pitch pine relies on fire for reproduction, and fire maintained open understory, created snags, and reduced sub-canopy clutter. It may have also influenced insect assemblages. Increased fire suppression has reduced the incidence and extent of natural fires in this region, allowing stands to develop denser, more cluttered understories, and allowing growth of shade-tolerant, non-fire adapted species. Periodic natural and human-made fires still occur, however, and result in an opening of potential flyways for bats to forage, commute, and roost. One such fire occurred on Long Island, NY in 2012, burning approximately 121 ha of coastal plain pitch pine-oak-heath woodland. This provided an opportunity to compare how bats used burned forest versus unburned forest in this community. We captured bats with mist nets in paired adjacent burned and unburned areas to compare frequency distribution of bat species in burned and unburned coastal plain pitch pine-oak-heath woodland. We captured big brown bats (*Eptesicus fuscus)* (n=80), eastern red bat (*Lasiurus borealis)* (n=20), and northern long-eared bat (*Myotis septentrionalis)* (n=25) across all sample sites. We found no difference in big brown bat capture frequency between burned and unburned sites, but found that eastern red bats were captured significantly more frequently in unburned areas, whereas northern long-eared bats were captured significantly more frequently in burned areas. This may have implications in forest management and the use of prescribed fire to manage for northern long-eared bats.

Habitat Use and Species Composition of Bats in a Northeastern Coastal Plain Ecosystem
Jessica J. Fletcher, Shannon L. Farrell and R. Bronson Curry
Department of Environmental and Forest Biology, State University of New York College of Environmental Science and Forestry, Syracuse, USA

Habitat use by bats in the Northeast has been well studied, particularly following the onset of white-nose syndrome and subsequent population declines. However, much of that work has been focused on interior locations, leaving coastal habitats relatively understudied. Cape Cod National Seashore (CACO) is on a coastal plain peninsula where our understanding of bat assemblages and habitat associations is limited to historical work from the early 1900's. This site provides a unique location to study bat habitat use and contrast these associations with what we would expect from similar interior sites. We used stratified random sampling to acoustically sample sites from eight habitat categories within CACO during the summers of 2015 and 2016. We conducted comprehensive vegetation surveys and used remote sensing data to quantify local and landscape factors associated with habitat use and species assemblage. We acoustically identified eight of the nine bat species known to occur in Massachusetts, including the recently listed northern long-eared bat. Use modeling from these acoustic classifications reveals key similarities and differences in habitat use by coastal bat populations versus interior populations. Our results will be useful as wildlife managers in the Northeast evaluate management tools for coastal populations of bats in response to the listing of the northern long-eared bat and declines in other species.

The Evolutionary Potential of Hibernation Phenology in *Myotis lucifugus*
Quinn E. Fletcher, Quinn M.R. Webber, Allyson K. Menzies, Mary-Anne Collis and Craig K.R. Willis
Department of Biology, University of Winnipeg, Winnipeg, CAN

As global climate changes, animals must adjust the phenology of major life-cycle events to ensure that energetically costly activities coincide with peaks in resource abundance. It is widely assumed that an evolutionary response of phenological traits is required for natural populations to remain viable in response to climate change. We tested the hypothesis that hibernation phenology of *Myotis lucifugus* has evolutionary potential by quantifying the predictors and repeatability (which sets an upper limit on heritability) of hibernation phenological traits. Bats (n=6326) were outfitted with passive transponders (PIT-tags) at five hibernacula in central Canada. PIT-tag dataloggers were positioned at the entrances of these hibernacula to record the dates that bats immerged (i.e., entered) and emerged (i.e., departed) from hibernation. We found that immergence dates for males and females did not differ, and that immergence date was neither repeatable nor correlated with immergence mass. Conversely, the emergence dates of females were, on average, 16 days earlier than emergence dates of males. For both sexes, emergence dates were significantly repeatable and bats with larger masses emerged earlier from hibernation. Our

finding that mass was repeatable, in addition to the phenotypic correlations we observed between emergence mass and emergence date, suggests the possibility that these traits are genetically correlated. Thus, natural selection on either of these traits could result in evolutionary changes in the other. Overall, our analysis suggests a possible genetic under-pinning of emergence (but not immergence) phenology, and is important for predicting how hibernators might respond to climate change.

Conservation Ecology of Bi-national Migratory Pollinating Bats: Lessons from *Leptonycteris*

Winifred F. Frick[1,2], Dave Waldien[1], Paul A. Heady III[3] and Rodrigo A. Medellín[4]
1 *Bat Conservation International, Austin, USA;* ***2*** *Ecology and Evolutionary Biology, University of California, Santa Cruz, USA;* ***3*** *Bat Conservation Research and Services, Aptos, USA;* ***4*** *Instituto de Ecologia, UNAM, Ciudad de Mexico, MEX*

Conservation of *Leptonycteris* species requires bi-national coordination as well as ecological research on seasonal phenology, migratory movements, and demography. The lesser long-nosed bat (*Leptonycteris yerbabuenae*) is protected as federally endangered in the United States at the northern extent of its migratory range and was recently de-listed from threatened status in Mexico. We present the first results describing the seasonal phenology and conservation status of *L. yerbabuenae* on the Baja peninsula, a spatially disjunct part of the species' range. We established long-term monitoring using passive integrated transponder (PIT) monitoring systems at roost entrances and conducted seasonal roosts surveys along a 450 km transect on the Baja peninsula to show geographic patterns in seasonal occupancy. Our results support a hypothesis that the majority of *L. yerbabuenae* population does not reside year-round on the peninsula. Local studies can better contribute to range-wide conservation planning through collaboration and coordination. We discuss results from our focused work on *L. yerbabuenae* to inform range-wide conservation planning. We share how coordinated efforts to collaborate across borders, including installing multiple PIT tag monitoring stations at key roosts, are also being employed for range-wide conservation research on the bi-nationally endangered *L. nivalis* through the Nivalis Conservation Network. Combining new technological approaches and collaborative networking are aiding efforts to assess and address range-wide conservation needs of these migratory bats.

A Unified Voice in the Fight against White-nose Syndrome

Ann R. Froschauer and the White-nose Syndrome Communications and Outreach Working Group
U.S. Fish & Wildlife Service, Lacey, USA

The White-nose Syndrome Communications and Outreach Working Group is one of seven working groups developed under the National White-nose Syndrome Plan to address research and management priorities. Comprised of about 30 members from federal and state agencies and non-governmental groups, the working group develops and carries out a plan for communicating information about white-nose syndrome to partners involved in the white-nose syndrome response, and to the public. As part of this effort, the USGS and the Working Group developed a poster and handout that you can use at meetings and other venues to educate people about white-nose syndrome. The materials provide updated information, introduce working team members and highlight our messages for the public. Working group members at the workshop will staff the poster at the poster session to talk with you about our priorities for 2016 and how we can help you with your outreach needs.

White-nose Syndrome Arrives in Western North America

Kyle G. George[1], Katherine H. Haman[2], Christopher D. Anderson[2], Jeffrey M. Lorch[1], Jonathan Palmer[3], Daniel Lindner[3], Jeffrey T. Foster[4] and Anne E. Ballmann[1]
1 *U.S. Geological Survey National Wildlife Health Center, Madison, USA;* ***2*** *Washington Department of Fish and Wildlife, Olympia, USA;* ***3*** *USDA Forest Service, Northern Research Station Center for Forest Mycology Research, Madison, USA;* ***4*** *University of New Hampshire, Department of Molecular, Cellular and Biomedical Sciences, Durham, USA*

White-nose syndrome has caused massive mortality of cave-hibernating bats in the eastern U.S. since the causative fungus, *Pseudogymnoascus destructans* (Pd), was first documented in New York in 2006. The fungus has since spread from its epicenter by approximately 200–900 km per year in a pattern consistent with a point-source introduction, reaching eastern portions of Oklahoma, Nebraska, and Minnesota by spring 2016, approximately 1,900 km from the first documented site. Here we describe the first detection of Pd in the western U.S., over 2,100 km away from the nearest known Pd occurrence. In March 2016, a debilitated little brown bat (*Myotis lucifugus*) was

found along a hiking trail in King County, Washington and was later confirmed to have white-nose syndrome. The fungal isolate obtained from this bat grouped with other isolates of Pd from the eastern U.S. based on whole genome sequencing and phylogenetic analyses. Furthermore, the bat was determined to be a western subspecies, *M. lucifugus alascensis,* through sequence analysis, and subsequent surveillance detected Pd on a second bat from King County. These findings indicate that the presence of Pd in Washington does not represent another novel introduction to North America and that these bats became infected in the Pacific Northwest. Sampling of bats and hibernaculum environments suggests that Pd is not yet widespread or abundant in western states, but more intensive surveillance efforts are needed. It is unclear how Pd will affect western species of bats, but the disease could have major implications for their conservation and management.

Demography of a Recovery: *Myotis lucifugus* Populations in the Northeast Rebounding from White-nose Syndrome

Katherine M. Gillman[1] and Jeffrey T. Foster[2]
1 *Natural Resources and Earth Systems Science, University of New Hampshire, Durham, USA;* ***2*** *Department of Molecular, Cellular, and Biomedical Sciences, University of New Hampshire, Durham, USA*

Little brown bat (*Myotis lucifugus*) populations throughout eastern North America have declined dramatically since the 2006-07 emergence of white-nose syndrome (WNS), a normally deadly disease caused by the fungus *Pseudogymnoascus destructans* (Pd). In the Northeast, some maternity colonies have been completely wiped out while others have persisted and are even showing signs of stabilizing or increasing in the last several years. Female survivors have also been recaptured at certain sites, some of which were reproducing. While these are positive signs, questions remain about the impact of WNS on key demographic rates, such as reproductive rate, survival of adults and juveniles, and recruitment of juveniles into the adult population. By studying maternity colonies in New England, one of the earliest areas to be hit by WNS, we hope to determine whether little brown bat populations are truly beginning to recover. The main emphasis of this research is to use mark-recapture techniques over multiple field seasons. During the first field season in 2016, we trapped bats from seven colonies between mid-May and mid-August using harp traps. In total, we captured over 600 individuals, approximately 16% of which were recaptures from previous banding efforts at five sites. The oldest bat was at least seven years old. Wing and buccal swabs, wing biopsies, and guano were collected during processing for future analyses. Capture data will ultimately be analyzed using program MARK and the results will be used to develop conservation strategies to promote reproduction, survival, and recovery of little brown bats.

Flying with the Enemy? Four *Pteronotus* Species Sharing a Dry Forest of Costa Rica

Luis Girón-Galván, Gilbert Barrantes, Luis Sandoval, Melissa E. Rodríguez and Bernal Rodríguez-Herrera
Escuela de Biología, Universidad de Costa Rica, San José, CRI

In the tropics there is a high species richness of insectivorous bats and this richness could be maintained by the efficient distribution of environmental resources. One family whose species of insectivorous bats can be syntopic, is the Mormoopidae. In Barra Honda National Park in Costa Rica, four mormoopid species occur: *Pteronotus davyi, P. gymnonotus, P. mesoamericanus* and *P. personatus*. The species roost in caves in large numbers, but it is unknown how these species are distributed spatially and temporally, in different microhabitats of the Park when they came out of the caves. To know this, from October 2015 to March 2016 we made ultrasonic recordings simultaneously in three microhabitats of the park: Closed Forest (closed understory / closed canopy), Open Forest (few understory / few canopy) and Rural (adjacent villages to the park). We found spatial differences in the acoustic activity of the *Pteronotus spp*., but there is no evidence of temporal distribution. The species *P. davyi* and *P. gymnonotus* presented more activity in Open Forest (χ^2=208.65, d.f=2, p<.001; χ^2=397.30, d.f=2, p<.001) and *P. mesoamericanus* in Closed Forest (χ^2=234.61, d.f=2, p<.001). For *P. personatus* there were two records in Open Forest. This indicates that the two largest species (*P. gymnonotus* and *P. mesoamericanus*) are not flying in the same microhabitats in Barra Honda National Park, which could be a strategy for better use of resources. In addition, we are analyzing morphological and acoustic characteristics of each species, to better understand how these species are adapted to coexist in this forest.

Determining the Distribution of Declining Bat Species in North Georgia

John F. Grider, Steven B. Castleberry and Jeffrey Hepinstall-Cymerman
Warnell School of Forestry and Natural Resources, University of Georgia, Athens, USA

Mortality from white-nose syndrome has led to several species of bats becoming management priorities. However, developing conservation strategies for these species is difficult due to limited knowledge regarding their distribution and habitat associations. To address this paucity of knowledge, we examined summer distribution and habitat use of declining cave-dwelling bat species in northern Georgia. We used mist-netting and acoustic records on public and private lands, from 2013-2016 to determine species distributions in a post-white-nose syndrome environment. Habitat use was determined using hierarchical generalized linear models, with variables such as land cover, aspect, elevation, and various landscape dynamics being considered. Variables were derived on several scales ranging from home range (65 ha) to landscape (3,420 ha) scales to explore potential multiscale habitat selection. Preliminary results for Northern long-eared bat (*Myotis septentrionalis*) suggest percent mixed forest and elevation at the home range scale are the best predictors of occurrence. However, mixed forest is not common on the landscape and is poorly mapped in regional land cover maps; therefore, our models may be under-predicting available habitat. Models for additional species, refinement of current distribution models, and the ability of these models to aid in land use decisions, such as highway development, will be discussed.

Enhancing Summer Bat Population Monitoring at Four Southeastern Caves Impacted by White-nose Syndrome

A. Robert Hagy[1], Emma V. Willcox[2], Kenzie A. Moore[2] and Steven C. Thomas[3]
1 *Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, USA;* ***2*** *Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, USA;* ***3*** *Cumberland Piedmont Network, Mammoth Cave National Park, National Park Service, Mammoth Cave, USA*

In 2014, regular monitoring of summer bats via cave emergence counts was initiated at 4 Southeastern National Parks (NPs; Chickamauga and Chattanooga, GA/TN; Cumberland Gap, KY/TN/VA; Mammoth Cave, KY; and Russell Cave, AL). Effective monitoring has become critical in recent years to inform management of bat populations affected by the fungal disease white-nose syndrome (WNS). The goal of our study was to temporarily increase the number of emergence counts conducted at these 4 NPs to determine the most effective methods (i.e., equipment, timing, and frequency) for collecting high-quality monitoring data. During the summer of 2016, we conducted emergence counts at 8 cave entrances over 3 sampling periods (May, June, July) and using 3 sampling methods. These sampling methods included physical counting of bats by technicians using night vision goggles, as well as the recording of emergence events using night vision and thermal infrared video cameras for later viewing and counting of bats. The number of bats emerging from our study caves ranged from 0−4376 individuals/night. Mammoth Cave had the largest mean emergence count at 2012 bats/night. We are in the process of conducting analyses examining differences in emergence counts between sampling periods and using different methods.

Townsend's Big-eared Bat in California: A Snapshot of Statewide Distribution

Leila S. Harris[1], Michael L. Morrison[2], Joseph M. Szewczak[3], Ashley M. Long[4] and Scott D. Osborn[5]
1 *Independent/ICF Jones & Stokes, Sacramento, USA;* ***2*** *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, USA;* ***3*** *Department of Biological Sciences, Humboldt State University, Arcata, USA;* ***4*** *Texas A&M Institute of Renewable Natural Resources, College Station, USA;* ***5*** *California Department of Fish and Wildlife, Nongame Wildlife Program, Sacramento, USA*

We are assessing Townsend's big-eared bat (*Corynorhinus townsendii*; hereafter COTO) roost sites throughout California. A broad-scale evaluation of COTO has not occurred since Pierson and Rainey's work in the late 1980s. The species has been proposed for California Endangered Species Act listing; understanding the current condition and distribution of roost sites will support management of this species, regardless of listing decision. Our work involves visual detection/no detection surveys at two types of sites: known historic roosts and potential roost habitat in randomly selected 10 x 10 km grid cells throughout the state. We gather data on bat detections, site structure and dimensions, environmental conditions (e.g., temperature, humidity), signs of disturbance, and distances to water. These data will inform a model seeking to explain COTO occupancy. Field work will continue through winter 2016-17, encompassing two hibernation seasons and two maternity seasons. Preliminary results suggest that many previously known sites no longer host bats, colonies are more likely to occur at sites that are protected or provide multiple roost choices, COTO detections are not uniformly distributed, and while structural complexity is positively

correlated with detections, individual COTO are encountered at a relatively wide range of temperatures and sites, often without a maternity roost site found in the area. It is not clear whether individual COTO are remnants of former populations or representative of yet undetected colonies. The role of presumed less ideal roost sites, both in defining species distribution and in maintaining COTO populations requires investigation.

External Surfaces of Bats as a Source of Novel Anti-fungal and Antibiotic Agents

Jennifer J. Marshall Hathaway[1], Nicole A. Caimi[1], Debbie C. Buecher[2] and Diana E. Northup[1]
1 *Department of Biology, University of New Mexico, Albuquerque, USA;* ***2*** *Buecher Biological Consulting, Tucson, USA*

Little is known about the natural defenses that external microbiota of bats can provide. Recent studies have shown that some bacteria living on the external surfaces of bats are capable of inhibiting *Pseudogymnoascus destructans,* the fungus responsible for white-nose syndrome (WNS). We hypothesize that these bacteria produce secondary metabolites that are anti-fungals. Polyketide type II (PKS II) genes are associated with secondary metabolite production, including antibiotics and antifungals. To further investigate the natural defense capabilities of the external microbiota of bats, the diversity of PKS II genes was investigated by screening for this gene from a total of 300 isolates cultured from six different bat species from New Mexico. Up to 10 PKS II positive isolates were then cloned and sequenced from each of the bat species to characterize the diversity of the genes on the bats. Differences among the number of positive isolates across bat species have been detected. The resulting sequences also revealed novel diversity of the PKS II genes on bats across New Mexico. This knowledge can help by suggesting targeted monitoring of species with less diversity in their natural defense capabilities, and help in early detection and the ability to counteract the spread of the WNS fungus as soon as it enters New Mexico.

A Risk Analysis Framework for Considering the Potential Spread of White-nose Syndrome in Western North America

Mark Hayes
Cherokee Nation Technologies, U.S. Geological Survey, Fort Collins, USA

Risk analysis has been extensively used to evaluate the potential spread and impacts of wildlife diseases and invasive species. Risk analysis for wildlife diseases and invasive species involves the following steps: problem description; hazard identification; risk assessment; risk management; risk communication; and implementation and review of the risk analysis process. The risk assessment step includes evaluation of the likelihood that a pathogen will be introduced into a given area of concern, the likelihood that a given species will be exposed to the pathogen, and the possible consequences of such exposure. Although species distribution models (SDMs) and maps have been extensively used in ecological and conservation research, they have not commonly been used as a tool in the risk assessment process. I discuss a risk analysis framework for considering the potential spread of white-nose syndrome (WNS) in western North America, focusing on SDMs as quantitative tools to support the risk assessment phase of risk analysis. I am using presence-only occurrence data to develop species distribution models (SDMs) for each of 7 bat species known to be affected by WNS in North America: big brown bat (*Eptesicus fuscus*); eastern small-footed bat (*Myotis leibii*); gray bat (*Myotis grisescens*); Indiana bat (*Myotis sodalis*); little brown bat (*Myotis lucifugus*); northern long-eared bat (*Myotis septentrionalis*); and tricolored bat (*Perimyotis subflavus*). I discuss how these models and maps can be combined to consider potential patterns of WNS spread in western North America and provide insights into opportunities for early detection, rapid response, and containment efforts.

Iodine Staining and MicroCT: A Window into Noctilionoid Sensory Structures

Brandon P. Hedrick[1], Abby Vander Linden[1], Laurel Yohe[2], Liliana M. Davalos[2], Karen E. Sears[3], Stephen Rossiter[4] and Elizabeth R. Dumont[1]
1 *Department of Biology, University of Massachusetts, Amherst, USA;* ***2*** *Department of Ecology and Evolution, Stony Brook University, Stony Brook, USA;* ***3*** *School of Integrative Biology, University of Illinois, Urbana, USA;*
4 *School of Biological and Chemical Sciences, Queen Mary University of London, London, UK*

Bats have radiated into a wide diversity of dietary niches and natural selection has shaped different sensory systems (sight, olfaction, echolocation) to optimize detection of different food items. For example, when searching for food, hearing (through echolocation) is very useful to insectivorous bats, while visual and olfactory cues are of secondary importance. Given their small body sizes and metabolic demands adapted for flight, bats have limited space for sensory structures possibly leading to competition among sensory structures. Sensory tradeoff hypotheses

are difficult to test without proper visualization and quantification of sensory structures. However, with the advent of contrast-enhanced iodine staining and microCT, we examined sensory structure morphometry across a wide range of noctilionoid bats with divergent diets. Due to the novelty of this approach, we performed sensitivity analyses scanning stained bats at weekly intervals across four weeks to optimize staining and evaluate shrinkage. Exposure to iodine did not lead to shrinkage, but it is clear that shrinkage is common in museum specimens. This is likely due to variation in initial fixation and subsequent storage methods, as well as time spent in storage. We recommend using fresh specimens whenever possible but propose alternative methods for accounting for differential shrinkage among museum specimens. We present results on iodine stained specimens in terms of sensory system use across disparate taxa, describe proper techniques for obtaining high resolution soft tissue scans, and evaluate the impacts of iodine staining on bat specimens.

Rationality in Decision-making in the Frog-eating Bat

Claire T. Hemingway[1,2], Michael J. Ryan[1,2] and Rachel A. Page[2]
1 *Department of Integrative Biology, University of Texas, Austin, USA;* ***2*** *Smithsonian Tropical Research Institute, Balboa, Ancón, PAN*

We generally assume that animals make decisions informed by millions of years of natural selection. As a result, most models of animal behavior assume rationality in animal's decisions, with animals maintaining strict preferences for different options. In the wild, however, animals often chose among several options simultaneously and their evaluations of each prey type may depend on the perceived relative values of other options. Frog-eating bats (*Trachops cirrhosus*) are ideal candidates for studying how animals make decisions in the wild. When given a choice between the calls of two species of frogs, *T. cirrhosus* will choose the call that is associated with the higher capture rate. Although in the wild *T. cirrhosus* often choose among multiple call options, most tests of prey preferences in this system include only two options. In this experiment, we tested whether *T. cirrhosus* alters relative preference for two call types that differ along two acoustic dimensions (amplitude and complexity) when presented with a third, "decoy" option, inferior to the two original options along either one or both dimensions. Results from this study demonstrate that under these circumstances, *T. cirrhosus* evaluates all three options independently of one another, and thus, preferences remain consistent and rational in both the presence and absence of a decoy. These results counter many other experiments for testing rationality in animal decision-making, indicating that there is likely an adaptive explanation for this behavior.

The Interplay of *Myotis* Species and *Eptesicus fuscus* in the Age of White Noses

John W. Hermanson
Department of Biomedical Sciences, Cornell University, Ithaca, USA

The status of *Myotis lucifugus* and *Eptesicus fuscus* maternity roosts were monitored in central New York throughout the past 26 years, providing insight into population fluctuations. These data are relevant after the decimation caused by white-nose syndrome (WNS). We reported an approximately 96% reduction in numbers of *M. lucifugus* at maternity roosts in our area (Hermanson et al., 2014) since the onset of WNS. Roosts were visited in 2016 to assess trends and to monitor the establishment of *E. fuscus* roosts in sites that were previously occupied by *M. lucifugus*. One site, that had relatively stable numbers of *M. lucifugus* (>200 bats), was lost due to the destruction of the structures that housed the bats (a barn and a separate bat box), demonstrating an impact of human activity on bat populations. Auditory monitoring of this site yielded no bat activity in the area. There was stability of *M. lucifugus* numbers, including some *M. septentrionalis*, in another site that has maintained bat populations since 2001 and that has seen *E. fuscus* sharing the barn. But, overall, the trend is downward in terms of little brown bats (*Myotis spp*.) in 8 locations we have monitored. Including the loss of one major roost, there is an approximately 97% reduction of little brown bat numbers from pre-WNS levels to the 2016 counts. The numbers of big brown bats at maternity roosts is holding steady. These data highlight the precarious nature of northeastern bat populations.

Stress Response in the Fishing Bat *Myotis vivesi* in Highly Seasonal Environments
Ulalume Hernández-Arciga[1,2], Luis G. Herrera-Montalvo[3], Marta C. Pardo[5], Ricardo Valdez[5], José J. Flores-Martinez[1], Roxana U. Miranda-Labra[4] and Mina Könisberg-Fainstein[2]
1 *Instituto de Biología, Universidad Nacional Autónoma de México, Ciudad de México, MEX;* ***2*** *Laboratorio de Bioenergética y Envejecimiento Celular, Universidad Autónoma Metropolitana, Unidad Iztapalapa, Ciudad de México, MEX;* ***3*** *Estación de Biología Chamela, Instituto de Biología, Universidad Nacional Autónoma de México, MEX;* ***4*** *Laboratorio de Fisiología Celular, Universidad Autónoma Metropolitana, Unidad Iztapalapa, Ciudad de México, MEX;* ***5*** *Departamento de Fisiología Biofísica y Neurociencias, CINVESTAV, Ciudad de México, MEX*

Allostasis is the process of achieving stability through change in anticipation of physiological requirements due to environmental and life history seasonal changes. The fishing bat (Myotis vivesi) is endemic to desert islands in the Gulf of California, Mexico, where summers are extremely hot (up to 45ºC) and reproductive season occurs, and winters are cold (~5ºC). We evaluated how physiological parameters related to stress (e.g., antioxidant activity [a.a.] and bactericidal killing capacity of plasma [BK]) Fluctuate seasonally and how are they affected by an acute stress stimulus (e.g., movement restriction in small cotton bags for 6 and 12 h). Superoxide dismutase (SOD) and catalase (CAT) basal a.a. increased during autumn in contrast to summer and winter, suggesting the existence of antioxidant accumulation probably as a protective measure for the upcoming winter season. Acute stress resulted in an enhancement of SOD (post 12 h stimuli), and glutathione peroxidase (GPx) (post 6 h stimuli) a.a. only during summer and early winter. Basal BK was higher during summer and early winter, highlighting the importance of increasing the defense against infections during these periods. BK was enhanced by acute stress (12 h post stimuli) during summer. These results agree with the allostasis hypothesis as basal and stress-related immune and antioxidant activity varied seasonally.

Temporal Variation in *Myotis sodalis* Echolocation and Social Calls at Maternity Roosts
Julia P.S. Hoeh and Joy M. O'Keefe
Center for Bat Research, Outreach and Conservation, Indiana State University, Terre Haute, USA

Indiana bats (*Myotis sodalis*) form large summer maternity colonies in fairly ephemeral primary roosts and social behaviors may aid in group cohesion. Social communication likely plays a role during the fission-fusion process that occurs as individuals or groups select day roosts within a maternity season. To determine if behavioral communication plays a role in roost selection, we evaluated acoustic behaviors including echolocation and social calls at new artificial roosts. We determined if acoustic behaviors change with time to peak occupation of a roost. During some parts of the maternity season, group cohesion is likely more important and, therefore, we also evaluated acoustic behaviors by reproductive period. Acoustic activity was greater during the post-lactating period than during pregnancy (Kruskal-Wallis, $p<0.00$; Dunn's test $p<0.001$) or lactation (Dunn's test $p<0.009$), but the number of call files recorded during pregnancy and lactation were not significantly different from each other. We did not find a significant correlation between number of days before and after peak bat emergence and number of call files ($r = -0.348$). We may have detected more behaviors during post-lactation due to the presence of volant juveniles. With more detailed analysis of echolocation and social calls we will be able to determine if acoustic surveys can be used to evaluate the importance and functional role of roosts used by members of an Indiana bat maternity colony.

Assessing Bat Activity in Pennsylvania's National Parks: Captures and Acoustic Monitoring
Justin M. Hoffman, Joshua J. Reeder, Kaitlin L. Leffler, Russel A. Leinbach and Karen A. Campbell
Department of Biology, Albright College, Reading, USA

We conducted surveys of bat activity at Valley Forge National Historic Park (VAFO) and Hopewell Furnace National Historic Site (HOFU), through a cooperative agreement established between Albright College and the US National Park Service in the summer of 2014. This mist-netting survey was modelled after a pre-white-nose syndrome (WNS) study performed in 2005. Despite greater effort (123 net nights compared to 91 in 2005), we captured a similar number of bats (47 compared to 50). The species composition showed a shift from 70% *Myotis* spp in 2005, to only 4% (2 bats) in 2014, when *Eptesicus fuscus* comprised 75% of the captures and 21% were *Lasiurus* spp. Much of the area of VAFO and HOFU (over 1700ha) is open and unsuitable for efficient mist-netting, so we augmented this survey in the summer of 2015 through stationary recording of echolocation signals and acoustic driving transects. While only 35 bats were captured in 95 net nights, we recorded 1463 identifiable bat passes at the net sites, and 280 along driving transects throughout the parks. Acoustic data revealed activity divided

between E. fuscus (34%) and *L. borealis* (30%), which were the only two species captured, as well as *L. cinereus* (31%). The remaining bat passes recorded were consistent with call characteristics of *Perimyotis subflavus* (1.2%) and *Myotis* spp (3.8%). We are continuing to complete driving transects at the two parks to monitor bat populations and provide additional data to inform park management practices.

Teaching Echolocation and Bat Conservation Biology in Formal and Informal Science Education
Craig S. Hood
Department of Biological Sciences, Loyola University New Orleans, New Orleans, USA

Bats have been used extensively in informal nature education in nearly every sort of setting, from National Parks, National Wildlife Refuges and US Forests, to many state and local nature centers, worldwide. Bat researchers regularly participate in these outreach events, hosting bat forays and demonstrations of the use of bat detectors. During the past 3 years, I have integrated bat echolocation and conservation biology into a variety of undergraduate courses and citizen science settings and report here on participant learning outcomes. At Loyola University, we have developed an innovative introductory non-science majors course (replacing standard survey courses) that engages students in 4-6 week modules taught by different science faculty using active learning approaches. My module focuses on bat echolocation and its application to conservation biology. Students engage in Spallanzani's studies, the Griffin/Galambos studies, modern biosonar studies, as well as case studies of bat/moth jamming, bat/bat jamming, bat/frog predation, bat food habits and applications to assessing biodiversity and conservation status. They analyze ANABAT data sets and pose their own questions about seasonal occurrence and activity patterns. Pre- and Post-class SALG surveys showed significant increases in student self-assessment of understanding and skills of scientific experimental design and the role of peer review, as well as knowledge of animal echolocation, evolution, and ecology and their application to conservation biology.

Assessing the Effectiveness of Mitigation Measures at Reducing Turbine-related Bat Mortality in Ontario
Lauren A. Hooton[1] and J. Ryan Zimmerling[2]
1 *Normandeau Associates, Gainesville, USA;* ***2*** *Canadian Wildlife Service, Environment and Climate Change Canada, Ottawa, CAN*

The effectiveness of mitigation measures at reducing bat mortality has not been adequately assessed for most jurisdictions in Canada. In the province of Ontario, wind energy facilities (WEFs) that exceed the mortality threshold of 10 bats/turbine/year must implement an increased cut-in speed of 5.5 m/s from July 15 to September 30 for all wind turbines across the entire WEF for the life of the project. We conducted a large-scale assessment of the effectiveness of mitigation in Ontario by comparing pre- and post-mitigation bat mortality within and among WEFs across multiple years. We also compared the species-specific effectiveness of mitigation at reducing mortality. Overall, our results demonstrate that increasing the cut-in speed of wind turbines to 5.5 m/s reduces bat mortality to varying degrees, with estimated bat mortality at mitigated turbines exceeding the provincial threshold at nearly half of the WEFs in the study. Additionally, the effectiveness of increased cut-in speed was somewhat species dependent. We suggest that the effectiveness of mitigation measures in Ontario could be increased by utilizing an adaptive management framework.

Flight Modalities in the Group Behavior of Free-tailed Bats
Nickolay I. Hristov[1,2], Louise C. Allen[1] and Brad Chadwell[3]
1 *Winston-Salem State University, Winston Salem, USA;* ***2*** *Center for Design Innovation, Winston-Salem, USA;*
3 *Ohio University HCOM, Cleveland, USA*

From the seemingly chaotic movement of unicellular organisms to the grandiose migrations of ungulates, the collective behavior of organisms belongs to some of the most striking displays in nature. Based on the characteristics of the individual but framed in the context of the group, the behavior of animal groups poses an evolutionary paradox - how to balance the costs and benefits of grouping. Bats are excellent models for studying collective behavior that could offer insights about how and why organisms group. Studying the group behavior of bats poses significant challenges; nevertheless, recent advances in recording techniques and visualization methods give new opportunities to study the natural group behavior of bats in the field. Using an array of high-speed video cameras we recorded the emergence and return of a large colony of free-ranging Brazilian free-tailed bats (*Tadarida brasiliensis*). Three-dimensional reconstructions of the flight kinematics and behavior of individual bats in the column, paired with a reconstruction of the group formation indicate significant differences in the flight behavior

and collective patterns under these two different flight regimes. Emerging bats utilize powered flight, fly slower, space closer and interact more frequently with each other. The group displays characteristics of a formation for predator defense (avoidance). Bats returning to the roost predominantly glide/dive, move faster, space themselves further apart, and rarely contact each other. The formation appears organized by the need to avoid collisions. How morphology, ecology and flight performance of bats affect these two flight regimes remains to be studied further.

Craniometric Distinctiveness of *Perimyotis subflavus* from Atlantic Canada

Howard M. Huynh[1], Hugh G. Broders[2] and Donald T. Stewart[3]
1 *Department of Biological Sciences, Texas Tech University, Lubbock, USA;* ***2*** *Department of Biology, Saint Mary's University, Halifax, CAN;* ***3*** *Biology Department, Acadia University, Wolfville, CAN*

The tricolored bat, *Perimyotis subflavus*, is at the northern extent of its geographic range in Atlantic Canada, with the only known summering population residing in southwest Nova Scotia in Kejimkujik National Park & Historic Site. Relatively little is known about *P. subflavus* in this part of their range, and the prospects of this population being geographically disjunct may make the species nationally significant. Observed morphological and behavorial traits that appear to be unique in this population highlight a need to characterize the level of population differentiation between *P. subflavus* found in Atlantic Canada and the rest of North America. To characterize inter-population morphological variation, vouchered specimens of *P. subflavus* (n = 218) from across their geographic range were examined and measured in several museum collections in northeastern North America. Comparative morphometric analysis of craniodental data showed that *P. subflavus* from Atlantic Canada exhibit characteristically larger skulls than other recognized subspecies. Given the craniometric distinctiveness and unique roosting behavior, the population from Atlantic Canada may represent a new and undescribed subspecies of *P. subflavus*. This research emphasizes the importance of studying and determining the taxonomic status of peripherally-isolated populations of a widespread species.

The Mexican Bat Acoustic Monitoring System (SIMMA): Evaluating the Effects of Environmental and Methodological Factors

Ana Ibarra-Macias[1], Tania Gonzalez-Terrazas[2], Abigail Martinez-Serena[1], Luis Viquez-R[2], Tonatiuh Ruiz[2], Leonora Torres[1], Kirsten Jung[2], Marco Tschapka[2,3] and Rodrigo Medellin[1]
1 *Instituto de Ecologia, Universidad Nacional Autonoma de Mexico, Mexico City, MEX;* ***2*** *Institute of Evolutionary Ecology and Conservation Genomics, University of Ulm, Ulm, DEU;* ***3*** *Smithsonian Tropical Research Institute, Balboa, PAN*

Knowledge on status of bat populations is crucial to implement conservation and management actions, especially given the increasing threats faced by bats all over the world. In Mexico, as in most tropical countries, standardized, large-scale, long-term monitoring programs for determining bat population trends are almost non-existent and those that are currently underway are limited in time and space due to the amount of resources needed. As part of a national effort to monitoring biodiversity, we designed a standardized acoustic bat monitoring protocol for Mexico (Sistema Mexicano de Monitoreo Acustico, SIMMA) using automated ultrasonic recorders, with the aim to adapt it to Mexican different ecosystems. Previously, we reported the preliminary evaluation of this protocol. In this ocassion, we present the results of the evaluation of the protocol for a full year cycle, including the effects of monitoring schedule, number of days, lunar phase, precipitation, habitat type (gap vs. forest interior) and season on species richness, composition and activity level of bats in the Lacandona tropical rain forest. Overall, results of this first cycle of bat monitoring showed that bat activity levels decreased in the rainy season compared to the dry season, while the pattern of high bat activity in tree fall gaps and low activity in forest sites remained in both seasons. Evaluation on the performance of this protocol and the effects of environmental factors will improve the design and implementation of this protocol on the context of implementing a standardized, long-term bat monitoring program at the national scale in Mexico.

Corridor Use by Neoptropical Bats in the Chiquibul Forest Reserve, Belize

Reilly T. Jackson[1], Emma V. Willcox[1] and William M. Giuliano[2]
1 *Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, USA;* ***2*** *Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, USA*

The Chiquibul Forest Reserve in the Cayo District of Belize is home to one of the largest selective logging concessions in the country. Since 2006, when they were issued their logging permit, the concessionaire has

constructed multiple roads, trails, and tracks through the reserve to facilitate timber extraction. This has created numerous open corridors through the otherwise thick tropical evergreen seasonal broadleaf forest. In the summer of 2016, we devised a pilot study to understand the role corridor structure may play in determining use by neotropical bats. We deployed mist nets to capture bats and measured corridor structure characteristics (corridor height, corridor width, ground cover, canopy cover, etc.) at 11 corridor locations. We captured 24 species of bats from 4 families (Phyllostomidae, Mormoopidae, Vespertilionidae, and Emballonuridae) using corridors. Of the 44 recorded extant species found in the Chiquibul, we captured 52%. In addition, we captured a species not previously reported for the area. We will present the results of initial analyses examining how species richness and relative abundance of captured bats were affected by corridor structure characteristics.

Life on the Trailing Edge: Muscle and Elastin in Bat Wings

Elissa Johnson[1], Justine J. Allen[1] and Sharon M. Swartz[1,2]
1 *Department of Ecology and Evolutionary Biology, Brown University, Providence, USA;* ***2*** *School of Engineering, Brown University, Providence, USA*

Bat wings contain muscles and elastin bundles embedded in skin that is unusually thin and mechanically distinctive. These components are present in all species studied to date and are thought to affect wing extensibility and camber. To understand the mechanistic basis of wing performance, it is critical to determine the structure and arrangement of these fibers throughout the wing, particularly in functionally important regions. We examined the trailing edge of Seba's short-tailed fruit bat, *Carollia perspicillata,* using histological techniques. In this species, the proximodistally-oriented, caudalmost edge of the armwing comprises two layers of collagen surrounding an array of muscle fibers and a large, organized elastin bundle. We examined the arrangement of muscle and elastin along the trailing edge of the armwing, and investigated their modes of attachment at the plagiopatagium's proximal (hind limb) and distal (digit V) ends. We observed muscle near the trailing edge, particularly near the ankle, suggesting that *C. perspicillata* has active control of this part of the wing membrane. We hypothesize that muscle provides stiffness when contracted, and helps maintain skin tension during upstroke. The large elastin bundle could act as a "hem" that prevents tearing and provides mechanical stability. It might also help fold the wing during upstroke and/or keep the trailing edge taut, reducing flutter, throughout the wingbeat cycle. Studying the morphology of the trailing edge of bat wings can help us understand how skin is modified for flight and improve the design of compliant materials for aeronautical applications.

Status and Summer Roost Sites of Threatened *Myotis septentrionalis* on the Island of Martha's Vineyard

Luanne Johnson[1], Elizabeth Baldwin[1], Zara Dowling[2], Susanna L. von Oettingen[3] and Jonathan D. Reichard[4]
1 *BiodiversityWorks, Martha's Vineyard, USA;* ***2*** *University of Massachusetts, Amherst, USA;* ***3*** *U.S. Fish & Wildlife Service, Concord, USA;* ***4*** *U.S. Fish & Wildlife Service, Hadley, USA*

Myotis septentrionalis was historically abundant on the island of Martha's Vineyard (MV), Massachusetts prior to the spread of white-nose syndrome (WNS) across Northeastern United States. We initiated surveillance and tracking studies in 2014 after acoustic evidence and opportunistic sightings revealed persistence of *M. septentrionalis* on the island. In summer 2014, we captured bats in mist nets at three locations and captured one juvenile male roosting in a deck umbrella, suggesting MV provides potentially important habitat to this federally threatened species. To document maternity colonies, characterize roosts, and verify reproduction in the population, we conducted the first study of *M. septentrionalis* roosting behavior during summer and fall of 2015 and 2016. We captured *M. septentrionalis* in June and July and used radiotelemetry to track 16 lactating females to 36 roosts (67% trees, and 33% structures). All roosts were 130-760 m from capture locations and 4 primary roosts were under roof trim boards of occupied houses. Emergence counts at these roosts revealed small but active colonies of 6-15 bats, and juveniles were captured in both years. In September 2015, we tracked two female *M. septentrionalis* over 16 days to 11 daytime roosts (64% structures and 36% trees). In 2016, we deployed 3 stationary receiving towers to gather additional information on local and seasonal movements until November 2016. In fall 2016 we will attempt to track *M. septentrionalis* on the island to their swarming and winter roosts.

Winter and Summer Torpor in a Free-ranging Subtropical Desert Bat

Dave S. Johnston[1], Valeria B. Salinas R.[2], Jose Juan Flores-Martinez[3] and L. Gerardo Herrera M[4].
1 *H. T. Harvey & Associates, 983 University Avenue Building D., Los Gatos, California, USA.* ***2*** *Posgrado en Ciencias Biologicas, Instituto de Biologia, Univ Nacional Autonoma de Mexico, MEX;* ***3*** *Lab. de Sistemas de Informacion Geografica, Depart. de Zoologia, Inst. de Biologia, Univ. Nacional Autonoma de Mexico, MEX;*
4 *Estacion de Biología Chamela, Inst. de Biologia, Univ Nacional Autónoma de Mexico, MEX*

Use of torpor likely favors the survival of subtropical bats in harsh environments. The fishing myotis (*Myotis vivesi*) is a species endemic to desert islands in the Gulf of California, where summers are extremely hot and winters are cold and windy. We explored thermoregulating abilities of *M. vivesi* measuring skin temperature (T_{skin}) on free-ranging individuals in winter 2010 and 2011, and in summer 2010. We also measured ambient (T_a) and roost (T_{roost}) temperatures during the study, and we obtained data for wind speed at night time during winter periods. We found that all bats entered torpor in both winters and that at least three individuals hibernated for several days, which had not been reported previously for bats in subtropical deserts. In summer, three individuals entered short bouts of shallow torpor in early mornings. Roosts were slightly warmer than Ta in winter at nightime, and in summer they never reached temperatures > 38.7°C, even at $T_a \approx 45$°C. Roost occupancy in winter was higher during windy nights in 2010 but no pattern was found in 2011. Therefore, in winter fishing myotis were more likely to remain in their night roosts and enter torpor when ambient conditions (e.g., strong winds) limit fishing on marine waters. In summer, roosts provide good insulation against high T_a, and bats might not need to resort to torpor to lower their metabolic rate except for a brief period during early mornings. When resources are limited the use of torpor may increase this insular species' chances of survival.

Habitat Suitability Modelling of *Myotis septentrionalis* in a Managed Forest in Southern Indiana

Jocelyn R. Karsk[1], Timothy C. Carter[1] and G. Scott Haulton[2]
1 *Department of Biology, Ball State University, Muncie, USA;* ***2*** *Division of Forestry, Indiana Department of Natural Resources, Indianapolis, USA*

Silvicultural treatments have long been implemented on state forest lands in Indiana. There is a need to better understanding these influences on bat species in order to understand which forest management practices might best promote bat conservation, especially for threatened and endangered species. The northern long-eared bat (*Myotis septentrionalis*) was federally listed in 2015 and this listing is having major implications for land managers since the northern long-eared bat uses forested landscapes for summer roosting habitat. Our goal was to create a habitat suitability model that included both landscape variables and harvest history. Our study site was at the Hardwood Ecosystem Experiment (HEE) located in the Morgan-Monroe State Forest and Yellowwood State Forest in southern Indiana. We generated presence-only models of roost selection using the program MaxENT using known roost locations to identify areas important to summer roosting habitat within our study area and to identify important stand-scale factors in habitat selection. The landscape variables that we used were elevation, aspect, slope, distance to major roads, and forest type. With decreasing populations and likelihood of captures, models may become an important alternative for informing future management actions.

Thermoregulation and Timing and Rates of Reproduction in *Myotis septentrionalis* and *M. lucifugus* in Northern Canada

Laura A. Kaupas
Department of Biological Sciences, University of Calgary, Calgary, CAN

The energetic demands on reproductive female bats may be particularly high at northern latitudes, where nightly foraging time is limited, and summer length is short. The use of torpor during reproduction may conserve energy, but may also delay parturition and juvenile development. Tree-roosts provide lower roost temperatures than building-roosts, possibly resulting in different energetic costs and thermoregulatory patterns in bats using different roost types. I examined reproductive tree-roosting *Myotis septentrionalis*, and building-roosting *M. lucifugus* in the Northwest Territories, Canada, to determine whether thermoregulatory patterns, timing and rates of reproduction, and foraging duration differ between species. Despite significantly lower tree-roost temperatures than building-roost temperatures, reproductive *M. septentrionalis* and *M. lucifugus* used similar daily torpor depth and duration. Therefore, it is unsurprising that the timing of parturition and fledging of juveniles were similar between species. However, this suggests higher energetic costs for tree-roosting *M. septentrionalis*. *Myotis septentrionalis* emerged to forage at a similar time as *M. lucifugus*, but returned to the roost significantly later. *Myotis septentrionalis* may be

able to balance the higher energetic costs of lower roost temperatures through longer foraging duration, which may be achieved due to its ability to glean prey at low temperatures.

Primary Productivity Explains Size Variation across the Pallid Bat's Western Geographic Range
Rochelle M. Kelly, Rachel Friedman and Sharlene E. Santana
Department of Biology and Burke Museum of Natural History and Culture, University of Washington, Seattle, USA

Body size directly influences many aspects of the life history, ecology, and physiology of organisms. Within a species, body size can vary substantially across space and time. For endothermic mammals, Bergmann's Rule predicts a negative relationship between body size and temperature. Despite broad support for this pattern, its underlying mechanism is heavily debated. Numerous alternative explanations have been proposed to explain why larger animals are found in colder climates, and vice versa. In the present study, we used the Pallid bat, *Antrozous pallidus*, to evaluate Bergmannian size patterns and the relative support for major explanatory hypotheses of geographic body size variation. We tested the hypothesis that geographic size variation is driven by productivity, as opposed to seasonality, heat conservation, or dissipation. Additionally, we investigated the potential ecomorphological consequences of size variation in Pallid bats by determining if skull shape is also influenced by environmental factors, via changes in size. We found that Pallid bat populations in northern latitudes are composed of larger individuals, and that productivity is the primary predictor of latitudinal size variability in this species. We also found that skull shape in Pallid bats changes in tandem with skull size, with larger bats having cranial traits associated with greater bite force production. Our study illustrates that productivity, and thus resource availability, is a key driver of geographic body size variability in the Pallid bat. This adds to the growing evidence that resource availability is responsible for variation in body size across space and time among mammals.

Canopy-roosting Southeastern Myotis: An Anomaly?
S. Piper Kimpel[1], Susan C. Loeb[2] and Patrick G.R. Jodice[3]
1 *College of Agriculture, Forestry, and Life Sciences, Clemson University, Clemson, USA;* ***2*** *USDA Forest Service, Southern Research Station, Clemson, USA;* ***3*** *U.S. Geological Survey, South Carolina Cooperative Fish and Wildlife Research Unit, Clemson University, Clemson, USA*

Little is known about winter roosting habits of southeastern myotis, *Myotis austroriparius*, in Coastal Plain forests. Our objective was to quantify roost habits of southeastern myotis in Congaree National Park, an old-growth bottomland hardwood forest in the Upper Coastal Plain of South Carolina during December-March 2015-2016. A 1000-year flood event occurred during fall 2015 and heavy rains continued through the winter resulting in exceptionally high floodwaters. We located roosts through opportunistic cavity searches and by tracking radio-tagged bats. We counted bats in roots using a light and mirror or during roost emergence counts. During the study period we radio-tagged 14 bats and located 10 bats ≥ 1 times. Of the 42 roosts located, 64% were in trees with basal cavity openings, 2% were in trees with cavities in the upper bole, and 33% were roosts in the upper branches (canopy roosts). Five bats were tracked to canopy roosts. Overall, bats used 3.1 ± 1.4 roosts (range 1-5) and switched roosts 3.0 ± 2.5 times (range 1-7). Canopy roosting bats used 4.2 ± 0.8 roosts and switched roosts 4.8 ± 2.3 times, while cavity roosting bats used 2.0 ± 0.7 roosts and switched roosts 1.2 ± 0.5 times. The number of bats per roost ranged from 1 to 15 in cavity roosts whereas only solitary bats used canopy roosts. Use of canopy roosts has not been reported previously for southeastern myotis. It is not known whether this is a common phenomenon or whether canopy roosting is a response to high water.

Signal Characteristics and Echolocation Challenges of Mexican Free-tailed Bats during High-speed Flight
Laura N. Kloepper[1] and Meike Linnenschmidt[2]
1 *Department of Biology, Saint Mary's College, Notre Dame, USA;* ***2*** *Division of Neurobiology, Ludwig-Maximilians University, Munich, GER*

Female Mexican free-tailed bats (*Tadarida brasiliensis*) form large maternal colonies numbering up to several million. After their nightly emergence and feeding, they return to the roost from high elevations and speeds nearing 100km/h. At these speeds, the bats should experience, among other things, difficulties in object distance encoding due to the large distance travelled before echo returns and significant Doppler shifts to their echoes. Further, they face navigational challenges from nearby conspecifics. In this study, we characterized the acoustics of returning Mexican free-tailed bats and investigated for possible Doppler shift compensation during various flight speeds. Synchronized acoustic and thermal imagery recordings were conducted at several caves across multiple mornings

during cave re-entry. Call sequences for individual bats were extracted for different flight speeds, and changes in call parameters were compared within each call sequence. First basic analysis indicates a possible lack of Doppler shift compensation during fast and steep re-entry flights. Further, these bats demonstrate a flexible signal design and extreme behavioral maneuvers in flight.

Hung Out to Dry? Arid Adaptation in Hibernating Big Brown Bats

Brandon J. Klüg-Baerwald and R. Mark Brigham
Department of Biology, University of Regina, Regina, CAN

Hibernation is typically a period of water deficit and therefore humidity strongly influences hibernation patterns of small mammals. Dry conditions reduce length of torpor bouts, stimulate arousals, and decrease overwinter survival. To mitigate these effects, many small mammals hibernate in near saturated (100% RH) conditions. However, big brown bats (*Eptesicus fuscus*) hibernate in a wider variety of conditions and tolerate lower humidity than most other hibernating bats. To assess arid adaptation in this species, we compared torpid metabolic rate (TMR) and total evaporative water loss (TEWL) between two populations of *E. fuscus* with differing winter ecologies: one that hibernates in a humid (>98% RH) karst cave in Wood Buffalo National Park (WBNP), Alberta, and one that hibernates in dry (ca. 65% RH) rock-crevices in Dinosaur Provincial Park (DPP), AB. We used flow-through respirometry to measure TMR and TEWL of bats in relatively dry (<10% RH) and humid (ca. 85% RH) conditions. Torpid metabolic rate did not differ between populations or with humidity. However, TEWL was significantly lower in bats from DPP than those from WBNP. Our results suggest that *E. fuscus* hibernating in arid environments possess adaptations to decrease cutaneous evaporative water loss that are not evident in bats which hibernate in humid sites. This adaptation complements the sedentary nature of *E. fuscus*, likely allowing them to tolerate more variable microclimates during hibernation and thus increasing the availability of overwintering habitat.

Diversity of Bacteria on Bats Associated with *Pseudogymnoascus destructans* Infection in Europe

Veronika Kovacova[1], Hana Bandouchova[1], Tomas Bartonicka[2], L. Paula Garcia-Fraile[3], L. Kohoutova[5], Miroslav Kolarik[3], Natália Martínková[4], Jan Zukal[4] and Jiri Pikula[1]
1 *Department of Ecology and Diseases of Game, Fish and Bees, University of Veterinary and Pharmaceutical Sciences, Brno, CZE;* ***2*** *Department of Botany and Zoology, Masaryk University, Brno, CZE;* ***3*** *Laboratory of Fungal Genetics and Metabolism, Institute of Microbiology ASCR, Prague, CZE;* ***4*** *Institute of Vertebrate Biology, ASCR, Brno, CZE;* ***5*** *Department of Infectious Diseases and Microbiology, University of Veterinary and Pharmaceutical Sciences, Brno, CZE*

Hibernating bats from temperate regions are challenged by a skin disease caused by *Pseudogymnoascus destructans*. This fungal infection called white-nose syndrome (WNS) has devastated North American bat populations during the past decade. *P. destructans* was also confirmed in Eurasia; however, without reports of mass mortality of bats. Little is known about bat skin diversity of microorganisms and their interactions with *P. destructans*. When monitoring WNS and *P. destructans* we examined *Myotis myotis, M. emarginatus, M. daubentonii, M. bechsteinii, M. mystacinus M. nattereri,* and *M. brandtii.* Skin samples from each bat were cultured for fungi and bacteria and quantified for fungal load (qPCR). Bacterial isolates obtained from bats were identified by MALDI-TOF and sequence analysis of 16S rRNA gene. Wing WNS lesions were enumerated using UV transillumination. *Pseudomonas* (50% prevalence) and *Serratia* (26%) bacteria were found consistently, followed by *Arthrobacter* (7%), *Stenotrophomonas* (3%), *and Ewingella* (3%). We found *Lonsdalea quercina* ssp. *britannica*, the causal agent of bark canker and drippy nut disease of oaks, in the sample from a lesser horseshoe bat (*Rhinolophus hipposideros*). *In vitro*, all *Pseudomonas* isolates were able to inhibit the *Pseudogymnoascus* fungus, while *Serratia* isolates mostly did not. This finding corresponds with field data. When *Pseudomonas* only was present on the bat´s skin, the number of lesions was significantly lower compared to the skin colonization by *Serratia* only. Deciphering the diversity and function of these microbes may provide insights into the roles they play in maintaining skin health of bats.

Regional-scale Movements of Migratory Bats

Jennifer J. Krauel[1], Liam P. McGuire[2] and Justin G. Boyles[1]
1 *Department of Zoology, Southern Illinois University, Carbondale, USA;* ***2*** *Department of Biological Sciences, Texas Tech University, Lubbock, USA*

Most migratory bats are considered regional migrants, thought to move relatively short distances (<100km) between hibernacula and maternity sites. However, our understanding of these movements has largely been limited to banding studies or detailed tracking of small numbers of bats by aircraft. Inferring population-wide behavior from small samples is difficult and can introduce bias. For example, there are clearly cases where regional migrants can travel distances of 500km or more, but these may better be considered as outliers. Common departure and arrival behaviors and navigation decisions en route are poorly understood. We tracked movement of 108 Indiana bats (*Myotis sodalis*) across the mid-western US in 2015 using a regional network of stationary radio telemetry receivers to address these questions: 1) Are movements >100km common or rare? 2) Do bats follow landscape features? and 3) Do bats move directly across the landscape? Only 3% of tagged bats traveled >100km, suggesting that longer-distance movements may be outliers. In spring, bats left the hibernacula site immediately and primarily moved north despite available maternity roosts in all directions. We found no evidence that bats follow rivers, the predominant linear element in the landscape. In fall, bats visited swarming sites at hibernacula but did not remain there, and after swarming some females moved 100km to areas without known hibernacula. Common assumptions about movement of regional migrants may not be representative of population behavior and care should be taken with respect to management decisions based on those assumptions.

***The Relationship between Core, Fur, and Skin Temperature in Little Brown Bats**

Emma L. Kunkel, Ana M. Breit, Quinn E. Fletcher and Craig K.R. Willis
Department of Biology, University of Winnipeg, Winnipeg, CAN
*** Emma L. Kunkel** received the **Basically Bats Wildlife Conservation Society Award**.

During periods of resource scarcity many species of temperate-zone bats enter torpor to reduce body temperature (T_b) and conserve energy. Many studies rely on measurements of skin temperature (T_{sk}) to quantify torpor expression by bats during winter and summer, most recently in the context of white-nose syndrome (WNS). Skin temperature is typically recorded using temperature-sensitive radio-transmitters or dataloggers (e.g., iButtons) attached to the skin of the dorsum between the scapulae. Commonly, the fur between the shoulders is trimmed or shaved prior to attachment and the transmitter is glued onto bare skin. However, the shaving process could add to the stress experienced by the animals, particularly if transmitters need to be removed later (e.g., for re-use in experiments with captive bats). Removal of the fur could also increase heat loss, and therefore energetic requirements, after transmitters are shed by free-ranging bats. Attaching transmitters to the fur without shaving could reduce stress while still providing data of adequate quality for some studies. We tested this hypothesis by measuring T_b (based on rectal temperature), T_{sk} and fur-surface temperature (T_{fur}) of little brown bats (*Myotis lucifugus*). We captured swarming bats at a hibernaculum in central Canada in August 2016 and used a handheld digital thermocouple thermometer to measure T_b, T_{sk} and T_{fur}. We exposed bats to a range of ambient temperatures (T_a) to quantify relationships across a range of T_a and T_b (i.e., during torpor and normothermy). Our results have implications for the design of studies quantifying thermoregulation in bats.

Vocal Plasticity in *Phyllostomus discolor*

Ella Z. Lattenkamp[1,2], Kobin Kendrick[3], Sonja Vernes[2] and Lutz Wiegrebe[1]
1 *Department Biology II, Ludwig-Maximilians University Munich, DEU;* ***2*** *Neurogenetics of Vocal Communication Group, Max Planck Institute for Psycholinguistics, Nijmegen, NLD;* ***3*** *Language and Cognition Department, Max Planck Institute for Psycholinguistics, Nijmegen, NLD*

Bats have a sophisticated audio-vocal system that allows them to orientate in the dark, acoustically discriminate prey and surface structures, and identify conspecifics. To date, research into this area has largely focused on bat echolocation. However, their highly social nature and complex communication calls make them a well-suited animal model for studying vocal communication: several bat species have been found to have extensive call repertoires and to exhibit a rich palette of acoustic social interactions. Sophisticated song and syllable formation, the ability for vocal learning, and complex social interactions such as turn-taking (antiphonal vocalizations) have all been observed. Given the importance of vocal learning in humans for spoken language and turn-taking for linguistic interactions, we are investigating these abilities in the lesser spear-nosed bat *Phyllostomus discolor.* To assess turn-

taking behavior we are evaluating vocal interactions between groups of animals in audio/video recordings. To verify vocal learning, and specifically production learning, we have developed a multistage training plan, in which adult bats will be trained via an ultrasonic intercom to adjust their calls according to electronically transmitted calls of conspecifics. Adult bats will be trained with food reward to adjust the spectral and/or temporal parameters of their calls to match playbacks of modified conspecific calls (assessed via spectro-temporal analyses before and after the training period). These studies will demonstrate fundamental aspects of vocal communicative behaviour in *Phyllostomus discolor*, including behaviors that may ultimately be relevant for our understanding of the evolution of spoken language in humans.

Hibernation Ecology and Thermoregulation of Silver-haired Bats Overwintering in British Columbia, Canada

Cori L. Lausen[1] and Thomas J. Hill[2]
1 *Wildlife Conservation Society Canada, Kaslo, CAN;* ***2*** *Fish and Wildlife Compensation Program Columbia Region, Nelson, CAN*

The Silver-haired Bat (*Lasionycteris noctivagans*), is generally considered a 'migratory-hibernator,' migrating to areas where it overwinters with periods of dormancy. It has long been hypothesized that this species may not be migratory in British Columbia, or migration distances are short, supported by its year-round detection in the province. We studied *L. noctivagans* at three study locations in southeast British Columbia (B.C.), Canada from 2009–2014. Using temperature-sensitive transmitters in winter, we radiotracked bats and documented arousal patterns of both sexes. We determined that *L. noctivagans* hibernate in mines, rock-crevices, trees and snags, often switching roosts during the winter period. Hibernacula microclimates, are high in humidity, but colder than required for optimal growth of *Pseudogymnoascus destructans*. By banding individuals at two mines in both summer and winter, we documented the first evidence of year-round residency at mines by male *L. noctivagans*. Recaptures of both males and females banded as juveniles and recaptured as adults in subsequent years confirms roost fidelity. Using deuterium isotope analysis, we also determined that this species, if migrating, make only short distance migrations. Evidence of winter mating was found in some January and February captures. Patterned acoustic recordings by *L. noctivagans* could be described as "songs" and may be associated with mating behavior given their predominance during fall and winter. We conclude that *L. noctivagans* are generally year-round residents of B.C., hibernate during winter in various types of roosts, and arouse and fly periodically during winter.

Long-term Effects of Forest Harvesting on Habitat Use by Insect Eating Bats

Audrey Lauzon
Department of Biology, University of Regina, Regina, CAN

Forest harvesting is generally considered as a disturbance with only indirect effects on bat species. However, with the recent listing of three bat species in Canada and the now well-known importance of bats in food web and ecosystems, attention needs to be focused on the long-term effects of forest management on insectivorous bats. This project will allow us to better understand the effects of forest management on insectivorous bats and to potentially improve bat conservation in Canada. I will repeat a study (Grindal and Brigham 1995) conducted near Nelson, British Columbia to test whether and how forest management has affected the long-term habitat use by foraging bats. Grindal and Brigham's principal objective was to use acoustic detectors to evaluate bats use of forest edges created by clear-cut logging. I will revisit the same precise locations 20+ years later and determine how bats treat these same edges as they "blur" due to forest regrowth. As was done in 1995, I will assess bat activity along edges in combination with three different habitat factors: habitat type, stand age-class, and elevational zone. I predict that bats' foraging activity will be highest within mature forest patches, considering the possible decrease of forest edge advantages due to regrowth for foraging bats in harvested areas. As Grindal and Brigham found, locations with greater prey availability and at lower elevational zones should also be associated with greater bat foraging activity.

Bats, Agaves, and People: An Interdisciplinary Study of Potential "Bat-friendly" Agave Management by Northeast Mexican Communities

Kristen M. Lear[1], Jeffrey Hepinstall-Cymerman[1], Elizabeth G. King[1,2], Laura German[3] and Jose Juan Flores Maldonado[4]

1 *Integrative Conservation, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, USA;* ***2*** *Odum School of Ecology, University of Georgia, Athens, USA;* ***3*** *Department of Anthropology, University of Georgia, Athens, USA;* ***4*** *Especies, Sociedad y Habitat, A.C., Monterrey, MEX*

In northeast Mexico, agaves (*Agave spp.*) are harvested from the wild and cultivated for the sale of market products and for other cultural uses by local communities. However, current use of agaves may be contributing to the declines of the endangered Mexican long-nosed bat (*Leptonycteris nivalis*), which relies on the nectar of agaves in the northern portion of its migratory range. "Bat-friendly" agave management, such as allowing some agaves to flower or replanting wild agaves, can potentially be encouraged within local communities to help conserve the species. This research integrates ecological and social science methods to understand where and how "bat-friendly" management practices could be implemented. The first objective is to examine the factors that influence foraging behavior of *L. nivalis* at agaves and create statistical models that can be used to identify target areas for "bat-friendly" agave management. This will be achieved by monitoring bat feeding activity at flowering agaves with infrared recording systems and correlating feeding activity to individual agave and patch characteristics. The second objective is to assess the current management and harvest of agaves by local communities and the factors that may influence adoption of "bat-friendly" practices. This will be achieved by conducting key informant interviews, focus groups, and household surveys with community members that use agaves to understand current management practices, rules governing agave harvest, and ecological knowledge of bats and agaves. Results from the first field season will be presented. Ultimately, this research can help inform conservation efforts for the endangered Mexican long-nosed bat.

***Effect of White-nose Syndrome on the Skin Microbiome of Bats in Canada**

Virginie Lemieux-Labonté[1], Anouk Simard[2], Craig Willis[3] and François-Joseph Lapointe[1]

1 *Département de sciences biologiques, Université de Montréal, Montréal, CAN; 2 Direction de la biodiversité et des maladies de la faune, Ministère des Forêts de la Faune et des Parcs, CAN;* ***3*** *Department of Biology, University of Winnipeg, Winnipeg, CAN*

*** Virginie Lemieux-Labonté** received the **Karl F. Koopman Award**.

Since 2006, it has been estimated that over 6 million bats have been killed in Eastern North America by the white-nose syndrome (WNS), the infection caused by the fungus *Pseudogymnoascus destructans*. Up to now, this disease is not fully understood, and no treatment is currently available. The microbiome consists of the communities of microorganisms associated with a host organism; it is known to coevolve with its host to provide essential functions, including protection against pathogens. The fungus affecting bat dermal tissues is surely interacting with the skin microbiome, such that distinct microbial assemblages could explain differences in resistance among bat populations. In this context, this study is the first to investigate the skin microbiome of bats at localities tested positive (Québec) and negative (Manitoba) for WNS in Canada. The survey was performed in bat hibernacula, where the skin microbiome of *Myotis lucifugus* and environmental samples were collected. Microbial communities were analyzed by high-throughput 16SrRNA gene sequencing. The locality was found to be the principal driver of bat microbiome structure. Interestingly, the genera *Rhodococcus* and *Pseudomonas* were identified as important components of bat skin microbiome, both indicators of WNS affected populations. In light of recent findings, bacteria from these two genera may have potential in the fight against WNS. Our results thus suggest that some of the bats living in caves tested positive for WNS could have developed particular skin community assemblages allowing resistance to the fungus.

Andean Influence on Biogeography of Bats in Peru Based on DNA Barcodes

Burton K. Lim

Department of Natural History, Royal Ontario Museum, Toronto, CAN

Peru is one of the most biodiverse countries in the world and bats, the second most speciose group of mammals, is no exception. A primary factor associated with this is the Andes mountain range that separates wet Amazonian forest in the east from dry Pacific habitats in the west. Evolutionary processes of speciation in bats can be inferred from genetic data that document their diversity and distribution in Peru. Molecular phylogenetics was used to

ascertain biogeographic patterns across the Neotropics based on the relationships of sister taxa to endemic species and phylogeographic structuring in widely distributed species. DNA barcoding of the cytochrome c oxidase subunit I (COI) gene is a good mitochondrial marker for comparative analysis with previously collected samples from Central and South America to ascertain levels of nucleotide divergence. Of the 62 bat species documented in this study, 35 species had a distinct phylogeographic pattern in Peru or across the Neotropics. Eleven of these species are endemic to the Pacific slope with approximately half having sister taxa west of the Andes. Five other species with a trans-Andean distribution in Peru exhibited distinct genetic differences of up to 8% sequence divergence between populations from the Amazon and Pacific-coast. In spite of the dispersal ability associated with flight, the Andes have had a direct influence on the biodiversity of bats. As represented by different biogeographic patterns within and among species, this barrier to dispersal has affected species diversity for millions of years.

Will the South's Bats Rise Again? The Devastating Effects of White-nose Syndrome in South Carolina

Susan C. Loeb[1], Eric A. Winters[1], Leanne K.L. Burns[2] and Pallavi Sirajuddin[2]
1 *USDA Forest Service, Southern Research Station, Clemson, USA;* ***2*** *Department of Forestry and Environmental Conservation, Clemson University, Clemson, USA*

Many scientists predicted that the effects of white-nose syndrome (WNS) would be less severe as it moved south. Our objective was to document the decline of bats in the Andrew Pickens District of the Sumter National Forest which is located in northwestern South Carolina. WNS was first detected in this area in 2013-2014. We counted all bats in Stumphouse Tunnel during the winters of 2014-2016 and swabbed 10-20 bats per year for the presence of *Pseudogymnoascus destructans*. In summer 2016 we mist-netted bats at nine sites that we netted in 2007. The number of tri-colored bats (*Perimyotis subflavus*) in Stumphouse Tunnel declined from 321 in 2014, to 148 in 2015, to 67 in 2016, a 79.1% decline. In 2007, red bats (*Lasiurus borealis*) were the most commonly captured species making up 39.7% of captured individuals followed by northern long-eared bats (*Myotis septentrionalis*; 25.3%), little brown bats (*M. lucifugus*; 19.4%), big brown bats (*Eptesicus fuscus*; 11.4%) and tri-colored bats (7.7%). In 2016, red bats were again the most common species captured (49.0%) but, big brown bats were the second most common species (40.8%) followed by evening bats (*Nycticeius humeralis*; 4.1%) and tri-colored bats (4.1%). No northern long-eared bats or little brown bats were captured in 2016 and a large colony of little brown bats near one of our netting sites has completely disappeared. Our results suggest that the effects of WNS have had a significant impact on the bat community of northwestern South Carolina.

Bat Conservation in California's Central Valley

Rachael Long[1], Katherine Ingram[2], Sara Kross[2], Meredith Niles[3], Devon O'Rourke[4] and Mylea Bayless[5]
1 *University of California Cooperative Extension, Woodland, USA;* ***2*** *Wildlife, Fish & Conservation Biology, University of California, Davis, USA;* ***3*** *Nutrition & Food Sciences, University of Vermont, Burlington, USA;*
4 *Molecular, Cellular & Biomedical Sciences, University of New Hampshire, Durham, USA;* ***5*** *Senior Director, Bat Conservation International, Austin, USA*

California's Central Valley is one of the most productive agricultural regions in the world. It is also one of the most biologically rich areas, with a high diversity of mammals, including bats. The most common types found in the valley include Mexican free-tailed, big brown, *Myotis* (Yuma and California), pallid, hoary, red, and pipistrelle bats. With most of the land developed for farming, there is a strong need to work with farmers to ensure bats are protected. In 2015, we conducted a landholder survey to determine perceptions of bats. Most participants viewed bats as beneficial for insect pest control and crop yields; bats were not considered harmful for food safety. However, disease transmission to animals and people and nuisances in buildings were of concern, likely detracting some landholders from encouraging bat activity on their farms. More research and outreach is needed to showcase the benefits of bats in agriculture to help conserve this important ally. To address this, we are studying the impact of bats on the key codling moth pest in walnut orchards. Preliminary data from 2008 documented that 5% of a colony of 3,000 bats on a walnut farm in the Central Valley fed on this pest, showing an economic benefit, which we are in the process of quantifying. Other agricultural pests detected in the guano samples included *Lygus* bugs and armyworms. Outreaching information on the benefits of bats to agencies such as the USDA Natural Resource Conservation Service, will help protect bats on farms.

A Proposal for Intraspecific Variation in Bat Pollination Services to Baobab Trees in South Africa
Macy A. Madden[1], Peter J. Taylor[2] and Tigga Kingston[1]
1 *Department of Biological Sciences, Texas Tech University, Lubbock, USA;* ***2*** *School of Mathematical and Natural Sciences, University of Venda, Thohoyandou, ZAF*

Studies of ecological interactions have recently focused on the role of individuals. Especially important are individual variations among pollinators, because pollinator movements directly affect plant fitness. I will explore how morphology affects pollination by individual bats (primarily *Rousettus aegyptiacus*) in a bat-baobab (*Adansonia digitata*) mutualism in southern Africa. In bats, individual variation in flight morphology may lead to differences among individuals in foraging behavior. Wing loading, influenced primarily by body mass, correlates with flight speed. Adult male *R. aegyptiacus* range in body mass from 79g to 165g, resulting in potential flight speeds between 11.8 m/s and 14.3 m/s. Consequently, the largest bats could fly approximately 10 more kilometers per hour than the smallest. I hypothesize that intraspecific variation in wing morphology influences foraging and pollinator behavior. I predict individuals with greater wing loading values (typically, heavier individuals) will fly longer distances and visit more baobabs per night, and hence be more effective pollinators. Using VHF radio transmitters attached via collars to 20 adult male *R. aegyptiacus*, bats will be detected at trees using an array of manned receivers throughout the night. Nightly data can be combined for each individual to create foraging tracks. Radio tracking data aggregated with wing morphology data taken from pictures evaluated with ImageJ makes analysis of individual foraging behaviors possible. Understanding individual behavior in this system is important because bats face many threats across Africa (i.e., hunted for bushmeat) and implications of losing more effective individuals from a population of pollinators is currently unknown.

The Effect of Environmental Factors on Emergence Time in Mexican Free-tailed Bats
Cassi J. Mardis and Laura N. Kloepper
Department of Biology, Saint Mary's College, Notre Dame, USA

Mexican Free-tailed bats (*Tadarida brasiliensis*) form large maternal cave colonies and emerge each night in large densities. The bats are thought to leave around sunset, but there are other factors that may contribute to emergence time. In this study, we examined what factors may predict emergence time in Mexican Free-tailed bats across 8 caves and 8 weeks. At each cave and each night, light, temperature, wind speed, barometric pressure, wind direction, direction of flying bats, and the number of visual predators were recorded every 2 minutes prior to and during emergence. Additionally, daily recordings of high temperature, low temperature, altitude, drought, cloud coverage, moon phase, precipitation, and magnetic field were noted. The effect of all parameters on emergence time was investigated using Generalized Linear Models. Here, we describe which parameters are most likely to predict emergence time in Mexican Free-tailed bats.

Genetic Structure of the Migratory Eastern Pipistrelle Bat, with Implications for Sex-biased Dispersal
Alynn M. Martin[1], Maarten J. Vonhof[2] and Amy L. Russell[3]
1 *School of Biological Sciences, University of Tasmania, Sandy Bay, AUS;* ***2*** *Department of Environment and Sustainability Sciences, Western Michigan University, Kalamazoo, USA;* ***3*** *Department of Biology, Grand Valley State University, Allendale, USA.*

In mammals, dispersal from the natal site decreases inbreeding risk, increases potential resource availability, and reduces kin competition; while bidirectional migration allows for seasonal relocation to more favorable conditions. These movements directly influence population genetic structure, and have implications for disease and conservation management. While a number of taxonomically diverse species partake in dispersal and migration, these behaviors are less understood in cryptic species. North American temperate vespertilionid bats generally exhibit male-biased dispersal. The eastern pipistrelle bat (*Perimyotis subflavus*) is commonly assumed to follow the same pattern of male-biased dispersal across its range, yet little work has been done to test that assumption. Previous work using radio-tracking and stable isotope analyses have suggested that females exhibit site fidelity to summer roosts, while males complete longer north-south migratory movements. We present a phylogeographic study of *P. subflavus* to reveal the dispersal patterns and genetic structure across the midwestern portion of the species' range. The presence of genetically differentiated populations in this migratory bat species indicates the importance of catchment areas in genetic diversity. This calls for the management and protection of both hibernacula and swarming locations which promote gene flow among individuals from isolated summer locations. Rising threats to

this bat species, such as habitat destruction and fragmentation, white-nose syndrome, and wind energy, make population connectivity increasingly useful in conservation management decision-making.

The Southeastern Bat in Mississippi

Chester O. Martin[1], Alison S. McCartney[2], Kathy Shelton[3] and Becky Rosamond[4]
1 *Mississippi Bat Working Group, Vicksburg, USA;* ***2*** *Southeastern States Field Office, U.S. Bureau of Land Management, Jackson, USA;* ***3*** *Mississippi Museum of Natural Science, Mississippi Department of Wildlife, Fisheries, & Parks, Jackson, USA;* ***4*** *North Mississippi Refuges Complex, U.S. Fish and Wildlife Service, Grenada, USA*

The southeastern bat (*Myotis austroriparius*) was previously listed as an S1/S2 species (critically imperiled and vulnerable to extinction) by the Mississippi Natural Heritage Program. However, few studies had been conducted on the species in Mississippi prior to the year 2000, and little was known about its distribution, population status, and habitat use. In fact, historic records documented occurrence in only six Mississippi counties. We report the results of recent studies (2000-present) that have verified occurrence in numerous additional localities based on state and federal land surveys, annual mist-net events, private land investigations, and bridge and culvert surveys conducted as part of white-nose syndrome inspections. Significant populations (highest counts shown) were documented in airstrip culverts (n=892), abandoned cisterns (n=6,486), cavity trees in bottomland hardwoods (n=620), and caves (n=8,000+). Southeastern bats are now known to occur in 36 counties, which has led to a change in its designation to an S3 (Tier 2) species (rare or uncommon) in Mississippi. However, clearing of bottomland hardwoods, destruction of riparian habitat, lack of cave protection on private land, and damage to artificial roosting structures continue to threaten the species. Follow-up surveys are needed to assess change to roost sites and monitor key populations over time.

Evening Bat Population Resurgence and Expansion in Indiana and the Upper Midwest

Megan K. Martin, Dale W. Sparks and Virgil Brack, Jr.
Environmental Solutions & Innovations, Inc., Cincinnati, USA

Despite overall declining bat populations because of white-nose syndrome (WNS), evening bat (*Nycticeius humeralis*) populations appear to be resurging and expanding north. As recently as 2008, evening bats were considered extremely rare in Michigan, Illinois, and Ohio with a declining population in Indiana. A long-term on-going highway project in Indiana indicates that this bat is persistent and the population is possibly growing in southern Indiana. Additional bats have been captured consistently during presence-absence projects in northern Ohio, and new records have been recently added in northern Illinois and western Michigan. Evidence of range expansion was also recently demonstrated with a capture by MNDNR in Arden Hills, Minnesota. Two factors may be contributing to the expansion of this typically southern species: 1) the increase of average temperatures in these areas due to climate change and 2) the opening of a niche with the decrease in population of *Myotis* or *Perimyotis* due to WNS. The range and status of evening bats in Indiana, Illinois, Michigan, Kentucky, and Ohio should be re-evaluated based on recent population data and a preponderance of new records.

Assessment of Aerial Insectivorous Bats in Oil Palm Plantation at the Selva Lacandona, Chiapas, Mexico

Abigail Martínez-Serena[1], Ana Ibarra-Macías[1], Tania P. González-Terrazas[2], Kirsten Jung[2,] Luis Viquez-R[2] and Rodrigo Medellín[1]
1 *Departamento de Ecología de la Biodiversidad, Instituto de Ecología, Universidad Nacional Autónoma de México Ciudad de México, MEX;* ***2*** *Instituto of Evolutionary Ecology and Conservation Genomics, University of Ulm, Ulm, DEU*

The expansion of oil palm plantations (*Elaeis guineensis*) in tropical regions has caused habitat and biodiversity loss. The assessment of the effect of this plantation on aerial insectivorous bats´ is essential due to their role maintaining insect populations in natural habitats, and controlling pests in economically important crops. Using ultrasound detectors, composition (species richness and evenness) and activity levels of bats were compared between oil palm plantations, three fall gaps and forest interior sites, in the Selva Lacandona, Mexico. The recordings were obtained simultaneously in the different habitats for each dry and rainy season. Through a software-aided identification and manual review 11 species and 7 sonotypes were identified. Gaps were the habitat with the highest species richness in both seasons. Evenness in dry season was greater in gaps, meanwhile in rainy season it was greater in plantations. In both seasons forest interior had the lowest species richness and evenness. In oil palm

plantations two forest-dependent species were not registered: *Centronycteris centralis* and *Pteronotus gymnonotus*. Differences between habitats were found comparing composition and habitat use based on occurrence count and mean activity: gaps and oil palm plantations are grouped closer to species and sonotypes who forage in open areas. Activity was similar in dry and rainy season for oil palm plantations, and greater in gaps and forest interior in dry season. The results of this study show that oil palm plantations modify the aerial insectivorous bats´ assemblages changing their composition and activity levels.

Survival of Indiana Bats Infected with White-nose Syndrome and Its Implications for Population Recovery

Brooke Maslo[1], Amanda Bevan[1], Oliver Stringhan[1], Amanda Brumbaugh[2] and Chris Sanders[2]
1 *Department of Ecology, Evolution and Natural Resources, Rutgers University, New Brunswick, USA;* ***2*** *Sanders Environmental, Inc., Bellefonte, USA*

Quantification of annual survival rates and demographic trends among remnant colonies of hibernating bats that experienced mass mortality from white-nose syndrome (WNS) is needed to determine long-term population viability of species impacted by this disease and to implement effective and feasible management intervention. Using mark-recapture data, we estimated the first apparent annual survival rates for infected Indiana bats (*Myotis sodalis*) for four years following WNS detection Mt. Hope Mine, Rockaway, NJ USA. We detected a decreasing trend in annual survival, with estimates declining from 0.81 (95% CI: 0.66-.090) in 2011 to 0.59 (95% CI: 0.32-0.82) in 2014. We incorporated these survival estimates into stochastic matrix projection models to examine the long-term trajectories of our study population under three future scenarios, including a: 1) return of survival rates to pre-WNS estimates; 2) stabilization of survival rate at its 2014 estimate; and a 3) continued decline in survival rate. Mean yearly growth rates ranged from 0.60 to 1.09 with stable stage distribution occurring between 5 and 28 years. In all cases, the probability of extinction remained above 50% for the next 25 years. Our results highlight the degree of uncertainty remaining in our understanding of the demographic response of host populations and emphasize the bleak prognosis for population recovery.

Monitoring Effects of White-nose Syndrome on Bat Populations in National Parks of the Great Lakes Region

Parker J. Matzinger[1], William T. Route[2], Mark C. Romanski[3], Jeffery C. Gruver[4] and Kevin L. Murray[5]
1 *Natural Resources Department, Northland College, Ashland, USA;* ***2*** *Great Lakes Inventory and Monitoring Network, National Park Service, Ashland, USA;* ***3*** *Isle Royale National Park, National Park Service, Houghton, USA;* ***4*** *Western Ecosystems Technology, Inc., Laramie, USA* ***5*** *Western Ecosystems Technology, Inc., Bloomington, USA*

The National Park Service, Great Lakes Inventory and Monitoring Network (GLKN) coordinates monitoring efforts for nine national parks that cover one million acres. Many of these parks are within fifty miles of white-nose syndrome (WNS) documented locations and contain up to five bat species that are susceptible to WNS. In response to this imminent threat, an acoustic monitoring program was initiated in 2015 at five national parks to track bat populations through time. The program added three more national parks in 2016 and was assimilated under GLKN management. Each park rotated 3 to 5 SM3Bat and SM4Bat detectors (Wildlife Acoustics) every 7 to 14 days across spatially balanced survey blocks from June to August. Sound files were identified to species with Kaleidoscope Pro (Wildlife Acoustics) and then qualitatively reviewed by bat experts. In 2015 we sampled a total of 60 stations, containing 901 bat-detector nights, spread across the upper Great Lakes region and collected 143,000 files containing bat calls. Results from 2015 indicated the little brown bat was detected at the highest percentage of stations (96.1%), followed by eastern red bat (94.2%), silver-haired bat (93.5%), big brown bat (92.8%), hoary bat (84.5%), and northern long-eared bat (43.6%). We potentially detected the Indiana bat and tri-colored bat outside of their current documented ranges, requiring further study before declaring species presence. In conclusion, the 2015 data and long-term monitoring plan provide a solid foundation to assess trends in regional and local bat populations as the effects of WNS progresses.

Risk to *Tadarida brasiliensis* from Emerging Wind Energy Development in Central Texas

Gary F. McCracken[1], Winifred F. Frick[2] and Mylea L. Bayless[2]
1 *Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, USA;* ***2*** *Bat Conservation International, Austin, USA*

Diverse stakeholders often have very different perspectives on appropriate sites for industrial wind power development. Central Texas is an area of emerging wind development potential, but it also poses a risk to large

concentrations of *Tadarida brasiliensis*. Nearly half of the 25 major maternity roosts for *T. brasiliensis* in North America are concentrated in the Texas Hill Country making it among the densest concentration of bats in the world. We'll discuss wind impacts to this species and explore the challenges of wind development in the region. We provide two case studies of wind companies operating in this area of high risk to *T. brasiliensis*. In June 2016, ENEL Green Power (ENEL) canceled plans for the Mason Mountain wind power project that was proposed 16 miles from the Eckert-James River Bat Cave, a maternity site for 2 to 4 million *T. brasiliensis*. ENEL abandoned this project after years of planning, after commissioning environmental risk assessments, and after securing leases for construction from private land owners. Another energy company, E.On, completed construction of 55-turbine facility 33 miles from Frio Bat Cave, the second largest maternity roost for T. *brasiliensis*. We will explore these different scenarios and discuss how science based advocacy can provide a model for cooperation to inform a discussion on siting of wind development that can serve bat conservation.

Profiling Bat Species Presence in Managed Wildlife Landscapes

Thomas McElroy and Maggie Aduddell Hunt
Department of Ecology, Evolution, and Organismal Biology, Kennesaw State University, Kennesaw, USA

Restoration of endemic flora or reintroduction of at-risk fauna may include methods such as controlled forest burns or artificial habitats to encourage presence and breeding for target organisms. These methods may also affect the activity of other wildlife. Bats inhabit key ecological niches in several ecosystems and are often considered indicators of ecosystem health. We investigated the effect of forest management history and current forest management practices on bat species presence and activity. We deployed bat detectors to passively monitor species presence and activity from June 2016 to October 2016. Monitoring was done concurrently for two wildlife management areas in the Raccoon Creek Watershed of northwest Georgia, USA, that differ in landscape management histories and current long leaf pine restoration practices. Our preliminary results indicate a difference in species presence and activity between regions that differ in landscape management histories, but no significant differences among contemporary restoration practices.

Gathering Baseline Data on Wintering Bats and Roosts in Texas

Melissa B. Meierhofer[1], Jonah Evans[2], Brian L. Pierce[1], Joe M. Szewczak[3] and Michael L. Morrison[4]
1 *Institute of Renewable Natural Resources, Texas A&M University, College Station, USA;* ***2*** *Wildlife Diversity Program, Texas Parks and Wildlife Department, Boerne, USA;* ***3*** *Department of Biological Sciences, Humboldt State University, Arcata, USA;* ***4*** *Department of Wildlife & Fisheries Sciences, Texas A&M University, College Station, USA*

White-nose syndrome (WNS), caused by a deadly fungus (*Pseudogymnoascus destructans*), has led to substantial declines in bat populations in eastern Unites States. Of the 33 species in Texas, four are known to be susceptible to the fungus. Based on current rates of expansion, WNS could possibly arrive in Texas within the next few years. To understand the potential threat of WNS to bats in Texas, we monitored for signs of WNS, as well as collected data on bat species, abundance, distribution, and environmental characteristics at 19 sites from January-March 2016. We visited an additional 67 sites in the late spring-summer and assessed for a potential re-visit in the winter of 2017. We recorded four bat species over the course of our winter surveys. Of the 120 bats swabbed for WNS, 117 were tested for *P. destructans* using real-time PCR. All swabs were negative for *P. destructans*. EL-UBS-2 data loggers were placed at 11 of 19 sites and will be retrieved in the winter of 2017 to collect data for one year on temperature, humidity, and dew point. Baseline data on winter roosts and bats in Texas will play a critical role in developing management plans prior to the arrival of WNS, and how to proceed should it arrive.

Rabies in Bats of Illinois

Jean M. Mengelkoch[1], Joyce E. Hofmann[1], Connie C. Austin[2] and Steve B. Amundsen[1]
1 *Illinois Natural History Survey, University of Illinois Urbana Champaign, USA;* ***2*** *Illinois Department of Public Health, Springfield, USA*

Every year thousands of bats in the United States are submitted for rabies testing. We have identified most of the bats submitted in Illinois since 2002. Although the number of bats submitted for testing in Illinois has varied widely, the percentage of submitted bats that test positive for rabies has remained relatively constant. The vast majority of the submitted bats are big brown bats (*Eptesicus fuscus*), which frequently use buildings for roosting in the summer and hibernating in the winter. However, the bats with the highest prevalence of rabies are bats that are

not typically associated with humans (hoary bat [*Lasiurus cinereus*], eastern pipistrelle [*Perimyotis subflavus*], and eastern red bat [*Lasiurus borealis*]). We will continue to monitor and examine long term trends of bats submitted for rabies testing in Illinois.

Threats to North American Bats Prioritized by Region

Rob Mies[1], Charles M. Francis[2], Rodrigo A. Medellin[3], Jeremy Coleman[4], Rita Dixon[5], Brian Carver[6], Vanessa G. Rojas[7], D. Scott Reynolds[8], Jorge Ortega[9], Jordi Segers[10], Angie McIntire[11], Jeff Gruver[12] and Cori Lausen[13]
1 *Organization for Bat Conservation, Bloomfield Hills, USA;* ***2*** *Environment Canada, Ottawa, CAN* ***3*** *Departamento de Ecología de la Biodiversidad, Instituto de Ecología, Universidad Nacional Autónoma de México Ciudad de México, MEX;* ***4*** *U.S. Fish & Wildlife Service, Hadley, USA;* ***5*** *Western Bat Working Group, Boise, USA;* ***6*** *Southeastern Bat Diversity Network, Cookeville, USA;* ***7*** *Midwest Bat Working Group, Terre Haute, USA;* ***8*** *Northeast Bat Working Group, Concord, USA;* ***9*** *Institute Politecnico Nacional and Program for the Conservation of Mexican Bats, MEX;* ***10*** *Canadian Wildlife Health Cooperative, Charlottetown, CAN;* ***11*** *Arizona Game and Fish Department, Phoenix, USA;* ***12*** *WEST, Laramie, USA;* ***13*** *Wildlife Conservation Society Canada, Kaslo, CAN*

The North American Bat Conservation Alliance Steering Committee developed a list of 21 threats facing bats in North America, classified by IUCN criteria. Over 200 bat experts from 12 regions of Canada, United States of America (USA) and Mexico participated in an electronic survey and provided their best estimate of proportion of bat species affected by each threat in their region; the scope and severity of the threat to those species; and the trend in that threat. We used the mean value of a Scope-Severity index to rank threats within regions. The impact of pathogens and microbes on bats ranked as the top threat in most regions in Canada and the USA, but was considered a relatively low threat in Mexico and the Pacific Southwest. The impacts of evicting and/or eradicating bats from roosts ranked as high threats in eastern and western Canada and Mexico. Agricultural crops ranked as a high threat in Mexico and the USA's Midwest, Southeast, and Pacific Southwest regions. Farming and ranching were also a high threat in Mexico. Regionally specific threats such as recreation activities in USA's Mountain region and Alaska, fire suppression and management in the USA's Pacific Northwest and Alaska, and dams and water management in USA's Southwest were of high concern. Other major threats included impacts of renewable energy, climate change, industrial/urban development, forestry practices, and mining/quarry activity. The next step will be to create a survey to collect detailed information from bat biologists on ways to mitigate the highest-ranking threats.

Roost Site Habitat Requirements of *Lasiurus blossevillii* and *L. xanthinus*

Ronald J. Mixan[1], Joel M. Diamond[1], Allen W. Calvert[2], Martin D. Piorkowski[1] and Daniel P. Sturla[1]
1 *Arizona Game and Fish Department, Wildlife Contracts Branch, Phoenix USA;* ***2*** *National Park Service, Mojave Desert Network, Inventory and Monitoring Program, Boulder City, USA*

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) was developed to provide regulatory compliance for water and power users of the LCR by implementing conservation measures for 31 different fish and wildlife species. Conservation measures for *Lasiurus blossevillii* (western red bat) and *Lasiurus xanthinus* (western yellow bat) require creation of 765 acres of habitat for each species. A study was conducted in 2011 to 2013 to better understand their habitat needs to assist project managers with creating habitat. Bats were captured at habitat creation areas (treatment) and natural areas (control) located in 16 riparian areas in Arizona and one riparian area in California and then tracked to roost trees using radio telemetry. A total of 23 *L. blossevillii* and 22 *L. xanthinus* were successfully tracked to at least one roost tree. *L. xanthinus* roosts were all in non-native palms; all but two in Mexican fan palms (*Washingtonia robusta*). Fremont cottonwoods (*Populus fremontii*) accounted for 85% of *L. blossevillii* roosts. At control sites, *L. blossevillii* roost trees were statistically larger than nearby non-roost trees. At treatment sites there was no difference between roost trees and non-roost trees. *L. xanthinus* appears to only use the monitored habitat creation areas as foraging habitat. Management recommendations for *L. blossevillii* roosting habitat within habitat creation areas include planting cottonwoods with adequate spacing that allows for trees to grow to a larger size that is favorable for the roosting of *L. blossevillii*.

Year-round Use of Rock Crevices by Two Species of Bats in Virginia

Paul R. Moosman, Jr., P. Reid Anderson and Martin Frasier
Department of Biology, Virginia Military Institute, Lexington, USA

Relatively few species of bats in Eastern North America are known to roost in rock-crevices, and most knowledge of their roosting habits is based on studies in summer. We documented year-round use of emergent rock-

formations by eastern small-footed bats and big-brown bats in the Blue Ridge Mountains of Virginia. Bats were documented by repeated visual surveys of rocky habitats. Eastern small-footed bats were the primary species observed on talus slopes from March until November. However, we observed both species on South facing rock-ledges intermittently between early December and mid-April of 2016. Winter roosts of both species tended to be shorter (27±3 cm) and narrower (3.0±0.5 cm) than randomly selected nearby crevices, and crevices used by eastern small-footed bats were closer to the ground (60±22 cm) than those of big-brown bats (137±14 cm). Although rock ledges were in forest, they received high amounts of sunlight because of the lack of foliage during winter. We suspect bats selected roosts based on physical dimensions and temperature. It is unclear whether bats hibernated exclusively in emergent rock-formations, or if they made frequent movements between rock-formations and hibernacula such as caves and mines. Results demonstrate that the life-history of these species is more complex than has been conventionally assumed. Use of emergent rock-formations in winter could help to explain why eastern small-footed bats and big-brown have suffered lower mortality rates from white-nose syndrome.

Abandoned Railroad Tunnels Serving as Hibernacula: A Refuge for Bats in a White-nose Syndrome World
Juliet J. Nagel and J. Edward Gates
University of Maryland Center for Environmental Science, Appalachian Laboratory, Frostburg, USA

Three abandoned railroad tunnels, constructed in 1904, have been serving as bat hibernacula in Western Maryland since they were abandoned in 1975. Each is between 0.5 and 1.3 km long. Spring emergence and fall swarming surveys have been conducted at the tunnels beginning in 2006, about 4 years before white-nose syndrome (WNS) was first detected in Maryland, and continuing through spring 2016. Bats were captured using harp traps placed at the entrance of the tunnels and banded so recaptured bats would be recognized in future years. WNS spores have been detected on bats hibernating inside the tunnels, but not on the tunnel substrate, unlike caves in the area. Bats hibernating in the tunnels also have not shown the white fungal growth on exposed skin characteristic of WNS. Even so, several species known to be susceptible to the disease have declined: *Myotis lucifugus, Myotis septentrionalis,* and *Perimyotis subflavus* in particular have all decreased, though all are still present in low numbers. On the other hand, *Eptesicus fuscus* and *Myotis leibii*, a state-endangered species in Maryland, both continue to use the tunnels in pre-WNS numbers. Banding has revealed that at least some bats are surviving and returning to use the tunnels for multiple years in a row: the most recent surveys recaptured several big brown bats that had been banded three years earlier. These tunnels likely provide vital habitat for hibernating bats in the region.

Effects of Call Classification Techniques and Survey Method on Site-Occupancy Models
Benjamin D. Neece[1], Susan C. Loeb[2] and David S. Jachowski[1]
1 *Department of Forestry and Environmental Conservation, Clemson University, Clemson, USA;* ***2*** *USDA Forest Service, Southern Research Station, Clemson University, Clemson, USA*

Acoustic monitoring is a popular approach to studying bat populations. A number of automated call classification programs are available, but recently were shown to have low agreement, and it is widely recommended to manually vet calls. Therefore, it is important to understand the impacts of survey method and call classification techniques on the results of acoustic research, including long-term monitoring programs. Our objective was to examine the effects of survey and classification methods on detection probabilities and occupancy models of tri-colored bats (*Perimyotis subflavus*). During summer 2015, we conducted mobile transect and stationary point acoustic surveys in 35 spatially balanced and randomly distributed 100 km^2 cells across South Carolina using North American Bat Monitoring Program guidelines. Calls were filtered for noise, classified to species using EchoClass 3.1 and Kaleidoscope 3.1.5, and manually vetted. We compared species detection probabilities between mobile and stationary surveys and single-season Bayesian site-occupancy models among the three classifiers. Tri-colored bats were detected in 30, 35, and 27 cells by EchoClass, Kaleidoscope, and manual vetting, respectively. Across survey occasions, EchoClass had a higher false-negative rate and lower false positive rate than Kaleidoscope. False positive and false negative rates were higher in mobile surveys than stationary surveys for both programs. Best detection and occupancy model covariates differed among classifiers, but the estimated number of occupied cells did not differ significantly. Thus, we found different results from classification techniques but reached similar conclusions. However, we suggest manually vetting calls when possible to avoid misclassifications and achieve accurate occupancy models.

Parturition in *Eptesicus fuscus*

Christopher W. Nicolay[1], Marina J. Braine[1] and Rebecca J. Hoffman[2]
***1** Department of Biology, University of North Carolina Asheville, Asheville, USA; **2** College of Veterinary Medicine, Lincoln Memorial University, Harrogate, USA*

This study observed parturition and behavior in a maternity colony of big brown bats (*Eptesicus fuscus*) in western North Carolina. The colony roosted between the outer slats and inner screen of an attic window, which provided a 2-dimensional surface upon which the bats roosted and enabled filming from within the attic. Births occurred the first week of June. In the preparatory phase of parturition, bats rotated to hang inverted (by the thumbs) so the pup would be caught in the uropatagium. Females in labor often spaced themselves apart from the main aggregate of the colony. A significant period of obvious, strong contractions preceded expulsion of the pups. Characteristic of vespertillionids, presentation was breech (feet-first). There was a long and apparently difficult period between initial extension of the feet and final delivery of the pup. Females regularly licked themselves and pulled at the pup to facilitate delivery. Females in labor also often interacted with other females, both in aggressive encounters and in interactions that may suggest midwife-like behavior. Both twin (most commonly) and singleton births were observed. Cleaning of the newborn and attachment to the teat followed expulsion. Time spent in all phases of parturition was highly variable. Neonates were left alone in the roost the same day they were born, as females left the roost (presumably to feed). Females were selective about which pups they nursed upon return to the roost.

Detecting Molecular Signatures in Thermoregulatory Genes in Bats

Margaret Elizabeth O'Brien[1], Frank Burbrink[2] and Nancy Simmons[3]
***1** Ecology, Evolution and Environmental Biology Department, Columbia University, New York City, USA;*
***2** Department of Herpetology, American Museum of Natural History, New York City, USA; **3** Department of Mammalogy, American Museum of Natural History, New York City, USA*

While all bat species are endothermic, they employ different thermoregulatory strategies including hibernation, torpor, homeothermy, or the requirement of a hot roost. It is crucial to understand the thermoregulatory function of a bat species given that some regimes are disproportionately affected by disease, climate change, and food scarcity. Unfortunately, thermoregulatory strategies remain undocumented in the majority of bats. The most efficient way to uncover the thermoregulatory regime of a species may be to identify it using key genetic markers associated thermoregulation in the lab. A molecular signature was looked for in 31 species that were previously identified as being a hibernating, torpid, homeothermic, or "hot-roosting" species. Potential genetic signatures were examined by running a correlation analysis of the sequences of two genes associated with thermoregulation in bats, the leptin gene and the LEPR gene. Proteins associated with these genes were analyzed in order to see if the phenotype of the proteins could further serve as a molecular signature. The presence of this molecular signature in bats is examined. We consider how this can influence conservation efforts and how it can assist in further research on the molecular mechanisms behind thermoregulation.

Thermoregulation in the Heat: Efficient Evaporative Cooling in Two Southern African Feathered Bats

Ryan S. O'Connor[1], Blair O. Wolf[2], R. Mark Brigham[3] and Andrew E. McKechnie[1]
***1** DST-NRF Centre of Excellence at the Percy FitzPatrick Institute, Department of Zoology and Entomology, University of Pretoria, Private Bag X20, Hatfield 0028, RSA; **2** Biology Department, University of New Mexico, MSC03-2020, Albuquerque, USA; **3** Department of Biology, University of Regina, Regina, CAN*

Nightjars represent a model taxon for investigating physiological determinants of heat tolerance due to their habit of roosting and nesting in sunlit microsites during the heat of the day. This is ecologically similar to bats roosting in hot sites. We investigated the relationships between body temperature (T_b), resting metabolic rate (RMR) and total evaporative water loss (TEWL) at air temperatures (T_a) ranging from 10 – 56°C in Rufous-cheeked (*Caprimulgus rufigena*) and Freckled Nightjars (*Caprimulgus tristigma*); for the latter species, we obtained data from an arid and a mesic site. At $T_a \approx 56$°C, T_b was 41.7°C and 41.4°C in *C. rufigena* and *C. tristigma*, respectively. Lower critical limits of thermoneutrality occurred at $T_a = 35 – 37$°C, but there were no clear upper critical limits. In both species, TEWL began to increase rapidly at $T_a = 37.0 - 39.9$°C. Increasing evaporative heat dissipation incurred small metabolic costs, with the RMR of neither species ever increasing by >20% above thermoneutral values. In *C. tristigma,* mass-specific TEWL at $T_a > T_b$ was ~18% lower in the arid-zone vs. mesic conspecifics. At $38 < T_a < 48$°C, mass-specific RMR of was ~16% higher in summer vs. winter. In *C. rufigena*, maximum evaporative heat

dissipation represented ~515 % of metabolic heat production (MHP) at $T_a \approx 56°C$ which is greater than values for other birds with efficient cooling systems. Our results strongly reinforce the general notion that caprimulgids possess extremely efficient evaporative cooling mechanisms.

Relative Abundance, Sex Ratios, and Roosts of Silver-haired Bats in Upper Michigan

Delainey Nicole O'Donnell and Allen Kurta
Department of Biology, Eastern Michigan University, Ypsilanti, USA

Although well studied in the West, little is known about the ecology of silver-haired bats (*Lasionycteris noctivagans*) in eastern North America. We conducted mist-netting surveys of bats in two areas of the Upper Peninsula of Michigan to determine the relative abundance and sex ratio of these migratory bats. Based on published literature, we predicted that silver-haired bats would represent less than 5% of all bats captured and that most adults would be male. However, we discovered that silver-haired bats actually were common, representing 24% of all bats caught near White Pine, Michigan, in 2015, and 51% of the population at Pictured Rocks National Lakeshore in 2016. A total of 60 silver-haired bats were captured; all were adults, and all were male, which suggests that adult females migrate to areas north of Lake Superior for the summer. Although transmitters were placed on eight silver-haired bats in 2016, only three roost trees were located—two in red maple (*Acer rubrum*) and one in American beech (*Fagus grandifolia*). Observations of evening emergence indicated that each bat roosted alone under exfoliating bark.

White-nose Syndrome Extirpated One-quarter of the Bat Species in Great Smoky Mountains National Park

Joy M. O'Keefe[1], Joseph L. Pettit[2] and Susan C. Loeb[3]
1 *Center for Bat Research, Outreach, and Conservation, Indiana State University, Terre Haute, USA;* ***2*** *College of Natural Resources, Utah State University, Logan, USA;* ***3*** *USDA Forest Service, Southern Research Station, Clemson University, Clemson, USA*

White-nose syndrome (WNS) is an emerging infectious disease that has killed over 6 million bats in North America since its discovery in New York in 2006. Population declines have been described for winter hibernacula, but there is less information on changes in bat communities during the active season (April–September). We aimed to measure the impacts of WNS in Great Smoky Mountains National Park (GRSM), an ecologically rich protected area that hosts 12 bat species, by comparing bat abundance pre-WNS and 2–4 years after WNS was first confirmed in GRSM hibernacula. We compared captures per unit effort (net area*hr) for surveys at long-term summer monitoring sites in 2009–2012 (10–15 nights/year) and 2014–2016 (21–40 nights/year). By 2016, we could no longer capture *Myotis septentrionalis* and *M. lucifugus*, once two of the most commonly captured species in GRSM. We also detected substantial declines *for M. sodalis* (-97%), *Perimyotis subflavus* (-87%), and *Corynorhinus rafinesquii* (-52%). Interestingly, we captured *Eptesicus fuscus* and *M. leibii* at higher rates in 2016 than pre-WNS. This epidemic disease has essentially extirpated 4 (25%) of the bat species in this biologically important natural area. With such a large proportion of species declining, we expect a significant change in insect populations and, subsequently, forest health in GRSM and surrounding areas. In areas presumed to be WNS-free, we recommend gathering baseline data on bat abundance via mist netting surveys or acoustic monitoring to facilitate future assessments of the impacts of this devastating disease on bat populations.

How the Matrix Matters: Bats Respond to Farm Management and Landscape Context in an Agricultural Hotspot

Elissa M. Olimpi
Environmental Studies Dpt., University of California, Santa Cruz, USA

In agricultural landscapes, multi-scalar drivers of biodiversity loss extend from the farm- to landscape scale, yet it is often unclear how to best manage species that provide valuable ecosystem services. Mobile species in higher trophic levels generally respond to factors at larger scales; however, for insectivorous bats, the availability of insect prey also drives patterns in foraging, and insects respond to local management practices. We assessed the local and landscape effects of agricultural intensification on bats using passive acoustic monitoring data from 54 sites in the Central Coast Region, CA on paired farms (low and high intensification) and in nearby natural habitat spanning a range of farming practices and landscape contexts. We hypothesized that factors at both the local- and landscape-scale would impact bat communities, with stronger responses to landscape-scale factors. We found that both farm-scale and landscape-scale factors impact bat communities. Diversified farming practices, including higher vegetative

diversity and hedgerows, were associated with greater relative bat abundance and differences in community composition. At the landscape scale, the amount of surrounding agriculture and distance from the coast predicted bat species richness and activity. Factors across scales interact, pointing toward the importance of conserving small forest fragments in intensive agricultural areas. In addition, adding a diversity of vegetation on farms increases matrix quality for some bats. Application of our findings could decrease the negative effects of agriculture and prevent regional declines in bat biodiversity, as well as enhance benefits to farmers in the form of free, natural pest suppression.

Vocalizations During Altruistic Behaviors by Common Vampire Bats

Lydia Olson Friedlander and Miranda B. Dunbar
Biology Department, Southern Connecticut State University, New Haven, USA

Common vampire bats (*Desmodus rotundus*) subsist entirely on blood, a nutritive-poor food source and as such, they must feed frequently and regularly to survive. Still, on any given night members of a vampire bat colony may fail to feed; bats unsuccessful in feeding will seek nourishment via a regurgitated bloodmeal from a known conspecific. While tactile methods for solicitation of bloodmeals have been documented, there are no data regarding other modes of communication that may be used during this social interaction. Therefore, our goals were to first determine if vampire bats engaging in food sharing behaviors use vocal communications and then to determine whether those vocalizations differ from other types of social calls. Working with a captive colony of vampire bats, we created experimental pairs of 'food-deprived' and 'satiated' bats to induce solicitation behaviors and monitored behavior and simultaneous vocalizations using video- and Anabat Walkabout-recordings. Our data show that vampire bats vocalize when engaging in food sharing behaviors. We will compare these data to a baseline library of vampire bat behaviors and social calls recorded from within the same colony; we predict that conversations being had during food solicitation are unique and thus partly responsible for prompting an altruistic act (ie, bloodmeal sharing). Our work provides new and much needed information regarding the complex communicative abilities of the vampire bat, a highly social creature. In a broader context, these data have implications for all social and gregarious animals, enhancing future ethological research.

Collateral Damage or Shadow of Safety? Effect of Predatory Bats and Parasitic Midges on Frog Calling

Rachel A. Page[1], Ximena E. Bernal[1,2], Michael S. Caldwell[1,3], Wouter H. Halfwerk[1,4], Mallory O. Wessel[1,4] and Paula A. Trillo[1,3]
1 *Smithsonian Tropical Research Institute, Balboa, PAN;* ***2*** *Department of Biological Sciences, Purdue University, West Lafayette, USA;* ***3*** *Department of Biology, Gettysburg College, Gettysburg, USA;* ***4*** *Department of Ecological Science, VU University, Amsterdam, NLD;* ***5*** *Department of Biological Sciences, Butler University, Indianapolis, USA*

Across the animal world, males produce conspicuous, often costly, advertisement signals to attract mates. Eavesdropping predators and parasites exploit these signals to detect, assess and localize potential prey. Males often display from mixed-species aggregations, but the influence of nearby heterospecifics on risks associated with sexual signaling has not been previously investigated. We tested whether predation and parasitism risks depend on proximity to heterospecific signalers. Using field playback experiments with calls of two species that often display from the same ponds, túngara frogs and hourglass treefrogs, we tested two hypotheses: (1) calling near heterospecific signalers attractive to eavesdroppers results in increased attention from predatory bats and parasitic midges (collateral damage hypothesis) or (2) calling near heterospecific signalers reduces an individual's predation and parasitism risks, as eavesdroppers are drawn to the heterospecifics (shadow of safety hypothesis). Bat visitation was not affected by calling neighbors. The number of frog-biting midges attracted to hourglass treefrog calls, however, rose threefold when played near túngara calls, supporting the collateral damage hypothesis. We thus show that proximity to heterospecific signalers can drastically alter both the absolute risks of signaling and the relative strengths of pressures from predation and parasitism. Through these mechanisms, interactions between heterospecific guild members are likely to influence the evolution of signaling strategies and the distribution of species at both local and larger scales.

Survival of Hibernating Tri-colored Bats prior to White-nose Syndrome
Roger W. Perry and Phillip N. Jordan
Southern Research Station, USDA Forest Service, Hot Springs, USA

The tri-colored bat (*Perimyotis subflavus*) is the most commonly encountered species found hibernating in caves, mines, cisterns, wells, and culverts throughout the Southeast U.S., but their populations are being depleted by white-nose syndrome (WNS). In areas hard hit by WNS, some tri-colored bats appear to remain present. However, it is unknown if these individuals are survivors of the epidemic or migrants from other areas. In 2014, we initiated a study evaluating survival rates of tri-colored bats hibernating in small mines of the Ouachita Mountains of Arkansas, an area on the leading edge of the WNS spread. Our goal was to determine apparent survival rates prior to, and after arrival of WNS using mark-recapture and Cormack-Jolly-Seber models. Bats were banded in 4 mines at the beginning of hibernation and again near the end of hibernation to estimate apparent survival rates during winter hibernation and the summer active season. To-date, 143 bats have been banded. Preliminary data for the first 2 years suggests that monthly apparent survival differed among the four mines and ranged from 0.73 to 0.94 among the 4 mines. The fungus associated with WNS was first detected at one mine in winter 2014-2015, but visible WNS was not present. The following winter, no bats at that site tested positive and survival rates remained stable. This study will continue for 2-3 years to build more accurate models and compare survival rates after WNS becomes widespread in the area.

Flight or Fright: The Relationship between Personality and Physiological Stress in Little Brown Bats
Amelia Peterson[1], Kaleigh J.O. Norquay[1], Quinn E. Fletcher[1], Quinn M.R. Webber[1], Darcy Childs[2], W. Gary Anderson[2] and Craig K.R. Willis[1]
1 *Department of Biology, University of Winnipeg, Winnipeg, CAN;* ***2*** *Department of Biological Sciences, University of Manitoba, Winnipeg, CAN.*

The Pace of Life Syndrome Hypothesis predicts that species and individuals with long lifespans, slow growth rates and delayed reproduction will exhibit physiological traits that favour a long life, including a strong physiological stress response to facilitate responses to environmental stressors (e.g., predators). Recently, links have also been made between individual behavioural variation (i.e., personality) and physiological stress in several model taxa but, to date, this relationship has not been tested for bats. We tested the hypothesis that personality and physiological stress responses co-vary in *Myotis lucifugus*. We used a hole-board test to quantify activity, exploration and anxiety components of personality for 102 bats captured at a hibernaculum during fall swarming. We collected baseline (within 5 min of capture) blood samples from 18 individuals and stress response (after 15 min of handling) samples from 27 different individuals and determined plasma cortisol concentrations using radioimmunoassay. We found that handling caused a significant stress response, and that cortisol response was negatively correlated with body condition. We did not find the predicted relationship between plasma cortisol and common personality traits but a non-significant trend between activity and baseline cortisol concentration suggests that this relationship should be revisited with a larger sample size or during early summer when baseline cortisol concentrations are lower. The relationship we observed between body condition and baseline cortisol suggests that handling bats in poor body condition (e.g., suffering from white-nose syndrome and/or emerging from hibernation) could exacerbate chronic stress and should be minimized.

Microbiome Structural and Functional Interactions Across Bat Dietary Niche Space
Caleb D. Phillips[1], Paul Webala[2] and Tigga Kingston[1]
1 *Department of Biological Sciences, Texas Tech University, Lubbock, USA;* ***2*** *Department of Tourism and Wildlife Management, Maasai Mara University, Narok, KEN*

The mammalian gut hosts a complex ecosystem of microbes now known to play integral functional roles in host nutrition and metabolism, physiology, immunology, health and behavior. Host diet is a primary environmental factor shaping gut-microbe communities, and in bats there are consistent differences in gut-microbiome diversity among different trophic groups. However, the extent to which co-distributed species sharing similar niche space differ in their microbiome community composition is unclear. We analyzed fecal microbiomes and diets of sympatric bats (*Hipposideros beatus, Kerivoula cuprosa,* and *Neoromicia tenuipinnis*) that are strictly insectivorous forest interior specialists from Kenya. Community composition, function, and diet differed between species. Importantly, we detected greater congruence between diet and community function than with phylogenetic composition. Individual functions, inferred from KEGG pathway modules, fell into two groups, those that differed among host bat species

(functions diverging) and those that did not (functions conserved). We then looked at the bacterial community composition contributing each function. Divergence in function correlated with divergence in taxonomic composition as expected. These divergent functions were significantly more derived (i.e., contributed by less phylogenetic branch length), suggesting host differences in community function can arise by selection of novel trait space. However, for ~ 75% of conserved functions, microbial community composition differed, indicative of functional equivalence owing to homologous gene sets across bacterial communities. These findings help elucidate how environmental filtering of function contributes to the assembly process of bat microbiomes.

Vitamin B_2 Overproduction by *Pseudogymnoascus destructans* and Hyperaccumulation within Infected Skin: The Host-Pathogen Interplay

Jiri Pikula[1], Hana Bandouchova[1], Jan Cerny[2], Miroslav Flieger[3], Milada Chudíčková[3], Miroslav Kolarik[3], Veronika Kovacova[1], Petr Novák[3], Ondřej Šebesta[2], Eva Stodůlková[3] and Natália Martínková[4]

1 *Department of Ecology and Diseases of Game, Fish and Bees, University of Veterinary and Pharmaceutical Sciences, Brno, CZE;* ***2*** *Department of Cell Biology, Faculty of Science, Charles University in Prague, Prague, CZE;* ***3*** *Laboratory of Fungal Genetics and Metabolism, Institute of Microbiology, Academy of Sciences of the Czech Republic, Prague, CZE;* ***4*** *Institute of Vertebrate Biology, Academy of Sciences of the Czech Republic, Brno, CZE*

Pseudogymnoascus destructans is one of the most deadly pathogens in recent history of wildlife diseases. We identified the main extracellular compound of *P. destructans* as riboflavin. Riboflavin is produced by pathogenic *P. destructans* isolates in a significantly higher quantity than by *Pseudogymnoascus* sp. strains. Its production curve over 12 weeks shows continual accumulation of the compound in the cultivation medium. Fluorescent properties of riboflavin characterized with lambda scan using a confocal microscope show the same pattern of fluorescence as in wing membrane skin lesions of bats infected naturally by *P. destructans*. Riboflavin concentration in bat skin lesions exceeds that found in culture, possibly due to chronic infection and hypoperfusion of hibernating bats' tissues, facilitating riboflavin deposits. High riboflavin concentrations affect bats' primary fibroblasts and induce cell detachment, loss of mitochondrial membrane potential, polymerization of cortical actin, and cell necrosis. Recognition of UV fluorescence of fungal cupping erosions, which has been validated as a field-applicable diagnostic method for white-nose syndrome (WNS) surveillance, is caused by hyperaccumulation of riboflavin produced by *P. destructans*. Although vertebrates cannot synthesize it, riboflavin participates in oxidoreduction metabolic processes and energy metabolism. We argue that riboflavin hyperaccumulation in skin causes oxidative injury upon arousal and reperfusion of tissues that manifests as severe pathology in bats with WNS and determines morbidity or mortality outcome of the infection. High vitamin B_2 production seems to be essential for *P. destructans* and highlights potential use of the riboflavin biosynthetic pathway as a target of novel anti-infective strategies.

Life on a Small Island: Population Trends of Bats on St. Thomas, U.S. Virgin Islands

Renata J. Platenberg[1,2] and Steve B. Matthews[2]

1 *Department of Natural Resource Management, University of the Virgin Islands, St. Thomas, USA;* ***2*** *St. Thomas Bat Team, St. Thomas, USA*

The Caribbean region is associated with high levels of biodiversity although many of the islands are experiencing ongoing loss and degradation of natural habitats. St. Thomas, U.S. Virgin Islands, is a small, densely populated island within the greater Puerto Rican bank archipelago that has undergone significant habitat alteration from land use changes and hurricanes. The island supports five species of bats, and in order to better manage their populations and evaluate vulnerability, we need to understand small population dynamics in response to ecosystem changes. We conducted monthly mist-netting surveys at a local nature preserve from 2010-2014, resulting in the capture of 244 *Artibeus jamaicensis*, 181 *Molossus molossus*, 14 *Noctilio leporinus*, 6 *Brachyphylla cavernarum*, and 1 *Stenoderma rufum*. We found that while capture numbers fluctuate across seasons and years, they show a slight decline overall. We saw immediate species-specific responses to habitat manipulation resulting from management actions. Our data suggest possible population trends due to shifts in seasonal climate patterns. We did not observe changes in body condition indices or reproduction patterns, suggesting that individuals may be resilient to inconsistent availability of resources. Long-term monitoring across seasons is important for differentiating between seasonal fluctuations and population trajectories, particularly in evaluating climate change vulnerabilities and adaptations needed to maintain the valuable ecosystem services provided by these species.

Incomplete Lineage Sorting Results in Conflict between the Nuclear and Mitochondrial Phylogenies of *Myotis*
Roy N. Platt II[1], Brant Faircloth[2], Kevin AM Sullivan[1,] Richard D. Stevens[3], Thomas E. Lee[4] and David A. Ray[1]
1 *Biological Sciences, Texas Tech University, Lubbock, USA;* ***2*** *Biological Sciences, Louisiana State University, Baton Rouge, USA;* ***3*** *Natural Resource Management, Texas Tech University, Lubbock, USA;* ***4*** *Department of Biology, Abilene Christian University, Abilene, USA*

The diversification of *Myotis* into more than 100 species in less than a few million years is one of, if not the most successful mammalian radiation events. Efforts to understand the phylogenetic relationships within *Myotis* have primarily utilized mitochondrial gene markers due to lack of resolution in their more slowly evolving nuclear counterparts. As a result, our current understanding of relationships within *Myotis* is biased towards a set of phylogenetic markers that may not effectively track the true species tree. To resolve this issue, we sequenced the full mitochondrial genomes of 37 *Myotis* spp. in addition to targeted sequencing of more than five thousand ultraconserved elements (UCEs). We explored various coalescent and summary phylogenetic methods as well as combinations of markers based on informativeness or levels of missing data. The phylogenies generated from the nuclear UCE data do not agree with the phylogenies recovered from the complete mitochondrial genomes. This suggest that the *Myotis* genome was subjected to massive amounts of incomplete lineage sorting and potential hybridizations during the initial stages of the species radiation. As a result, mitochondrial genomes, which evolve as a single genetic unit are a poor approximation of the true species tree in *Myotis*.

Effects of White-nose Syndrome on Reproduction in *Myotis lucifugus*
Lisa E. Powers[1], Joseph A. Kath[2], Jeanette Bailey[3], Elizabeth Pritchard[4], B. Magnus Francis[4] and Brent J. Sewall[1]
1 *Department of Biology, Temple University, Philadelphia, USA;* ***2*** *Illinois Department of Natural Resources, Springfield, USA;* ***3*** *Department of Biology, Eastern Michigan University, Ypsilanti, USA;* ***4*** *School of Integrative Biology, University of Illinois, Urbana, USA*

Many hibernating bat species in North America face population declines due to the disease white-nose syndrome (WNS). This includes the little brown myotis (*Myotis lucifugus*), which has historically been one of the most abundant and widespread species in North America. WNS population models demonstrate severe population declines for *M. lucifugus*. WNS-related mortality is also well documented for this species. However, the effects of WNS on reproduction are not well known. We studied the effects of WNS on reproductive capacity in *M. lucifugus* using two methods: a histological study of winter fertility in *Pseudogymnoascus destructans*-infected females; and annual field studies of reproductive rates at an Illinois maternal colony pre- and post-WNS (2011-2015). For the field study, we compared annual reproductive rates of a sympatric maternal colony of big brown bats (*Eptesicus fuscus*), which are less effected by WNS, to distinguish effects of WNS from effects of annual climate variation. Our results indicate whether current WNS population growth models accurately represent reproductive rates. These data contribute to an improved portrayal of the ability of bat populations to recover in the post-WNS landscape.

Transposable Elements Contribute Lineage-specific miRNAs to Vesper Bat Genomes
David A. Ray[1], Roy N. Platt II[1], Michael W. Vandewege[2], Federico G. Hoffmann[2] and Richard D. Stevens[3]
1 *Department of Biological Sciences, Texas Tech University, Lubbock, USA;* ***2*** *Department of Biochemistry, Molecular Biology, Entomology and Plant Pathology, Mississippi State University, Mississippi State, USA;*
3 *Department of Natural Resources Management, Texas Tech University, Lubbock, USA*

Vesper bats (family Vespertilionidae) experienced a rapid adaptive radiation beginning around 36 Ma that resulted in the second most species-rich mammalian family (>400 species). Coincident with that radiation was a burst of DNA transposon activity that has continued into the present in some species. Such extensive and recent DNA transposon activity has not been seen in any other extant mammal. Indeed, retrotransposon activity is much more common in all other sequenced mammal genomes. We examined the small RNA fraction from a vesper bat, *Eptesicus fuscus*, dog and horse to reveal large numbers of putative miRNAs (miRNAs). Although the estimated origination rate of p/miRNAs is similar in all three taxa, most post-divergence p/miRNAs in *Eptesicus* are derived from bat-specific DNA transposons. We expanded the study by sequencing small RNAs from multiple tissues, in multiple individuals, from additional vesper bats and non-chiropterans. These results show that transposable elements in general are less likely to contribute to the p/miRNA pool than expected based on the previous work, however one repetitive sequence (Bar1_ML) consistently gives rise to miRNAs in all verspertilionids examined. This confirms that many miRNAs are derived from repeats specific to the vespertilionid bats and could be a mechanism for introducing functional genomic variation rapidly through the expansion of transposable elements.

This conforms to the TE-thrust hypothesis but also indicates that the relationship between miRNA origination and transposable elements is more nuanced than previously hypothesized.

The Impact of Agricultural Landscapes on Bat Foraging Activity
Joshua J. Reeder[1], Justin M. Hoffman[1], Kate Harms[2] and Karen A. Campbell[1]
1 *Biology Department, Albright College, Reading, USA;* ***2*** *Rodale Institute, Kutztown, USA*

Integrated Pest Management (IPM) strategies include natural biological controls, such as taking advantage of predator-prey relationships and crop diversity to reduce insect pests, while minimizing pesticide use. Using an ecosystem based approach saves on labor and expenses and protects natural resources. The Rodale Institute has over 60 years of experience in conducting research to develop and implement methods to aid farmers in biologically managing pests while maintaining or enhancing crop yields and food quality. As the primary consumer of flying nocturnal insects, bats undoubtedly play a role in insect pest management, and the economic importance of bats in agriculture has been demonstrated through other studies of bat foraging behavior in many applications. We monitored bat activity at different agricultural sites in southeastern Pennsylvania using echolocation recordings. Specifically, we compared foraging activity in paired organic and conventional plots, including grain fields, orchards and vegetable plots. In addition to exploring agricultural land use, we monitored the impact of boundary tree lines around orchards and grain fields, as well as the presence of insectary strips in organic vegetable plots. Preliminary data show that the presence of boundary tree lines has a positive effect on bat activity, in both organic and conventionally managed landscapes, but there is no statistical difference in bat activity over similar fields managed by organic or conventional methods.

Autofluorescent Imaging Illuminates the Indiscernible Network of Bat Wing Morphology
Jeremy C. Rehm[1], David B. Boerma[1] and Sharon M. Swartz[1,2]
1 *Department of Ecology and Evolutionary Biology, Brown University, Providence, USA;* ***2*** *School of Engineering, Brown University, Providence, USA*

Bat wings house an elaborate network of inconspicuous and sometimes microscopic anatomical features that may contribute to mechanical, sensory, and aerodynamic control of the wing. Efforts to understand the diversity and function of these features, such as muscles, elastin bundles, and somatosensory domes, first require methods to see and image them. But many previously described methods—the use of white marker, traditional back lighting, SEM, and our recently developed cross-polarized imaging technique—fall short of visibly displaying the features in detail or in their entirety. We introduce a relatively simple and affordable technique that produces images of wing membrane structure with exceptional detail by exploiting autofluorescent characteristics of elastin and collagen. These proteins are found in or near the morphological features of interest and absorb and emit light at similar wavelengths. With this technique, formerly indiscernible features become conspicuously visible, many even to the naked eye. We applied the autofluorescence imaging method to alcohol-preserved specimens from 13 bat families, and obtained high quality images in all cases except with pteropodid bats, which often appeared flushed with light and revealed little more than normal imaging can. By efficiently producing high resolution images of morphological characters without histological preparation, autofluorescent imaging can uncover novel structures in the wing membrane, strengthen phylogenetic analyses and inspire new functional/mechanical studies.

Frostbite on the Frontier?
Jesika P. Reimer and Laura A. Kaupas
Alaska Center for Conservation Science, University of Alaska Anchorage, Anchorage, USA

Little brown myotis are widespread across North America, however, little is known about their wintering behavior at the northern extent of their range. Large hibernacula have been discovered in the Northwest Territories, however, where bats hibernate in Alaska and Yukon, in the absence of large cave sites, is still unknown. During a recent summer survey of maternity colonies along the Copper River, Alaska, a large proportion of the populations exhibited signs of mild to severe tissue damage of the ears, similar to that caused by frostbite. We mist-netted little brown myotis at six known maternity roosts during July 2016, with colony sizes ranging from approximately 50 to 470 adults. Of the total number of captures (n=140), 12% had damaged ear tissue, and ear damage at each colony ranged from 0% to 24% of each population. Over the past few years, residents from interior Alaska have reported bats in human dwellings during the winter, and a recent study in southeast Alaska observed a small number of bats roosting in small cracks and crevices of scree fields and root wads. Whether these observations represent hibernating

colonies, or merely juveniles or poor condition adults that did not migrate to their typical winter sites has not been determined. The high frequency of ear tissue damage observed in our research however, may indicate bats are spending the winter in hibernation sites throughout interior Alaska where temperatures fluctuate and drop to very low figures rather than migrating to more stable hibernacula farther south.

The First Concern for the Ecosystem Services Provided by Bats: Juan Cristóbal Gundlach (1883)
Marco Riccucci
Museo di Storia Naturale, Università di Firenze, Sezione di Zoologia "La Specola", Firenze, ITA

The fundamental role of bats in the maintenance of ecosystems and their specific utility in the quality of life of human beings was underestimated until a few years ago. Chiroptera, with over 1300 species, are the second largest order of mammals (after Rodents) and settled in most of the natural environments in every continent, except Antarctica. Only in recent years has particular attention been paid to the economic value of bats in agriculture and forestry. The origins of modern interest for ecosystem services provided by bats can be found in the thought of Juan Cristóbal Gundlach (1810-1896), and in particular in his article "*Rehabilitación de algunos animales cubanos, perseguidos y maltratados por preocupación vulgar*'', published in 1883 in the Boletín de la Sociedad Cubana Protectora de Animales y Plantas. Gundlach argued that it is important to protect all species because they could one day be useful to man as was in the case of silkworms and bees. In particular, the bats that the common people feared and considered harmful, actually fed on insects noxious to humans and detrimental to agriculture, and their droppings are a valuable fertilizer comparable to the best guano from Peru. Gundlach was German by birth but became Cuban by adoption. He devoted over 50 years of his life to the study of Cuban fauna, with a substantial contribution to the knowledge of the island's bats, describing at least five new species as well as some subspecies.

Variations in the Morphology of the Wrist among Species of Chiroptera
Sarah Robinson and Deanna G.P. Byrnes
Department of Biology, Carthage College, Kenosha, USA

Bat wings vary in relative size and shape reflecting species' flight abilities relating to their hunting and feeding ecologies. In contrast with airplane and bird airfoils, bat wings are incredibly dynamic and rely on sophisticated control through complex, and in some cases unique, muscle, elastic and sensory tissues. Additionally, joints within the wing that flex, extend, and rotate allow the shape and orientation of the wing to uniquely interact with the flight environment. Of particular interest to the authors is the structure, function, and control of the leading edge of the wing which is likely to play a significant role in bats' abilities to maneuver at slow flight speeds. This research represents the beginning of a long term project to be conducted primarily by undergraduate researchers intending to more thoroughly describe variation in the anatomy and morphology of the carpals and m. occipitopollicalis of the bat wing across species exhibiting different flight ecologies. This basic work hopes to contribute to improved understanding of the function of the unique leading edge of bat wings. Here we describe the morphology of the carpal bones from select species of bats of the Phyllostomidae using micro-CT scans. The scans were processed using Avizo software to construct 3-dimensional models of the wrist. Physical models were printed in 3-D at a larger scale to enable examination of the articulations and possible movements of the wrist. Physical 3-D models and comparisons of relative carpal volumes and unique carpal shapes across species are presented here.

Analyzing the Matrix: Bats Species Richness and Abundance in Two Agricultural Matrices in El Salvador
Melissa E. Rodríguez[1], Gustavo Gutiérrez-Espeleta[1], José Edgardo-Arévalo[1], Luis Girón-Galván[1], Raquel Alvarado Larios[2], Gabriel Vides[3] and Bernal Rodríguez-Herrera[1]
1 *Escuela de Biología, Universidad de Costa Rica, San José, CRI;* ***2*** *Museo de Historia Natural de El Salvador, San Salvador, SLV;* ***3*** *Escuela de Biología, Universidad de El Salvador, San Salvador, SLV*

Land use changes and fragmentation are one of the major threats to biodiversity. However, the characteristics of the forest remnants and the matrix, could allow the persistence of many species. El Salvador is the most fragmented country in Central America, and forest remnants are surrounded by agricultural matrix, mostly shaded coffee and grasslands. We determined bats species richness and abundance in forest remnants of these types of matrix. From January 2015 to July 2016, we conducted a sampling effort of 21 days for each type of matrix. We used mist nets to capture bats in five remnants with shaded coffee matrix and six remnants with grasslands matrix. In shaded coffee remnants, 24 species of bats were found and 27 species in grassland, showing no significant differences (χ^2=0.494, d.f.=1, p=0.48). For the abundance, we obtained 973 captures of 33 species, 598 for remnants with shaded coffee

and 375 for grassland matrix, showing higher species abundance for shaded coffee (χ^2=33.49, d.f.=1, p<.001). Bats species richness could be similar considering that forest remnants in El Salvador are scarce and valuable regardless of the matrix. On the other hand, shaded coffee can allow higher abundance for bats due to greater heterogeneity of the matrix. Matrix characteristics are important for bats species abundance, and shaded coffee plantations play a crucial role for bats in El Salvador. To continue with the matrix evaluation, we are estimating the genetic diversity of two phyllostomid bats in these remnants to see if there is gene flow between populations.

Ecological Networks between Tent-roosting Bats and the Plants Used in La Selva Biological Station, Costa Rica

Bernal Rodríguez-Herrera, Mauricio Fernández Otárola and Melissa E. Rodríguez
Escuela de Biología, Universidad de Costa Rica, San José, CRI

Roost ecology in bats is considered a complex interaction. There are approximately 22 bats species that modify leaves to stablish their roost, 17 of which are found in the Neotropics. Although there are many studies of tent-roosting bats, this is the first describing the interaction between them and the plants they are using as roosts. In here we describe the ecological network between these bats and the plants used in La Selva Biological Station. We calculated descriptors of the network (number of bats and plants conforming it), as well as the number of pairwise interactions (links between species) reported in the literature or observed. We used binary quantitative metrics like links per species, connectance and nestedness using the R package. As results, we classify a new type of interaction, which is a mechanical antagonism, where bats damages the leaves, reducing their fitness and lifetime. In La Selva the network is formed by eight bats species and 45 plant species reported through 60 pairwise interactions. Only 2.16% of vascular plant species in La Selva, are being used as roosts. The network presented low connectance (0.167) and no significant nestedness (NODF=24.64, p=0.48). There are few links between tent-roosting bats and plant species in La Selva, which shows the specialization of the existing network and the high dependence of many of these bats in using few plant species, even if it is a very specific and temporary resource.

Phenotypic Flexibility on the Fly: Short-term Variation in Body Composition in *Tadarida brasiliensis

Elizabeth J. Rogers, Amie S. Sommers and Liam P. McGuire
Department of Biological Sciences, Texas Tech University, Lubbock, USA

*** Elizabeth J. Rogers** received the **Organization for Bat Conservation Award.**

Many organisms exhibit phenotypic flexibility when faced with extreme challenges such as migration or hibernation. Our research addresses whether organisms also exhibit reversible variation in flexible phenotypic traits in response to regular and ongoing challenges. Migrating bats experience substantial phenotypic change during migratory periods, while also facing the challenges of pregnancy and lactation during summer breeding seasons. We hypothesized that migratory bats would continue to exhibit flexibility in fat and lean mass following migration in response to the increased energetic requirements of pregnancy and lactation. Using quantitative magnetic resonance (QMR), a non-invasive technology for rapid body composition analysis, we measured fat mass, lean mass, and total body water in a summer maternity colony of Brazilian free-tailed bats (*Tadarida brasiliensis*) to test our prediction that reproductive female bats exhibit temporal variation in body composition. Fat mass decreased with time throughout pregnancy and lactation, and lean mass, while decreased compared to pregnancy, increased during lactation. In contrast, males showed only small fluctuations in fat and lean mass. This suggests that the fluctuating energetic demands of reproduction result in variable rates of change in body composition. Due to the large sample sizes afforded by QMR measurement, our study provides a more detailed look at intra-seasonal changes in body composition than previous studies. Furthermore, our results support the idea that body composition is a flexible phenotypic trait that varies rapidly and continually with environmental condition and life-cycle stage, and suggest that phenotypic flexibility is not exclusive to periods of extreme energetic demand.

A Search for *Myotis septentrionalis* at Pictured Rocks National Lakeshore

Jacob A. Rogers and Allen Kurta
Department of Biology, Eastern Michigan University, Ypsilanti, USA

We mist-netted bats on over 100 net-nights, between 12 June and 21 July 2016, at Pictured Rocks National Lakeshore, in the Upper Peninsula of Michigan, to determine the status of the threatened northern long-eared bat (*Myotis septentrionalis*). We captured only 76 bats, including 39 silver-haired bats (*Lasionycteris noctivagans*), 16 little brown bats (*Myotis lucifugus*), 10 hoary bats (*Lasiurus cinereus*), 8 red bats (*Lasiurus borealis*), 2 northern

long-eared bats (*Myotis septentrionalis*), and 1 big brown bat (*Eptesicus fuscus*). We attribute the overall low number of captures to a combination of white-nose syndrome reducing populations of *Myotis* and to the effects of local climate. Pictured Rocks National Lakeshore spans 42 miles of shoreline along the southern coast of Lake Superior, which results in windy conditions and ambient temperatures as low as 3°C during the netting period. Both northern long-eared bats were post-lactating individuals captured on 16 July; such an early date for post-lactation suggests that their reproductive attempt was not successful. These bats were radiotracked to five roost trees, all of which were large-diameter American beeches (*Fagus grandifolia*). American beech is a canopy-dominant species that currently is being devastated by a fungal pathogen, leading to a plethora of potential roost trees in this national park.

Using False-positive Occupancy Models to Estimate Probability of Presence for *Myotis septentrionalis

Vanessa G. Rojas[1], Joy M. O'Keefe[1] and Susan C. Loeb[2]
1 *Center for Bat Research, Outreach, and Conservation, Indiana State University, Terre Haute, USA;* ***2*** *USDA Forest Service, Southern Research Station, Clemson University, Clemson, USA*
*** Vanessa G. Rojas** received the **Bat Conservation International Award**.

Although *M. septentrionalis* once comprised the bulk of mist-net captures in North Cherokee National Forest (CNF), populations are now in steep decline due to white-nose syndrome. Traditionally, mist-netting surveys were used to assess presence/probable absence, but mist-net surveys may not adequately represent dispersed, low-density bat populations. Acoustic surveys aid in detecting rare bats, but we risk false-positives. From May to August 2013–2015, we surveyed 34 road corridor sites on the North CNF for *M. septentrionalis*, using both mist-net and acoustic (Anabat SD2s; analyzed using Bat Call ID v2.7c) methods. *Myotis septentrionalis* were captured at 12 sites and represented <5% of acoustic files each year. We aimed to identify environmental and geographic factors that predict probability of occupancy for *M. septentrionalis*. To account for both non-detections and misidentifications, we compared 15 multi-season false-positive occupancy models (Presence v11.2) with 1–4 variables each. We chose sites with similar structure and vegetation and, thus assumed sites had similar detection probabilities; hence, we included only weather-related detection factors in our models. Our preliminary results indicated that sites with higher forest density and at lower elevations had a greater probability of presence for *M. septentrionalis*. False-positive model results gave us robust site-specific occupancy estimates ranging from 0.02–0.99 per site, whereas estimates were 0.75–0.99 with standard occupancy models. With decreasing populations and capture likelihoods, false-positive models may lead to more reliable distribution models and, hence, management plans.

***The Evolution of Wing Shape as an Anti-bat Strategy**

Juliette J. Rubin and Jesse R. Barber
Department of Biological Sciences, Boise State University, Boise, USA
*** Juliette J. Rubin** received the **Avinet Award.**

Across the natural world, predators and their prey are locked in perpetual evolutionary battle for survival. Bats and moths have evolved some of the most fascinating of attack and counter-attack traits, including bat-detecting ears that trigger erratic flight, and ultrasound production that warns bats of bad taste or jams their sonar. An entire Family of moths (*Saturniidae*), however, do not have bat-detecting ears or the ability to produce sound, yet navigate the bat-filled night sky. It was recently discovered that elongated, twisted and paddled hindwing tails confers a survival advantage of nearly 50% and has evolved at least four separate times within this group. Here we delve further into the evolution of elongated tails to surmise what intermediate steps saturniids may have followed to arrive at this morphological anti-bat trait. We pit experimentally manipulated tailed and non-tailed saturniid moths against big brown bats (*Eptesicus fuscus*) to test the hypothesis that as hindwing tails lengthen, bat attack is thwarted at an increasing rate. We also support our behavioral data with phylogenetic evidence and 3D flight path reconstruction.

Contractile Properties of a Carpal Extensor in *Carollia*: Are Wing Muscles Adapted to Operate below Core Body Temperature?

Andrea D. Rummel[1], Sharon M. Swartz[1,2] and Richard L. Marsh[1]
1 *Department of Ecology and Evolutionary Biology, Brown University, Providence, USA;* **2** *School of Engineering, Brown University, Providence, USA*

Bat wings are extremely compliant and possess a large number of joints that are controlled relatively independently by muscles within the wing. Because mechanical performance (i.e., contractile velocity, relaxation

rate, and power output) of skeletal muscle declines with temperature, environmental temperature could influence aspects of flight performance that depend on muscle function. Previous studies have shown that the temperature of bat wings is lower than that of the body during flight, and the distal wing approaches ambient air temperature. Bats are also known to use daily torpor and may initiate flight with reduced body temperatures. *Extensor carpi radialis longus* (ECRL) is forearm extensor that is critical to extending the wings and keeping them open during downstroke. Because the maintenance of this function across a range of environmental temperatures could be advantageous for bats, we predicted that the performance of the bat ECRL would be less temperature dependent than would be expected based what is known from other vertebrate skeletal muscles. We measured the isometric and isotonic contractile properties of the ECRL in *Carollia perspicillata* from 22 to 37°C at 5°C intervals from *in vitro* preparations. Between 27 and 37°C, temperature affected rate-dependent contractile properties in the ECRL significantly less than predicted based on values for other vertebrates. Whether or not the low thermal dependence is solely a property of the wing muscles or is also found in trunk muscles of this species requires further study.

Expanding the Search: Using SDM to Search for Northern Long-eared Bats in New Areas

Adam R. Rusk[1], Mark A. Hayes[2], Curtis J. Schmidt[1] and Elmer Finck[1]

1 *Department of Geosciences, Fort Hays State University, Hays, USA;* ***2*** *Cherokee Nations Technologies, U.S. Geological Survey, Fort Collins, USA;* ***3*** *Sternberg Museum of Natural History, Fort Hays State University, Hays, USA;* ***4*** *Department of Biology, Fort Hays State University, Hays, USA*

Given the threats facing some cave-roosting bats—such as white-nose syndrome (WNS)—it is imperative to develop a clear understanding of the distribution of hibernating species of conservation concern. Species distribution modeling (SDM) combines known occurrence locations with environmental variables to predict areas where a species may occur, including edges of distributions. The western edge of the distribution of Northern Long-eared bat (*Myotis septentrionalis*) occurs in Kansas, and biologists and managers have expressed an interest in developing an improved understanding of the distribution of this species in the state, especially given that this species is affected by WNS. This study modeled and mapped the distribution of Northern Long-eared bat using SDM techniques with an emphasis on determining new areas in Kansas that may represent suitable habitat for this species. We combined occurrence locations of Northern Long-eared bat from online repositories and museum records with bioclimatic data to model and map the distribution of this species in Kansas. We used the Software for Assisted Habitat Modeling (SAHM) and five SDM approaches, which facilitated comparison of models and maps using multiple SDM approaches. Preliminary results suggest that some areas of Kansas for which Northern Long-eared bat occurrences are not known may represent suitable habitat for this species. Thus, it may be useful to conduct surveys for this species in areas with higher estimated habitat suitability, but for which no occurrences have yet been documented, especially in areas that may represent suitable locations for hibernation and raising young.

Being Loud Won't Help You Find Your House: Contact-call Rates and Roost Finding in *Thyroptera tricolor*

Maria Sagot[1], Abigail J. Jago[1], Imran Razik[1] and Gloriana Chaverri[2]

1 *Department of Biological Sciences, State University of New York at Oswego, Oswego, USA;* ***2*** *Universidad de Costa Rica, Alamedas, Golfito, CRI*

Mobile social animals that use patchy and ephemeral resources, often rely on acoustic communication to maintain stability of social groups. This is the case of Spix's disc-winged bats (*Thyroptera tricolor*) which roost in furled leaves that are only available for one day. Despite the ephemerality of roosts, group composition in this species remains unchanged for several years. This strong group stability is maintained by contact calls during foraging that advertise position of newly available roosts. Furthermore, within groups, there are strong individual differences and high individual consistency in call production, suggesting distinct social roles in group vocalization. However, to date, it is not known whether being more vocal presents any individual benefits or constraints in roost finding. Thus, the objective of this study was to determine if efficiency in roost search is associated with call production rates. To do this, we captured 25 *T. tricolor* social groups and measured the number of contact calls produced by each individual. We also determined the time spent finding a roost located inside a flight cage. We found that both vocal and non-vocal individuals spend similar amount of time locating roosts, suggesting that efficiency in roost search is not associated with call production. Identifying costs/benefits associated with distinct social roles in call production, will allow us to understand the mechanisms necessary to maintain strong group stability in highly mobile organisms.

Once upon a Time in Mexico: Prehistoric Habitat Suitability of the Spotted Bat
Daniel E. Sanchez[1,2], Faith M. Walker[1,2] and Carol L. Chambers[1]
1 *School of Forestry, Northern Arizona University, Flagstaff, USA;* ***2*** *Center for Microbial Genetics and Genomics, Northern Arizona University, Flagstaff, USA*

The geographic origin of the spotted bat (*Euderma maculatum*), a cryptic species patchily distributed from Mexico to Canada, is poorly known with a single fossil record in Arizona. This ~10,000-year-old mummified specimen is the only indication that spotted bats lived north of Mexico in the early Holocene. To date, the species is thought to originate in Mexico but there is little environmental explanation of a northwestern immigration. Genetic analysis of 118 spotted bats revealed strong population structure (little to no gene flow) between bats in central Mexico, the southwestern US, and the northwestern US and Canada. Temporally, the pattern chronicled multiple genetic isolation events throughout the last 100,000 years, coincident with major climatic episodes of that period. To test this narrative, we used ecological niche modeling (MAXENT) to predict prehistoric range distributions for the southwestern clade because of its abundance in occurrence records and haplotypes. Predicted climate space was consistent with the known current distribution but did not extend into Canada, possibly indicating differences in environmental preference between the southwest and northwest populations. Projection into three paleoclimates (last interglacial, last glacial maximum, and mid-Holocene) showed suitable climate space centered in Mexico to the lower edge of the southwest with a northward range expansion and recession 100,000 years later. While we anticipate further model validation to demonstrate waxing and waning of suitable habitat into the northwest, our results complement phylogenetic patterns and suggest that the three populations are a product of vicariance from late and post Pleistocene climate shifts.

Serodiagnosis of *Toxoplasma gondii* in Bats from Urban Forest Fragments in Maringá, South of Brazil
Daniela Maria Sandoli[1], Marcelo Biondaro Góis[2], Débora de Mello Gonçales Sant'Ana[2] and Henrique Ortêncio Filho[3]
1 *State University of Maringá, Maringá, BRA;* ***2*** *Department of Morphological Sciences, State University of Maringá, Maringá, BRA;* ***3*** *Department of Science, State University of Maringá, Goioerê, BRA*

The fact that *Toxoplasma gondii* uses mammals as hosts arouses interest in studies involving the relation between that protozoan and chiropteran, because *T. gondii* is a cosmopolitan organism. Thus, the hypothesis is that anti-*T. gondii* serum antibodies occurs in bats and oocysts in the lakes from urban forest fragments in the city of Maringá, South of Brazil. The sampling was conducted between August 2013 and May 2016, using mist nets, totaling sampling effort of 17,446 m²h. After the capture, we collected biometrical data and 30 μL of blood, drawn by venipuncture and deposited on filter paper. To analyse the antibodies, we used the Direct Agglutination Method adapted to eluates. Samples of water (100 mL) were taken from the lakes at the park, and submitted to a Polymerase Chain Reaction analysis. The study evaluated 340 bats, from these, 49 (14.4%) presented anti-*T. gondii* serum antibodies. We considered as serum reagent: *Artibeus lituratus* 14.4% (23/159), *A. planirostris* 13.8% (4/29), *A. fimbriatus* 16.6% (6/36), *Carollia perspicillata* 50.0% (2/4), *Phyllostomus hastatus* 25.0% (2/8) e *Sturnira lilium* 14.4% (12/83). It was observed the presence of oocysts in water samples from the lake. Based on the results, the tested hypothesis was accepted, considering the presence of the parasite in bats. Furthermore, the lake was considered a source of contamination for those animals. Therefore, there are bats infected by *T. gondii* in urban forest fragments in the city of Maringá, which can serve as a source of study in the interaction of the parasite in this population.

Bridge Roosting Ecology of Eastern Small-footed Bats in the Arkansas Ozarks
D. Blake Sasse
Arkansas Game and Fish Commission

The eastern small-footed bat (*Myotis leibii*) is rare in Arkansas and prior to 2013 there were only 111 known records in 17 counties in the Ozark and Ouachitas mountains. Prompted by research in Tennessee, bats were captured by hand in bridges with concrete guardrails in the presumed range of the species from March through October in 2013-2016. Small-footed bats were found in 24 bridges of this design in 8 counties with colony sizes ranging from 1-23 bats. From 2013-2015 a total of 223 bats were captured 458 times and movements of up to 5.4km between bridges were documented. Populations at 6/7 maternity colonies appear stable despite the known or suspected presence of WNS in 6/8 counties.

Understanding Patterns of Turbine-caused Bat Fatalities: A Global Assessment
Michael R. Schirmacher and Cris D. Hein
Bat Conservation International, Austin, USA

Wind energy development is rapidly expanding across the globe, with over 60 gigawatts of installed capacity developed in 2015. As capacity increases, so do the concerns for bat populations, but limited data from most regions of the world make management decisions difficult. In northern latitudes across North America, bat fatalities typically peak during July–September and a high proportion of fatalities are comprised of migratory foliage-roosting species (e.g., eastern red bat and hoary bat). Similar patterns are seen across Europe. Yet, basic patterns such as these are absent for most areas where wind turbines are operating. This lack of data has implications on how best to study and reduce bat fatalities around the world. For example, altering turbine operations under low wind conditions for a narrow period of time during migration may be a cost-effective strategy in the U.S. and Canada, but may not apply in regions where migration is limited or non-existent. Here, we synthesize emerging data regarding patterns of turbine-caused bat fatalities from around the world, and identify challenges impeding our ability to better understand and minimize risk. We also provide examples of opportunities to improve collaboration among different countries and regions.

Determination of Personality Variation and Behavioral Syndromes in *Eptesicus fuscus*
Amanda M. Schmitt and Erin H. Gillam
Department of Biological Science, North Dakota State University, Fargo, USA

Animals encounter a variety of social, behavioral, and ecological situations, making a single behavioral response unlikely to be optimal in all scenarios. As a result, many species demonstrate behavioral plasticity, adapting responses to varying conditions. However, growing research on behavioral repeatability (personality) has shown animals exhibit limits to plasticity, with an individual's range of variation covering only a portion of the range observed across the entire population. Yet, little work on personality and behavioral syndromes (among-individual correlations between behaviors) have focused on bats, with only a handful of studies addressing these concepts in this diverse taxon. The proposed research expanded upon previous research to determine if personalities and behavioral syndromes occur within *Eptesicus fuscus*. We studied a captive population at the NDSU Conservation Research Facility in Fargo, ND, with four groups of four animals established in individual cages. Personalities were characterized through a series of behavioral trials measuring: 1) aggression (dyadic competitive trials over food), exploration (radial arm maze/hole board tests), and activity (open field test). Behavioral data were scored using Noldus Observer and Ethovision. Aggressive males displayed high levels of exploration and activity, and females showed a positive relationship between activity and exploratory behavior. Although no clear changes in personality occurred over short time periods (1-2 days) or longer time periods (2 weeks), behavioral response differed between genders (dyad competitions and radial arm maze trials). Results support that bats exhibit personalities and syndromes with slight variations amongst individuals. Further research will determine effects of social interactions on personality stability.

Little Brown Bat Maternity Colony Monitoring in Northern Colorado, USA
Robert A. Schorr and Jeremy L. Siemers
Colorado Natural Heritage Program, Colorado State University, Fort Collins, USA

North American populations of the little brown bat (*Myotis lucifugus*) have undergone precipitous declines due to white-nose syndrome (WNS). Most of these population impacts have been in eastern North America, but WNS appears to be moving westward. The dramatic population declines at cave and mine hibernacula have made the severity of WNS clear, yet there are many regions of North America where bat roosts are more dispersed and less conspicuous, making it more challenging to document population-level impacts. In western North America there are fewer known hibernating colonies that would allow diagnosis of dramatic population changes. Thus, monitoring maternity colonies may be a valid method of documenting persistence of western populations. We have conducted mark-recapture of two little brown bat maternity colonies in the Yampa Valley of northern Colorado, USA. In the third year of the project we provide insights into population parameters for young-of-year and adult little brown bats, and discuss temporal roost use patterns for individuals.

Persistence of Little Brown Bats in Northern Alaska

Rachel D. Shively and Perry S. Barboza
Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, USA

Little brown bats (*Myotis lucifugus*) are sensitive to cold winters, but consistent records of roosts in interior Alaska for over 30 years indicate that the range of this species extends to the subarctic. We assessed the geographic distribution of the little brown bat in northern Alaska with a combination of traditional ecological knowledge, captures, stable isotopes, and telemetry. We also examined the hypothesis that human structures are critical to persistence of this species in Alaska. We used citizen science to collect reports of bats that ranged over most of Alaska and included sightings in the arctic during autumn. The stable isotopes of N and C in hair from bats in interior Alaskan bats were significantly different from bats in Yukon and coastal Alaska ($\delta^{15}N$: $F_{2,74} = 21.27$, $p = 0.000$; $\delta^{13}C$: $F_{2,74} = 13.77$, $p = 0.000$), which indicated the use of a separate habitat through summer. Little brown bats in interior Alaskan roosts had a mean estimated fat mass of 1.83±0.55g (21% of total mass) in the fall prior to dispersal. Radio tracked bats in interior Alaska migrated short distances (<100km) to hibernacula in human structures. Overwintering in caves and crevices in interior Alaska is unlikely because air temperatures are consistently below -10°C. Consequently, the persistence of bats in interior and northern Alaska may be related to consistent availability of human structures in winter and reliable foraging areas in summer.

Oligocene Mormoopids from Florida: Surprising Ancient Diversity in a Neotropical Bat Family

Nancy B. Simmons[1], Nicholas J. Czaplewski[2] and Gary S. Morgan[3]
1 *American Museum of Natural History, New York, USA;* ***2*** *Oklahoma Museum of Natural History, University of Oklahoma, Norman, USA;* ***3*** *New Mexico Museum of Natural History, Albuquerque, USA*

The family Mormoopidae today consists of perhaps as many as 19 species distributed across the Neotropics. Prior to this study, the oldest known fossils of the family were Pleistocene records. Here we report on a new taxon of crown-group Mormoopidae from the Oligocene of Florida, a discovery that extends the fossil record of the family back in time almost 30 million years. The new taxon is known from two paleokarst deposits in northern Florida: the early Oligocene (Whitneyan, ~30 Ma) I-75 Local Fauna and the late Oligocene (early Arikareean, 26-28 Ma) Brooksville 2 Local Fauna. The new mormoopid is known from a large sample including 50 specimens including skull and postcranial elements. We included the new taxon in a phylogenetic analysis including representatives of all known mormoopid lineages plus exemplars from other noctilionoid families including Speonycteridae, a family of putative stem noctilionoids named in 2012 based on other Oligocene fossils from Florida. Using a molecular scaffold to constrain relationships among extant groups, we found strong support for a sister-group relationship between the new fossil species and *Mormoops*. Surprisingly, *Speonycteris* was also found to nest within the crown mormoopid clade as the sister-group of *Mormoops* + the new taxon. With two genera and three species of mormoopids co-occuring in Florida in the early Oligocene, North America was clearly an important area for ancient mormoopid diversification. These findings suggest the possibility that the family originated and underwent initial diversification in eastern North America rather than somewhere inside their current range.

Understanding the Vulnerability of Southeastern Tri-colored Bats to White-nose Syndrome: Torpor Patterns and Hibernacula Conditions

Pallavi Sirajuddin[1], Susan C. Loeb[2], Eric R. Britzke[3] and David S. Jachowski[1]
1 *Department of Forestry and Environmental Conservation, Clemson University, Clemson, USA;* ***2*** *USDA Forest Service, Southern Research Station, Clemson, USA;* ***3*** *US Army Engineer Research and Development Center, Vicksburg, USA*

Recent data from the southeastern U.S. suggest tri-colored bat (*Perimyotis subflavus*) populations have experienced > 80% declines due to white-nose syndrome (WNS) despite milder and shorter winters in the south. Most behavioral and physiological studies on responses of bats to WNS have been on northern populations of little brown bats (*Myotis lucifugus*) and as a result, data are lacking on responses of *P. subflavus*, the most common bat in southern hibernacula. We initiated a study to determine the torpor patterns of tri-colored bats in a WNS positive site in northwestern South Carolina in January 2016. We used temperature sensitive radio transmitters and Lotek data loggers to record *P. subflavus* skin temperature (T_{sk}), and HOBO data loggers and iButtons to record hibernacula temperature and relative humidity. We collected data on seven *P. subflavus* (five males, two females). Minimum torpor T_{sk} was 4.2°C and average torpor T_{sk} was 15.6°C. The longest torpor bout was 10 days and the shortest was 2 days. Mean arousal frequency was 4.2 times during the tracking period (mean = 17.1± 3.9 days) and arousal length

ranged from 31 minutes to 170 minutes. Our preliminary results suggest that *P. subflavus* T_{sk} during torpor is within the optimal temperature range for *Pseudogymnoascus destructans* growth. There was no evidence that bats left the hibernaculum to forage during warm nights. We will collect data from WNS negative sites in 2016-17, which will allow us to evaluate the relationships or correlation between WNS positive sites and torpor patterns.

Microclimates of Roosting Structures and the Influence on Thermoregulation and Behavior in Female *Myotis lucifugus*

Alexandra Slusher[1], Joseph Johnson[2], Michael Lacki[1] and John Treanor[3]
1 *Department of Forestry, University of Kentucky, Lexington, USA;* ***2*** *Department of Biological Sciences, Ohio University, Athens, USA;* ***3*** *Wildlife Health Program, Yellowstone National Park, National Park Service, USA*

Little brown bats (*Myotis lucifugus carissima*) in Yellowstone National Park (YNP), USA, survive in energetically challenging environments from 1,890 to 2,377 m asl during the warmer month, roosting primarily in buildings throughout the Park. We used temperature-sensitive radio-transmitters to sample thermoregulation and behavior in 45 adult females of varying reproductive conditions from 2012 to 2015. Tagged females were tracked to five types of roosting structures: wooden buildings (well insulated), wooden buildings (poorly insulated), a stone building, clay buildings, and natural rock roosts. Wooden and clay buildings were the most frequently used roosting structures by all female reproductive classes, and were associated with statistically significant differences ($P < 0.0194$) in average Tsk among different reproductive classes within roost types. Females primarily used morning torpor in both wooden and clay structures and evening torpor in natural roosts. In the stone building females used torpor equally across morning, afternoon, and evening periods. Average daily fluctuation in temperature was 9°C within well-insulated wooden buildings, 18°C within the poorly-insulated wooden buildings, and only 6°C within clay buildings. Natural rock roosts exhibited the most unstable microclimate with an average daily temperature fluctuation of 26°C. Females in natural rock roosts did not enter deep torpor, but did so to some extent when occupying all of the different building roosts. Our research suggests that type of roosting structure strongly influences the timing and use of torpor in females of this bat species.

Playback Experiments Reveal the Territorial Function of Singing in the Heart-nosed Bat

Grace C. Smarsh and Michael Smotherman
Department of Biology, Texas A&M University, College Station, USA

It is proposed that like songbirds some bats may use singing to defend private foraging territories. However, both singing and territoriality at foraging sites are poorly documented in bats. *Cardioderma cor*, the heart-nosed bat, roosts in groups in hollows of baobab trees during the day but disperses to exclusive foraging areas at night. Males forage early in the evening and sing bouts of loud, low-frequency songs back and forth with nearby neighbors as the night progresses. Individuals of this East African species return to the same area nightly during the long dry season, suggesting that male singing is a territorial behavior. We tested the hypothesis that individuals sing to create and maintain foraging territories by conducting song and echolocation playbacks to 10 individuals. We recorded songs throughout the trial, and noted singing rate, passes, approaches, and movements away from the speaker. Bats responded quickly and robustly to song playbacks with changes in singing and movement behavior, but did not significantly respond to echolocation playbacks. Songs vary within and across individuals, so we explored the possibility that song metrics indicate motivation or quality of individuals. Partial least squares regression suggests that stimulus song frequency and temporal parameters may influence the response to playback. In addition, the level of similarity between stimulus and target bat songs may more strongly predict playback response. Much like territorial songbirds, singing by *C. cor* males primarily functions as a signal of foraging territory tenure, and song variability may further signal motivational cues about conspecifics.

Identifying Bats Via eDNA in Water

Colin Sobek, Faith Walker and Carol Chambers
School of Forestry, Northern Arizona University, Flagstaff, USA

Environmental DNA (eDNA) has become a powerful tool for studying wildlife because a sample of water or soil can be taken and screened without disturbing the target organism. This has proven especially useful in monitoring aquatic species. Using an environmental sample, such as water, to identify local bat species would require less field effort and lead to a greater understanding of the environments that bats occupy. To this end, we applied a DNA mini-barcode that identifies bat species from genetic samples to water in lab and field trials. We

tested the efficacy of our assay at identifying low concentrations of bat DNA by constructing a dilution series of guano in water down to 0.628mg/L. Because DNA recovery from the environment is more difficult than laboratory tests due to low concentration and high degradation of the molecule, we modified existing protocols to ensure that the samples are collected and appropriately preserved in the field. In our dilutions we were able to accurately identify the bat species at every concentration. This work will guide our efforts to pump and filter higher volumes of water to capture more bat DNA, and to optimize our laboratory procedures to handle this challenging yet promising sample type.

Information Rich but Conservation Poor: How do we Conserve Bat Diversity in the Global Hotspot of Southeast Asia?

Pipat Soisook
Princess Maha Chakri Sirindhorn Natural History Museum, Prince of Songkla University, Hat Yai, THA

Southeast Asia's bat taxonomic network has grown rapidly during the last 10 years. This has been facilitated by national/international investment in in-country taxonomic training and by regional initiatives, such as Texas Tech University's Southeast Asian Bat Conservation Research Unit (SEABCRU), which have promoted networking within Southeast Asia and beyond. This has resulted in a huge increase in bat discoveries from the region. Southeast Asia is now recognised as one of the most important bat diversity hotspots globally. Superficially, it appears that as taxonomic knowledge keeps advancing, all seems promising for bats. However in reality, local scientists in many Southeast Asian countries are struggling with gathering basic information on ecology and in devising appropriate interventions to help conserve bat species and their habitats. In fact, conservation effort seems to be stark contrast with the rate of discovering new taxa. One of the major problems is that most Southeast Asian countries are poor and lack scientific expertise and political commitment to design and implement sustainable conservation policies that protect both the interests of man and nature in increasingly anthropogenic landscapes. There is an urgent need to focus on working with local government authorities and other stakeholders to promote bat conservation and to up-scale parallel activities, such as working with local communities to help raise awareness of the benefits of conserving biodiversity, especially in relation to ecotourism. Nevertheless, it is very obvious that these endeavours stand less chance of success without support from the international community of researchers. This challenge is also an opportunity for us all to work together to push forward conservation actions, which will help save Southeast Asia's rich bat diversity.

Genomes, Chromosomes and Transposable Elements: A Study of the Genome Architecture of Two Phyllostomid Bats

Cibele G. Sotero-Caio[1], Roy N. Platt II[1], Luiz Irber[2], C. Titus Brown[2], John D. Hanson[3], Caleb D. Phillips[1], Federico G. Hoffmann[4], Liam McGuire[1], Richard D. Stevens[5], Holly A. Wichman[6], LuAnn Scott[6], Fengtang Yang[7], Robert J. Baker[1] and David A. Ray[1]
1 *Department of Biological Sciences, Texas Tech University, Lubbock, USA;* ***2*** *Department of Population Health and Reproduction, University of California, Davis, USA;* ***3*** *Research and Testing Laboratory, Lubbock, USA;*
4 *Department of Biochemistry, Molecular Biology and Plant Pathology, Mississippi State University, Starkville, USA;* ***5*** *Department of Natural Resources Management, Texas Tech University, Lubbock, USA;* ***6*** *Department of Biological Sciences, University of Idaho, Moscow, USA; 7 Wellcome Trust Genome Campus, Wellcome Trust Sanger Institute, Hinxton Cambridge, GBR*

Phyllostomidae is a morphologically and ecologically heterogeneous family, with over 200 Neotropical species. Little is known about their genomes and the evolution of their genome architecture. The rapid diversification and extreme phenotypic variability in phyllostomids are accompanied by substantial chromosomal change, but the mechanisms underlying the genomic reshuffling in these bats are unknown. Transposable elements (TEs) have been implicated in such rearrangements in other taxa. Unfortunately, there is little information on the chromosomal distribution of repetitive sequences such as TEs in bats and their role for chromosomal stability and evolution. To better understand the evolution of the genome architecture of phyllostomids we sequenced the genomes of *Macrotus californicus* and *Desmodus rotundus*. We used initial assemblies and raw reads to perform a *de novo* annotation of TEs to identify the most prevalent TE families, as well as novel species- or phyllostomid-specific elements. Additionally, we performed chromosome mapping of the most prevalent TE (LINE-1 elements) of both species to correlate the presence of these elements on breakpoint regions. Like other mammals, a substantial portion of both genomes is comprised of repetitive DNA. Our mapping results suggest that the accumulation of TEs in phyllostomid chromosomes deviate from the mammalian norm, with enrichment of LINE-1 elements in the centromeric and

chromosome breakpoint regions. Cross-species hybridizations suggest that the centromeric enrichment derives from recent lineage-specific elements. These results suggest that the integration of genomic and chromosomal data can provide a broader perspective on how the evolution of genome architecture contributed to the diversification of phyllostomids.

Bacterial Diversity in Bat Flies of Three Phyllostomid Bats

Kelly A. Speer[1], Susan L. Perkins[1,2] and Nancy B. Simmons[1,3]
1 *Richard Gilder Graduate School, American Museum of Natural History, New York, USA;* ***2*** *Division of Invertebrate Zoology, American Museum of Natural History, New York, USA;* ***3*** *Division of Mammalogy, American Museum of Natural History, New York, USA*

Wildlife diseases are a key source of emerging infectious diseases in humans and have been the source of recent outbreaks of Ebola, SARS, and Lyme disease. As human populations continue to increase, so do interactions between humans and wildlife. We examine the impact of host feeding niche and roosting behavior on the microbiome of arthropod parasites. The microbiome influences the immune response and vector capacity of arthropod parasites. Changes in the composition of the arthropod microbiome or interactions with novel pathogens will likely impact disease ecology of bat communities. We used a metagenomic approach to assess the bacterial diversity in bat flies collected from 3 phyllostomid bat species: *Desmodus rotundus*, *Pteronotus mesoamericanus*, and *Sturnira lilium*. We hypothesized that the bacterial community of bat flies on *D. rotundus* would be distinct from and more diverse than that of bat flies parasitizing *P. mesoamericanus* and *S. lilium*. *Desmodus rotundus* is a sanguinivore and was collected from warm, stable roosts in tunnels under unexcavated Mayan temples. *Pteronotus mesoamericanus* is an insectivore and *S. lilium* is primarily a frugivore. We do not know where these species were roosting in our study area. Preliminary results from our collecting suggest that *D. rotundus* was more heavily infested with bat flies and ticks than the other study species, possibly due to roost preference and roosting behavior. Understanding wildlife diseases, especially in the face of habitat loss and increased human and domestic animal exposure to wildlife, will advance our ability to predict regions of high outbreak risk.

Predicting Habitat Use by Bats to Protect Bats and Inform Wind Energy Development

Clarissa Ann Starbuck and Carol L. Chambers
School of Forestry, Northern Arizona University, Flagstaff, USA

Although wind turbines are a clean, renewable source of energy, sometimes they incidentally kill bats and birds in large numbers. In 2012, an estimated 600,000 bats died due to encounters with turbines at wind energy facilities in the U.S. alone. Migratory species such as the Mexican free-tailed bat (*Tadarida brasiliensis*) and hoary bat (*Lasiurus cinereus*) have the highest mortality at wind energy facilities. Arizona has both high species richness of bats and a high proportion of migratory species that creates a high risk of mortality from interactions at wind energy facilities. Our objectives are to determine the species composition, examine bat use, study topographic features on the landscape that might influence bat movement, and identify elevational movements by bats. Our study area encompasses open grassland and shrubland in northern Arizona in areas where wind energy sites are being considered or proposed for development. We are sampling bat activity to determine habitat use and migratory patterns by bats in northern Arizona. Across our study area, we are deploying 34 acoustic detectors (Song Meter SM3BAT) at randomly-selected points that represent a range of measures for each habitat covariate (e.g., slope, aspect, elevation). We are surveying points during spring, summer, and fall of 2016 and 2017. We are using SonoBat 3 to identify bat calls to species. We will fit multi-season occupancy models to evaluate the effects of landscape covariates. We will create a map that predicts bat use in areas of northern Arizona that may also be suitable for wind energy development.

Real-time Turbine Integrated Mortality Reduction for Bats, Including *Myotis*

Christine L. Sutter[1], John Goodrich-Mahoney[2] and Sue Schumacher[3]
1 *Normandeau Associates, Inc, Gainesville, USA;* ***2*** *Electric Power Research Institute, Mystic, USA;* ***3*** *We Energies, Milwaukee, USA*

At the We Energies' Blue Sky Green Field wind facility near Fond du Lac, Wisconsin we conducted an EPRI-funded study to determine if using real-time measures of bat exposure (activity at the nacelle) and weather to initiate curtailment (smart curtailment) would reduce bat fatalities and increase operational time as compared to standard curtailment strategies. During the 2015 fall migratory season ten turbines operated normally and ten turbines

operated under a model that curtailed turbines in response to real-time bat exposure and weather conditions. The 20 turbines were searched daily for bat carcasses. The model-operated turbines had 83% fewer overall bat fatalities and 90% fewer *Myotis* fatalities as compared to the normally operating turbines. This is the first curtailment study to demonstrate a reduction in *Myotis* fatalities. The model-operated turbines produced 114 MW less of energy than normally operating turbines. This is an annual revenue loss of about $4500 per turbine per year, which is less than 1% of the annual revenue. These are the highest mortality reductions and the lowest revenue losses reported by any curtailment study to date. This win-win result is due to the strong correlation between bat exposure and fatality and the avoidance of unnecessary curtailment (curtailment when no bats are exposed to the blades). Replication of this approach at other wind energy facilities is being pursued to assess the robustness of this approach across a wide range of species and facilities.

More Reference Recordings Decreases, Rather than Increases, Acoustic Classification Performance of *Myotis sodalis* and *M. lucifugus*

Joseph M. Szewczak[1], John D. Chenger[2] and Janet D. Tyburec[3]
1 *Humboldt State University, Arcata, USA;* ***2*** *Bat Conservation and Management, Inc., Carlisle, USA;* ***3*** *Bat Survey Solutions, LLC, Tucson, USA*

Initial attempts to use recordings from species-known tracked bats to identify *Myotis sodalis* and distinguish it from the acoustically similar congener *M. lucifugus* indicated some acoustically distinct parts of their respective call repertoires. This encouraged continued tracking and recording of these species in hope that a larger data set would strengthen the statistical difference between their echolocation calls and provide more robust classification. Instead, additional data filled in parts of the data space previously reserved to the other species and vice versa. This implied that apparent classification success between these species might result from the stochasticity of the data used to base a classifier. To investigate this, we used a set of 10,955 species-known call samples recorded from tracked individuals in twelve states across its range. We randomly selected sets from 614 to 10,005 call samples to build and test classification performance using both the full SonoBat version 4 time-frequency and time-amplitude parameters and Analook-equivalent time-frequency parameters. Classification performance ranged from 95.0–69.9% correct using the full SonoBat parameter sets and from 88.6–56.9% correct for the Analook-equivalent parameter sets. Both approaches revealed greater range of performance for smaller data sets, a downward trend in classification performance with larger data sets, and both extrapolated to a meaningless 50% correct performance near 21,000 calls. This indicates that these species may make similar flight and foraging maneuvers requiring calls having similar solutions to the task at hand, and that any single call or sequence cannot identify these species definitively.

Shifts in Composition of Bat Assemblages Following Arrival of White-nose Syndrome in Mammoth Cave National Park

Marissa M. Thalken[1], Joseph S. Johnson[2] and Michael J. Lacki[1]
1 *Department of Forestry, University of Kentucky, Lexington, USA;* ***2*** *Department of Biological Sciences, Ohio University, Athens, USA*

The arrival of white-nose syndrome (WNS) in North America in 2006, and the subsequent decline of hibernating populations of bats, has potential long-term implications for communities of bats in heavily affected regions. Predictably, severe declines in wintering populations of bats should lead to concomitant shifts in the composition and relative abundance of bat species during the growing season in nearby forested landscapes. We used data from mist-net captures obtained from 2009 to 2016 to evaluate summer patterns in bat species abundance pre- and post-arrival of WNS in Mammoth Cave National Park, Kentucky, USA. We examined temporal patterns of abundance across the Park and also compared changes in capture success rates for a subset of net locations sampled both before and after WNS arrival in 2013. Data demonstrate a significant change in overall relative abundance of species captured following WNS ($\chi^2 = 134$, df = 7, $P < 0.001$). The northern long-eared bat (*Myotis septentrionalis*) was the most commonly captured species pre-WNS, but declined to the 5th most abundant species in mist-net captures post-WNS. Evening bat (*Nycticeius humeralis*) and eastern red bat (*Lasiurus borealis*) demonstrated the largest increases in capture success following arrival of WNS to the Park, and were the two most frequently captured species from 2014 to 2016. We present a series of hypotheses to account for the changes observed in relative abundance of bat species during the warmer months in the Park.

Effects of Post-disturbance Salvage Logging on Occupancy of *Myotis lucifugus* near its Northern Range Limit
Julie P. Thomas[1], Robert R.M.R. Barclay[1], Mary L. Reid[1] and Thomas S. Jung[2]
1 *Department of Biological Sciences, University of Calgary, Calgary, CAN;* ***2*** *Yukon Department of Environment, Whitehorse, CAN*

Bats at northern latitudes face unique challenges: cold temperatures limit the flight of aerial insect prey, and long summer days reduce time for nocturnal foraging and increase predation risk. Recent work suggests that northern bats are adapted to hunt in cluttered forests where they can glean non-aerial prey from vegetation surfaces, and where canopy cover provides darkness and protection from predators. These behavioural adaptations distinguish northern forest-dwelling bats from those at the core of their range, and may affect habitat selection and response to forest disturbance. In the summer of 2016 I studied the influence of spruce bark beetle infestation and subsequent salvage logging activity on patterns of habitat use in the little brown bat (*Myotis lucifugus*) near its northern range limit in southwestern Yukon, Canada. I conducted acoustic surveys using Anabat detectors at 90 sites, with 30 sites in spruce beetle-affected forest, and 60 in salvage-logged stands with varying degrees of structural retention. I will use occupancy models to examine the relationship between bat occupancy and salvage logging activity, as well as other landscape-level and site-level characteristics including tree density, canopy cover, distance to water features, and distance to known roosting sites. Preliminary results indicate that logged areas with high structural retention had the highest proportion of sites occupied (56.2%), followed by spruce-beetle affected forest (47.6%), and logged areas with low retention (27.3%). The results of this study will contribute to understanding of northern bat ecology, and will provide valuable information to inform post-disturbance forest management policies.

Using Thermal Imaging Photography as a Method to Locate Indiana Bat Maternal Tree Roosts
Darren R. Thornhill, Jaclyn Johnson and Anthony Elliott
Missouri Department of Conservation, Kirksville, USA

The Indiana bat (*Myotis sodalis*) utilizes exfoliating tree bark, usually from dead or dying trees, for maternal colony roosts. Due to the habitat type, roosts are often difficult to locate through passive means. Traditionally, roost sites have been located by capturing bats during night-time mist netting surveys, fitting them with radio transmitters, and then tracking them to roost trees during the day. This method is labor intensive, can be stressful to the handled bats, and often yields very few roost locations due to the short battery life of the radio transmitters and the number of bats capable of being tracked. We used a FLUKE TiX520 thermal imaging camera to investigate a passive method for locating Indiana bat roosts on Rebels Cove Conservation Area, Putnam County, Missouri. Indiana bats were captured using mist netting, fitted with radio transmitters, and tracked to roost trees. We scanned probable roost trees, as indicated by the radio telemetry, with the thermal imaging camera for likely heat signatures under the bark. We found significant heat signatures emanating from exfoliating bark actively utilized by Indiana bats versus that of empty trees. Visual observation of bats entering, exiting, and occupying the roosts confirmed them as the source of the heat signatures and verified the methodology. Further exploration of this technology should be conducted to determine if it can be used as a stand-alone, passive method for locating roost trees and/or determining bat colony size and expanse.

Bat Community Ecology in Northeastern Iowa
Francis E. Tillman, Jr. and Gerald L. Zuercher
Department of Natural and Applied Sciences, University of Dubuque, Dubuque, USA

Bats are an important component in healthy ecosystems. Effigy Mounds National Monument is a nationally-protected park along the Mississippi River in northeastern Iowa that contains diverse topography and associated upland and lowland forests interspersed with upland prairie. The park is home to at least seven bat species. White-nose syndrome is a deadly pathogen of bats caused by the fungus *Pseudogymnoascus destructans* (*Pd*). Since the initial detection in the northeastern United States, white-nose syndrome has spread and caused large population declines in many species of hibernating bats including several of those found at Effigy Mounds National Monument. Spatial and temporal patterns of bat communities were evaluated using acoustic detection and mist-netting methods. One goal was to assess the status of the Federally Threatened *Myotis septentrionalis*. *Myotis septentrionalis* has been one of the more commonly captured species and is acoustically detected throughout the park. A second goal was to assess the exposure to *Pd* by all bat species via swabbing the muzzles of captured bats and testing the isolated DNA. Currently, the exposure rate is ~5%. A third goal was to determine roost-site habitat characteristics for female *Myotis septentrionalis*. Several *Myotis septentrionalis* were tracked to their nesting trees in 2015 and 2016 using

telemetry. Comparison of summer roost site habitat to park-wide available habitat indicates little selection beyond tree height. Our results suggest that Effigy Mounds National Monument is an important protected area for bats, especially *Myotis septentrionalis*.

A Supralaryngeal Neuromuscular Apparatus for Sonar Beam Forming in the Free-tailed Bat
Samantha Trent and Michael Smotherman
Department of Biology, Texas A&M University; College Station, USA

There is behavioral evidence that echolocating bats can manipulate the acoustic projection pattern of their sonar pulse emissions, but the mechanism(s) for this are unknown. We hypothesized that the Mexican free-tailed bat (*Tadarida brasiliensis*) achieves this by finely adjusting the shape of its mouth (beam-forming). This hypothesis arose from our discovery that *Tadarida brasiliensis* raise their nose and lips preceding each echolocation pulse and that they possess a hypertrophied set of specialized facial muscles possibly analogous to the *levator labii aleque nasi*. We investigated whether this muscle complex 1) is active during sonar performance, 2) displays anatomical specializations consistent with the high-speed demands of echolocation, and 3) can effectively perform beam-forming through the fine manipulations of mouth-gape. Firstly, EMG recordings from awake echolocating bats confirmed that these muscles were activated in temporal coordination with pulse emissions. Secondly, we described the anatomical organization of the muscle complex, its origin and insertions, and its innervation patterns. Lastly, we directly measured how changes in face shape affected the sonar beamwidth. This muscle complex allows bats to lift the nose tip to create a small aperture producing a wide-angle beam, or to lift both the nose and the upper lips simultaneously creating a wider aperture but narrower beam. We confirmed that for a typical pulse (downward FM sweep, 50-20 kHz), raising and pulling back the lips narrowed the projection beam relative to raising the nose tip with lips held down. These results confirm that *Tadarida* possess a specialized supralaryngeal neuromuscular apparatus for sonar beam-forming.

High Levels of Inferred Gene Flow among Geographically Distant Populations of *Pteropus vampyrus* (Chiroptera: Pteropodidae)
Susan M. Tsang[1,2,3], Sigit Wiantoro[4], Maria Josefa Veluz[3], Nancy B. Simmons[2] and David J. Lohman[1,3]
1 *Department of Biology, City College and the Graduate Center, The City University of New York, New York, USA;* ***2*** *Department of Mammalogy, American Museum of Natural History, New York, USA;* ***3*** *Zoology Division, National Museum of the Philippines, Manila, PHL;* ***4*** *Museum Zoologicum Bogoriense, Indonesian Institute of Sciences, Cibinong, IDN*

Pteropus vampyrus, the largest bat in the world, has a broad geographic range covering much of Southeast Asia, making management of this threatened species an international issue. Understanding population dynamics of *P. vampyrus* is critical to addressing conservation issues and global health concerns alike, as the species is an important seed disperser and pollinator in forest ecosystems, and it is also a natural reservoir host for emerging infectious pathogens. We used phylogenetic inference and population genetic indices to infer past gene flow between populations of *P. vampyrus* throughout most of the species' range. Population genetic parameters indicate low levels of nucleotide variability with high haplotype diversity across its range, implying a demographic scenario of recent population expansion after a bottleneck. Lack of phylogenetic structure suggests widespread admixture in *P. vampyrus* from geographically distant populations. These findings indicate that *P. vampyrus* acts as a single, nearly panmictic population across its broad range. For conservation, this means that protection of the species requires international cooperation and monitoring to ensure population persistence. For disease ecology, this suggests that *P. vampyrus* is likely capable of pathogen transmission across international boundaries. Increased genetic sampling is needed to more accurately determine commonly-used dispersal routes of *P. vampyrus*, and to assess the possibility of asymmetric gene flow among populations. Protection of the species and its habitats are both important because environmental stress may lead to increasing frequency of emergence of infectious pathogens.

Strategies for Conserving Bats
Merlin Tuttle
Merlin Tuttle's Bat Conservation, Austin, Texas, USA

As recently as the early 1980s most Americans viewed bats as rabid and dangerous, and millions of dollars were spent annually on their eradication. Leading conservation organizations avoided them like the plague, and government agencies mostly ignored even the few that were listed as endangered. Together, in recent decades,

we've made much progress in replacing scary misconceptions with appreciation of values. Nevertheless, as leading colleagues have recently reported, bats again are facing formidable challenges that threaten their very survival. How can we address escalating threats from wind power facilities, white-nose syndrome and an alarming return to greatly exaggerated fear of disease? I will present examples from my personal experience and that of colleagues, suggesting a need for new emphases on interdisciplinary collaboration, greatly improved communication beyond colleagues and quality research focused on real human needs. Model examples point the way to a greatly improved future, both for bats and for those who study them.

Improving Bat Survey Efficiency and Occupancy Results by Using Simultaneous Capture and Acoustic Methods

Janet D. Tyburec[1], John D. Chenger[2] and Joseph M. Szewczak[3]
1 *Bat Survey Solutions, LLC, Tucson, USA;* ***2*** *Bat Conservation and Management, Inc., Carlisle, USA;* ***3*** *Humboldt State University, Arcata, USA*

All survey methods for bats are biased. Physical capture surveys, using mist nets will over-represent species that: (1) fly close to the ground, (2) have fast, un-maneuverable flight styles, and (3) are common. Passive acoustic surveys, using high-frequency microphones on bat detectors, will over-represent species that have echolocation calls that are: (1) high-amplitude, (2) low-frequency, and (3) unique (i.e., include repertoires that have little overlap with other species in the area). We illustrate the occupancy results of single-survey method efforts using either mist-nets or bat detectors and then compare occupancy results when acoustic and capture efforts are combined simultaneously. Surveys were conducted during the summer of 2016 at survey sites in three distinct geographic locations of the United States: the Southwest (southeastern Arizona), Northwest (extreme northern California), and Midwest (western Kentucky). Total bat species diversity known from each area is based upon decades of work by the authors at these three locations and ranged from 13-21 species. At each location, the completeness of bat surveys using single vs. combined methods was documented using species accumulation models. By combining both acoustic and capture survey methods, simultaneously, time spent in the field to determine the most accurate estimate of species occupancy was reduced by up to 60%. Researchers performing bat surveys will be more efficient and produce more reliable results when capture and acoustic methods are deployed simultaneously.

Seasonal Bat Activity and Ecology at Jean Lafitte National Park, Louisiana

Rebecca A. Urquhart[1] and Craig S. Hood[1,2]
1 *Environment Program, Loyola University New Orleans, New Orleans, USA;* ***2*** *Department Biological Sciences, Loyola University New Orleans, New Orleans, USA*

Previous mammal surveys in Jean Lafitte National Park documented that there were seven to eight species of bats with varying abundances throughout the park. Tri-colored bats, (*Perimyotis subflavus*) and evening bats, *Nycticeius humeralis* were the two most commonly detected species. We investigated major habitats in the park for fluctuations in habitat usage by species over the course of a year. Three different habitat sites were chosen for passive acoustic data collection; the Education Center (Hardwood Forest), Coquille Bridge (Swamp), and the Marsh. At each site, a passive Anabat Detector station was deployed to record the echolocation calls of bats. Data collection occurred for one calendar year in 2015, and the calls were identified using Analook software and local call libraries. Patterns of occurrence were analyzed using Microsoft Excel to compare species composition of each site by hourly / monthly activity. The Education Center included mostly *P. subflavus* and *Lasiurus borealis*, *N. humeralis* was most common at the Coquille Bridge, and *T. brasiliensis* at the Marsh site. Activity at the Education Center peaked in June, the Coquille trail in April, and the Marsh site in August. There is a decrease in activity at the Education site from July to August that appears to be inversely related to the increase in activity at the Marsh site. Future surveys will need to account for lost recording times and cover more area of the park's marsh habitat.

Effects of Landscape on Cave-dwelling Bat Communities in the Caatinga of Rio Grande do Norte in Northeastern Brazil

Juan Carlos Vargas-Mena[1], Eugenia Cordero-Schmidt[1], Diego de Medeiros Bento[2], Bernal Rodriguez-Herrera[3], Rodrigo A. Medellín[4] and Eduardo M. Venticinque[1]

***1** Departamento de Ecologia, Universidade Federal do Rio Grande do Norte, Rio Grande do Norte, BRA; **2** Centro Nacional de Pesquisa e Conservação de Cavernas, Rio Grande do Norte, BRA; **3** Escuela de Biología, Universidad de Costa Rica, San José, CRI; **4** Instituto de Ecología, Universidad Nacional Autónoma de México, México D. F., MEX*

Several internal factors influence cave selection in bats such as cave structure and species microclimate preferences that in turn structures the richness and composition of cave-bat communities. However, the effects of external landscape factors (e.g., natural and anthropogenic components) around caves on the structure on these bat assemblages are poorly studied. Thus, we assessed the effects of the composition of the landscape around different caves on the richness and community structure of cave-dwelling bats in the Caatinga of Rio Grande do Norte State in Brazil. We surveyed 13 caves distributed in two karstic cave systems. In a 1km buffer around each cave we extracted 14 variables (spatial, anthropogenic, cave dimensions and environmental) and performed analysis using single and multiple models. Models were selected using the Akaike Information Criterion. We observed that bat communities between the cave systems were different and significantly affected by spatial variables (specific landscape conditions of each cave system) and by anthropic variables (presence of human settlements and livestock density). Environmental variables such as high percentage of Caatinga cover and presence of water bodies had no significant effect on the structure of communities. The effects of these variables were observed in differences in the abundance (colony sizes) of shared species between the cave systems. There was no significant effect of any landscape variable on the bat richness but instead the cave size had significant effect. This study helped to see that the human activities in a Caatinga landscape matrix has a strong influence on the structure of cave-bat communities.

Bugs and Big Browns: Potential Transmission Routes for *Pseudogymnoascus destructans*

Karen J Vanderwolf[1,2], David Malloch[1] and Donald F McAlpine[1]

***1** New Brunswick Museum, New Brunswick, CAN; **2** Canadian Wildlife Federation, Ontario, CAN*

The transmission dynamics of *Pseudogymnoascus destructans* (*Pd*), the fungus that causes white-nose syndrome (WNS) in bats, is still poorly understood. Bats overwintering outside the underground environment are not believed to play a role in the epidemiology of WNS. Using quantitative real time polymerase chain reaction (qPCR), we provide molecular evidence for *Pd* on four big brown bats overwintering in heated buildings in New Brunswick, Canada. These findings demonstrate that bats over-wintering in heated buildings and other above-ground sites may carry cryptic *Pd* infections, but not necessarily be subject to the disease WNS, and could play a role in the local dispersal of *Pd*. While bats are assumed to be the main vector transmitting *Pd* cave-to-cave, the role of other fauna is unexplored. We documented the fungi associated with over-wintering arthropods in *Pd*-positive hibernacula, including sites where bats had been recently extirpated, to determine if arthropods carried *Pd*. Viable *Pd* was cultured from 15.3% of arthropods, most frequently from harvestmen (*Nelima elegans*). While it is unlikely that arthropods play a major role in the transmission dynamics of *Pd*, we demonstrate that arthropods may carry viable *Pd* spores and therefore have the potential to transport *Pd*, either naturally or anthropogenically, within or among hibernacula. This underlines the need for those entering hibernacula to observe decontamination procedures and for such procedures to evolve as our understanding of potential mechanisms of *Pd* dispersal improve.

Adaptation of Salivary Glands in Response to Diet in Phyllostomid Bats

Michael W. Vandewege and Caleb D. Phillips

Department of Biological Sciences, Texas Tech University, Lubbock, USA

Understanding the genetic changes that either cause or respond to ecological adaptation is vital to understand the origins of biodiversity, because phenotypic innovations often drive species diversification. Within Chiroptera, the family Phyllostomidae has over 200 species and the widest range of diets of any mammalian family. Phyllostomidae is relatively young with a shared common ancestor existing ~30 MYA. The rapid ecological radiation of this family provides an ideal system to study the mechanisms underlying evolutionary innovations. The submandibular gland in mammals exhibits wide anatomical variability. Moreover, the submandibular glands secrete components that serve a range of functions and it is hypothesized that these products play an important part in adaptive radiation. Here, we sequenced the submandibular transcriptomes of 10 phyllostomid bats to test two

hypotheses, 1) secretory proteins are evolving in an adaptive manner, and 2) species with similar diets would have similar gene expression profiles. *De novo* assembled transcriptomes were annotated and gene expression profiles were estimated for each species. We found that 263 out of ~7000 genes tested were evolving adaptively. Strikingly, 30% of the genes evolving adaptively were identified as secretory although secretory proteins make up only 10% of all transcriptomes. This suggests that although adaptation at the sequence level is uncommon, secretory proteins are enriched in this collection. We also found that diet and not phylogeny, was a strong predictor of gene expression profiles. These results suggest that salivary glands have played a significant role in the ecological radiation of Phyllostomidae.

Neotropical Bats that Cohabit with Humans Function as Dead-end Hosts for Dengue Virus

Amanda Vicente-Santos[1,2], Andrés Moreira-Soto[1,2,3,4], Claudio Soto-Garita[1], Luis Guillermo Chaverri[3], Andrea Chaves[2], Jan Felix Drexler[4,5], Juan Alberto Morales[6], Alejandro Alfaro[6], Bernal Rodríguez-Herrera[2] and Eugenia Corrales-Aguilar[1]

1 *Virology-CIET (Research Center for Tropical Diseases), Microbiology, University of Costa Rica, San José, CRI;* **2** *Biology, University of Costa Rica, San José, CRI;* **3** *Exact and Natural Sciences School, National Distance Education University, San José, CRI;* **4** *Institute of Virology, University of Bonn Medical Centre, Bonn, DEU;* **5** *German Centre for Infection Research, Bonn-Cologne, DEU;* **6** *Pathology, Veterinary Medicine, National University, Heredia, CRI*

Studies have shown Dengue Virus (DENV) presence in neotropical wildlife including bats, suggesting that bats may be susceptible to DENV infection. We aim to elucidate the role of house-roosting bats in DENV transmission cycle. Households were sampled from high and low dengue incidence regions during rainy and dry seasons in Costa Rica. We captured 318 bats from 12 species in 29 households. Necropsies were performed in 205 bats to analyze virus presence in heart, lung, spleen, liver, intestine, kidney, and brain tissue. Histopathology studies from all organs showed no manifestation of disease or infection. Sera were analyzed by $PRNT_{90}$ for a seroprevalence of 22% (53/241), and by PCR for 8.8% (28/318) positive bats for DENV RNA. From these 28 bats, 2 intestines were DENV RNA positive for the same dengue serotype detected in blood. Viral isolation from all positive organs or blood was unsuccessful. Viral load analysis in positive blood samples by qRT-PCR showed virus concentrations under the minimal dose required for mosquito infection. Simultaneously, 651 mosquitoes were collected and analyzed for DENV and feeding preferences (bat cytochrome b). Three mosquitoes were found DENV positive and none was positive for bat cytochrome b. Our results suggest an accidental presence of DENV in bats probably caused from oral ingestion of infected mosquitoes. Phylogenetic analyses suggest also a spillover event from humans to bats. We conclude that bats in these urban environments do not sustain DENV amplification; not having a role as reservoirs, but function as an epidemiological dead-end host for DENV.

Testing the Efficacy of Chitosan as a Potential Treatment for White-nose Syndrome

Maarten J. Vonhof[1], Timothy C. Carter[2] and Robert R. Eversole[1]

1 *Dept. of Biological Sciences, Western Michigan University, Kalamazoo, USA;* ***2*** *Dept. of Biology, Ball State University, Muncie, USA*

As white-nose syndrome (WNS) continues to increase in prevalence and expand across North America from the original locus, there is an urgent need to develop mechanisms and strategies to reduce mortality rates and limit transmission to new regions. We tested the efficacy of the non-chemical, naturally occurring biopolymer chitosan for the prevention and treatment of WNS. Chitosan is a powerful antimicrobial (antibacterial and antifungal) agent, has extensive wound-healing properties, and is fully biocompatible, biodegradable, and nontoxic. We first tested a chitosan preparation on experimentally-infected little brown bats in the laboratory to determine its influence on fungal growth, bat arousal behavior, and the histopathology of WNS. Little brown bats were collected at a hibernaculum in Michigan and brought into the lab where we set up two control (clean and infected but untreated) and six experimental treatments that differed in dose and timing of application. We observed that while fungal loads and arousal behavior were not different between treated and infected control bats, survival was higher for bats treated with chitosan. We performed a follow-up field experiment in Wisconsin that confirmed these results, and observed that for bats held in cages, survival of chitosan-treated bats was double that of infected controls. We discuss our ongoing research, and the potential of chitosan as a treatment for WNS until other options are developed.

Studying *Myotis lucifugus* Occupancy, Roost Fidelity, and Movements Using High-frequency RFID in Yellowstone National Park

Austin Waag[1], John Treanor[2], Jessica Kropczynski[3] and Joseph Johnson[1]
1 *Department of Biological Sciences, Ohio University, Athens, USA;* ***2*** *Yellowstone National Park, National Park Service, USA;* ***3*** *Department of Information Sciences and Technology, Pennsylvania State University, State College, USA*

Currently, there is a need for information regarding the population ecology and movements of bats in the Rocky Mountain region of North America. These data are especially beneficial to land managers in the region given the scarcity of known hibernacula. To study little brown myotis (*Myotis lucifugus*) seasonal occupancy, annual roost fidelity, and movements among roosts, we implanted high-frequency radio-frequency identification (HF RFID) tags in 132 adult females and 2 adult males in Yellowstone National Park from 2015-2016. We equipped one building roost with five HF RFID antennas in 2015, and increased our scope to three building roosts with eight antennas in 2016. As of August 1 2016, 5116 scans were recorded at one building, which comprised 14 of the 134 bats (11.2%). Of bats tagged in 2015, 7 (12.1%) were scanned in 2016. One male was recorded in a roost throughout winter, representing the first documentation of an over-wintering little brown myotis in Yellowstone. Additional data to be presented will include preliminary data from an additional roost, and individual detection rates. Although our percent of RFID 'recaptures' are low, our results will help refine antenna placement and increase effectiveness in 2017. These data represent the start of a long-term dataset, tracking the detection of little brown myotis marked as adults and juveniles, providing a means for monitoring the population in the absence of known hibernacula.

How Rare? Limits of Detection of a Genetic Assay for Species Identification from Guano

Faith M. Walker[1,2], Viacheslav Y. Fofanov[3], Abigail Tobin[1], Colin Sobek[1,2], Daniel E. Sanchez[1,2] and Carol L. Chambers[1]
1 *School of Forestry, Northern Arizona University, Flagstaff, USA;* ***2*** *Center for Microbial Genetics and Genomics, Northern Arizona University, Flagstaff, USA;* ***3*** *Informatics and Computing Program, Northern Arizona University, Flagstaff, USA*

At NASBR 2015 we reported on the development and coverage of a genetic assay for identifying bat species across Chiroptera from guano. Here, we explore the limits of detection of the Species from Feces assay (nau.edu/batdna), which uses high-throughput amplicon sequencing to identify bat species from hundreds of fecal pellets simultaneously, for increased utility and decreased costs. In controlled tests, we determined how rare guano from a bat species can be in a pooled sample and still be detected, and examined whether read number reflects the proportion of a species' feces. We further examined the sensitivity of the assay, and new applications, by testing soil samples collected at roosts and guano fertilizer of unknown age. Finally, to illustrate effectiveness of the approach, we identified bat species that contributed to guano samples collected from across >40 subterranean roosts in the southwestern U.S. For limits of detection, we found that all bat species in mock communities were detected to a 1:192 fecal DNA dilution along with other high concentration bat species. In practice, soil and fertilizer samples readily PCR amplified bat DNA, with species-level discrimination. Bat species were also genetically detected in all mines (1-4 species each), whereas in only 58% of mines were bats visually identified. We show that the Species from Feces assay is a sensitive, powerful, and practical means to survey roosts.

Population Estimates and Microclimate Data for Newly Established Overwintering Brazilian Free-tailed Bat Colonies in Central Texas

Sara P. Weaver[1], Thomas R. Simpson[2], John T. Baccus[3] and Floyd W. Weckerly[2]
1 *AECOM, Austin, USA;* ***2*** *Biology Department, Texas State University, San Marcos, USA;* ***3*** *Department of Natural Resources Management, Texas Tech University, Lubbock, USA*

Behavioral changes of migratory species have been globally documented in recent decades. However, there is a paucity of research on changes in migratory bat species. Brazilian free-tailed bats (*Tadarida brasiliensis*) roost in central Texas from March to November. These bats have historically migrated south in late fall, leaving summer roosts unoccupied during winter. Recently, overwintering populations have been discovered in central Texas. The objectives of our study were to determine presence or absence of overwintering free-tailed bats at six known summer roosts, obtain baseline population estimates, and evaluate microclimates of roosts during winters of 2010–2011 and 2011–2012. We used data loggers to monitor temperature and humidity hourly. We estimated population sizes with digital images using ImageJ software, previously established roosting densities, or both. Our results

indicated that occupied roosts were colder, had less stable temperatures, and had a stronger correlation between internal and external temperatures vs. unoccupied roosts. Population sizes increased at all occupied roosts from 2010 to 2011. Our results suggest a northward expansion in Texas of the winter range for the species.

To Spray or Not to Spray: Evaluating Alternative Management Approaches for White-nose Syndrome
Craig K.R. Willis, Quinn M.R. Webber, Quinn E. Fletcher, Kaleigh J.O. Norquay, Ana M. Breit and Christina M. Davy
Department of Biology, University of Winnipeg, Winnipeg CAN

Pseudogymnoascus destructans has led to severe declines of hibernating bats in eastern North America with three species now listed as endangered in Canada, and one as threatened in the United States. Media reporting on the U.S. listing process has highlighted controversy about possible management strategies for WNS. On the one hand, what we term "Stuff on Bats" (SOB) approaches to WNS management (i.e., chemical or biological treatments that could be applied to bats during winter) could improve winter survival, particularly for bats that can be accessed for treatment. On the other hand, protection and enhancement of summer habitats (i.e., the kind of actions that normally accompany listing of species at risk) could help support spring survival and summer reproduction by bats that survive the winter. This, in turn, could support or accelerate the evolution of resistance to *P. destructans* in remnant populations. We used data collected from laboratory experiments and field studies, combined with predictive population models built on estimated rates of survival and reproduction, to evaluate ecological and evolutionary costs and benefits of these alternative management responses to WNS. Our analyses suggest that protection and enhancement of summer habitats could be just as important for population recoveries as SOB. Moreover, under some scenarios SOB could have unintended negative consequences. Our results highlight a need for research to understand the potential of SOB to attenuate evolutionary responses of bat host populations to WNS or drive the evolution of treatment resistance in *P. destructans*.

Using Harp Traps at Caves with Belligerent Bats
Ashley K. Wilson
School of Biological Sciences, University of Northern Colorado, Greeley, USA

Puerto Rico is home to 13 species of bat, many of which prefer to roost in 'hot caves' where ambient temperatures reach 40°C and the humidity remains nearly 100%. Culebrones cave is a hot cave that houses over 300,000 bats from six different species, all of which use a single exit when emerging. I positioned a collapsible harp trap at the opening to Culebrones cave to sample the Puerto Rican Mormoopidae (*Mormoops blainvillei*, *Pteronotus parnellii*, and *P. quadridens*) for dietary analyses; however, the three other species that roost in this cave (*Brachyphylla cavernarum*, *Erophylla sezekorni*, and *Monophyllus redmani*) were also caught in this trap on a regular basis. One night, approximately 50 *P. quadridens* were in the harp trap along with one belligerent *B. cavernarum*. Upon closer examination, I noticed that five of these *P. quadridens* had broken forearms, and that the injured area on each bat was flanked by two puncture wounds. The gap between these two wounds was equidistant among all five *P. quadridens*, which was equal to the space between the canines of a *B. cavernarum* skull (ca. 6 mm). *B. cavernarum* has been described as pugnacious and petulant, and has been observed quarreling with *Artibeus jamaicensis* at foraging sites; therefore, it is likely that the *B. cavernarum* in my harp trap bit the wings of the injured *P. quadridens*. No additional injuries occurred during the remainder of this study, which was likely due to the immediate removal of all *B. cavernarum* from the harp trap.

North American Bats as Reservoir Hosts of Human Bacterial Pathogen, *Bartonella mayotimonensis*
Cali A. Wilson[1], Thomas M. Lilley[1], Kenneth A. Field[1], DeeAnn M. Reeder[1], Riley F. Bernard[3], Emma V. Willcox[3], Allen Kurta[4] and Arto T. Pulliainen[2]
***1** Biology Department, Bucknell University, Lewisburg, USA; **2** Institute of Biomedicine, University of Turku**,** Turku, FIN; **3** Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, USA; **4** Department of Biology, Eastern Michigan University, Ypsilanti, USA*

Bartonella is a genus of gram-negative bacteria infecting a wide range of mammals worldwide. Some *Bartonella* species are well known human pathogens (e.g., *B. quintana* and *B. henselae*), especially frequent in endocarditis cases, but new pathogenic species are emerging. A new species of *Bartonella*, *B. mayotimonensis* was detected in 2010 from aortic valve tissue of a person with endocarditis in Iowa. *Bartonella* strains similar to the Iowa *B. mayotimonensis* patient strain were recently detected or isolated from peripheral blood samples and the

ectoparasites of *Myotis daubentonii* in southwest Finland. We sampled 73 *M. lucifugus* and 19 *M. grisescens* from Tennessee, Michigan, and Pennsylvania in 2015. *Bartonella,* including *B. mayotimonensis* and yet undescribed species were detected in 7 *M. lucifugus* and 5 *M. grisescens.* This suggests that bats are reservoir hosts for *B. mayotimonensis* and potentially other *Bartonella* species in North America. The endocarditis patient in Iowa could have become infected through contact with bats. It remains to be studied how the hemotrophic *Bartonella* are transmitted from bats into the human host, possibly involving bat ectoparasites such as the bat bugs (*Cimex* spp.). Our data prompt a more detailed study on the interactions between humans, bats and their shared ectoparasites.

Pre-WNS Prey Preferences among Little Brown and Big Brown Bats in Southern Wisconsin

Amy K. Wray [1], Michelle A. Jusino[2], Mark T. Banik[2], Jonathan M. Palmer[2], J. Paul White[3], Emma Pelton[4], Heather Kaarakka[3], Daniel L. Lindner [2], Claudio Gratton[4] and M. Zachariah Peery [1]

1 *Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, Madison, USA;* ***2*** *Northern Research Station, United States Forest Service, Madison, USA;* ***3*** *Wisconsin Department of Natural Resources, Madison, USA;* ***4*** *Department of Entomology, University of Wisconsin-Madison, Madison, USA*

White-nose syndrome (WNS) was detected in Wisconsin in March 2014 and is predicted to cause precipitous declines among Wisconsin bats within the next four to five years, which could have significant trophic effects on arthropod community interactions. To establish baseline data for pre-WNS bat diets in Wisconsin, we developed an improved method to amplify and identify the arthropods found in bat guano using NGS. We compared the diets of the two most abundant species in the state: the little brown bat (*Myotis lucifugus*) and big brown bat (*Eptesicus fuscus*). Our results indicate that these species consume different communities of insects, with seasonality and location also having a significant effect on prey preference. Mosquito DNA was detected in at least 40% of the samples from *Myotis lucifugus,* and in at least 22% of the samples from *Eptesicus fuscus*. Additionally, we examined differences in bat diets among areas of varying agricultural and riparian habitat composition in order to determine possible effects of bat population declines on agricultural pest abundances. As WNS continues to move through Wisconsin in the next several years, these methods will continue to be used as a way to better understand pest suppression services, potential for dietary plasticity, and subsequent trophic effects on arthropod communities in response to disease-related bat declines.

RECENT LITERATURE

Authors are requested to send reprints (PDF files) of their published papers to the Editor for Recent Literature, **Dr. Thomas A. Griffiths**, (e-mail: **thomas.alan.griffiths@gmail.com**) for inclusion in this section. Receipt of reprints is preferred, as it will facilitate complete and correct citation. However, if reprints and/or PDF files are unavailable, please send a complete citation (including complete name of journal and corresponding author mailing address) by e-mail. The Recent Literature section is based on several bibliographic sources and for obvious reasons can never be up-to-date. Any error or omission is inadvertent. Voluntary contributions for this section, especially from researchers outside the United States, are most welcome and appreciated.

BEHAVIOR

Bartoničková, L., A. Reiter, and T. Bartonička. 2016. Mating and courtship behaviour of two sibling bat species (*Pipistrellus pipistrellus, P. pygmaeus*) in the vicinity of a hibernaculum. Acta Chiropterologia, 18:467–475. [bartonic@sci.muni.cz]

Patriquin, K. J., M. L. Leonard, H. G. Broders, W. M. Ford, E. R. Britzke, and A. Silvis. 2016. Weather as a proximate explanation for fission-fusion dynamics in female Northern Long-eared bats. Animal Behaviour, 122:47–57. [krista.patriquin@utoronto.ca]

Schöner, M. G., C. R. Schöner, G. Kerth, L. L. Ji, and T. U. Grafe. 2016. Bats attend to plant structures to identify roosting sites. Acta Chiropterologia, 18:433–440. [schoenerm@uni-greifswald.de]

Zeus, V. M., S. J. Puechmaille, and G. Kerth. 2017. Conspecific and heterospecific social groups affect each other's resource use: a study on roost sharing among bat colonies. Animal Behaviour, 123:329–338. [veronika.zeus@gmail.com]

CONSERVATION

Dekeukeleire, D., R. Janssen, A.-J. Haarsma, T. Bosch, and J. Van Schaik. 2016. Swarming behaviour, catchment area and seasonal movement patterns of the Bechstein's bats: implications for conservation. Acta Chiropterologia, 18: 349–358. [daan.dekeukeleire@gmail.com]

Dool, S. E., S. J. Puechmaille, C. Kelleher, K. McAney, and E. C. Teeling. 2016. The effects of human-mediated habitat fragmentation on a sedentary woodland-associated species (*Rhinolophus hipposideros*) at its range margin. Acta Chiropterologia, 18: 377–393. [serena.dool@gmail.com]

Dos Santos, A. J., T. B. Vieira, and K. de Cassia Faria. 2016. Effects of vegetation structure on the diversity of bats in remnants of Brazilian Cerrado savanna. Basic and Applied Ecology, 17:720–730. [karinafaria@unemat.br]

Furey, N. M., T. Whitten, J. Cappelle, and P. A. Racey. 2016. The conservation status of Cambodian cave bats. Pp. 82–95 *in* M. Laumanns (Ed.). International Speleological Project to Cambodia (Provinces of Stoeng Treng, Kampong Speu, Banteay Meanchey, and Battambang). Berliner Hohlenkundliche Berichte, 64:1–97 pp. [available by going to http://www.speleo-berlin.de/en_publikationen.php]

Kirkpatrick, L., S. J. Maher, Z. Lopez, P. R. Lintott, S. A. Bailey, D. Dent, and K. J. Park. 2017. Bat use of commercial coniferous plantations at multiple spatial scales: management and conservation implications. Biological Conservation, 206:1–10. [lucinda.kirkpatrick@stir.ac.uk]

Lintott, P. R., S. M. Richardson, D. J. Hosken, S. A. Fensome, and F. Mathews. 2016. Ecological impact assessments fail to reduce risk of bat casualties at wind farms. Current Biology, 26:R1135–R1136. [F.Mathews@exeter.ac.uk]

Monadjem, A., L. Richards, and C. Denys. 2016. An African bat hotspot: the exceptional importance of Mount Nimba for bat diversity. Acta Chiropterologia, 18: 359–375. [ara@uniswa.sz]

Raharfmfhaja, T. E. A., J. L.M. Rakotoarfson, P. A. Racey, and R. A. Andrfanafvoarfvelo. 2016. A comparison of the effectiveness of methods of deterring pteropodid bats from feeding on commercial fruit in Madagascar. Journal of Threatened Taxa, 8:9512–9524. [p.a.racey@exeter.ac.uk]

Uhrin, M., P. Benda, and P. Kaňuch. 2017. Different responses of attic-dwelling bat species to landscape naturalness. Mammalian Biology, 82:48–56. [kanuch@netopiere.sk]

Waring, S. D., and E. A. Essah. 2016. Morphometric analysis of body and claw dimensions of building dwelling UK bat species: to aid knowledge of bat interactions with roosting surfaces. Acta Chiropterologia, 18:527–534. [s.d.waring@reading.ac.uk]

DISTRIBUTION/FAUNAL STUDIES

González-Terrazas, T. P., L. R. Víquez, A. Ibarra-Macías, A. T. Ruíz, L. Torres-Knoop, K. Jung, M. Tschapka, and R. A. Medellín. 2016. New records and range extension of *Promops centralis* (Chiroptera:Molossidae). Revista Mexicana de Biodiversidad, 87:1407–1411. [tania.gonzalez@uni-ulm.de]

Tiunov, M. P. 2016. Changes in the fauna of bats in the south of the Russian Far East since the late Pleistocene. Quaternary International, 425:464–468. [tiunov@ibss.dvo.ru]

ECHOLOCATION

Hase, K., T. Miyamoto, K. I. Kobayasi, and S. Hiryu. 2016. Rapid frequency control of sonar sounds by the FM bat, *Miniopterus fuliginosus*, in response to spectral overlap. Behavioural Processes, 128: 125–133. [shiryu@mail.doshisha.ac.jp]

He, W., J. Feng, and L. Gao. 2016. Numerical study of lancet furrows dynamics behaviour in Greater Horseshoe bats. Optik — International Journal for Light and Electron Optics, 127:11840–11844. [jxfeng2016@gmail.com]

ECOLOGY

Amaral, T. S., L. M. Macário and L. M. De Souza Aguiar. 2016. Testing the coexistence of *Artibeus lituratus* and *A. planirostris* in a Neotropical savanna. Acta Chiropterologia, 18:441–449. [amaral.thales@gmail.com]

Cordero-Schmidt, E., M. Medeiros-Guimarães, J. C. Vargas-Mena, B. Carvalho, R. L. Ferreira, B. Rodriguez-Herrera, and E. M. Venticinque. 2016. Are leaves a good option in Caatinga's menu? First record of folivory in *Artibeus planirostris* (Phyllostomidae) in the semiarid forest, Brazil. Acta Chiropterologia, 18:489–497. [ecordero.s@gmail.com]

Downs, N. C., W. J. Cresswell, P. Reason, G. Sutton, D. Wells, and S. Wray. 2016. Sex-specific habitat preferences of foraging and commuting Lesser Horseshoe bats

Rhinolophus hipposideros (Borkhausen, 1797) in lowland England. Acta Chiropterologia, 18:451–465. [nick.downs@arcadis.com]

Hintze, F., V. Duro, J. C. Carvalho, C. Eira, P. C. Rodrigues, and J. Vingada. 2016. Influence of reservoirs created by small dams on the activity of bats. Acta Chiropterologia, 18:295–408. [fredhintze@gmail.com]

Istvanko, D. R., T. S. Risch, and V. Rolland. 2016. Sex-specific foraging habits and roost characteristics of *Nycticeius humeralis* in north-central Arkansas. Journal of Mammalogy, 97:1336–1344. [vrolland@astate.edu]

Ito, F., E. Bernard, and R. A. Torres. 2016. What is for dinner? First report of human blood in the diet of the Hairy-legged Vampire bat *Diphylla ecaudata*. Acta Chiropterologia, 18:509–515. [enrico.bernard@ufpe.br]

López-Baucells, A., L. Casanova, X. Puig-Montserrat, A. Espinal, F. Páramo, and C. Flaquer. 2017. Evaluating the use of *Myotis daubentonii* as an ecological indicator in Mediterranean riparian habitats. Ecological Indicators, 74:19–27. [adria.baucells@gmail.com]

López-González, C., A. Lozano, E. P. Gómez-Ruiz, and R. López-Wilchis. 2016. Activity of insectivorous bats is related to water availability in a highly modified Mexican temperate forest. Acta Chiropterologia, 18:409–421. [celialg@prodigy.net.mx]

Münzer, O. M., B. A. Schaetz, and A. Kurta. 2016. Consumption of insect pests by the Evening Bat (*Nycticeius humeralis*) in southeastern Michigan. The Great Lakes Entomologist, 49:36–40. [Liefvir@yahoo.com]

Münzer, O. M., B. A. Schaetz, and A. Kurta. 2016. Diet of a Nearctic species, the Evening Bat (*Nycticeius humeralis*), at the northern edge of its range. Acta Chiropterologia, 18:499–508. [Liefvir@yahoo.com]

Rachwald, A., T. Bradford, Z. Borowski, and P. A. Racey. 2016. Habitat preferences of soprano pipistrelle *Pipistrellus pygmaeus* (Leach, 1825) and common pipistrelle *Pipistrellus pipistrellus* (Schreiber, 1774) in two different woodlands in north east Scotland. Zoological Studies, 55:22. doi:10.6620/ZS.2016.55–22

Razafimanahaka, J. H., M. Ralisata, F. Randrianandrianina, R. K. B. Jenkins, J. Ratsirarson, and P. A. Racey. 2016. Habitat use by the endemic Malagasy bat *Hipposideros commersoni* in a littoral forest. Acta Chiropterologia, 18:423–431. [p.a.racey@exeter.ac.uk]

Voss, R. S., D. W. Fleck, R. E. Strauss, P. M. Velazco, and N. B. Simmons. 2016. Roosting ecology of Amazonian bats: evidence for guild structure in hyperdiverse mammalian communities. American Museum Novitates no. 3870, 1–43. [available online at http://digitallibrary.amnh.org/handle/2246/6694]

FLIGHT

[Anonymous.] 2016. Bats smash bird flight speed record. New Scientist, 232 (3099) (12 November issue), p. 15.

NATURAL HISTORY

Ing, R. K., R. Colombo, G.-C. Gembu, Y. Bas, J.-F. Julien, Y. Gager, and A. Hassanin. 2016. Echolocation calls and flight behaviour of the elusive Pied Butterfly Bat (*Glauconycteris superba*), and new data on its morphology and ecology. Acta

Chiropterologia, 18:477–488. [hassanin@mnhn.fr]

NEUROSCIENCE

Finkelstein, A., L. Las, and N. Ulanovsky. 2016. 3-D maps and compasses in the brain. Annual Review of Neuroscience, 39:171–196. [nachum.ulanovsky@weizmann.ac.il]

Geva-Sagiv, M., S. Romani, L. Las, and N. Ulanovsky. 2016. Hippocampal global remapping for different sensory modalities in flying bats. Nature Neuroscience, 19:952-958. [nachum.ulanovsky@weizmann.ac.il]

PARASITOLOGY

Da Costa, A. P., P. H. Nunes, B. H. S. Leite, J. I. G. da S. Ferreira, R. Tonhosolo, A. R. da Rosa, P. A. da Rocha, C. C. Aires, S. M. Gennari, and A. Marcili. 2016. Diversity of bats trypanosomes in hydroeletric [sic] area of Belo Monte in Brazilian Amazonia. Acta Tropica, 164:185–193. [amarcili@usp.br]

Herrera M., L. G., S. Ortega-García, J. B. Morales-Malacara, J. J. Flores-Martínez, G. López-Ortega, and A. D. Richman. 2016. Geographical and seasonal patterns of spleen mass and Acarine load in tropical and subtropical Leaf-nosed bats. Acta Chiropterologia, 18:517–526. [gherrera@ib.unam.mx]

Hodo, C. L., C. C. Goodwin, B. C. Mayes, J. A. Mariscal, K. A. Waldrup, and S. A. Hamer. 2016. Trypanosome species, including *Trypanosoma cruzi*, in sylvatic and peridomestic bats of Texas, USA. Acta Tropica, 164:259–266. [shamer@cvm.tamu.edu]

Tahir, D., C. Socolovschi, J.-L. Marié, G. Ganay, J.-M. Berenger, J.-M. Bompar, D. Blanchet, M. Cheuret, O. Mediannikov, D. Raoult, B. Davoust, and P. Parola. 2016. New *Rickettsia* species in soft ticks *Ornithodoros hasei* collected from bats in French Guiana. Ticks and Tick-borne Diseases, 7:1089–1096. [bernard.davoust@gmail.com]

PALEONTOLOGY

Cleary, D. M., B. P. Onac, F. L. Forray, and J. G. Wynn. 2016. Effect of diet, anthropogenic activity, and climate on δ15N values of cave bat guano. Paleogeography, Paleoclimatology, Palaeoecology, 461:87–97. [bonac@usf.edu]

PHYSIOLOGY/ENERGETICS

Bartonička, T., H. Bandouchova, H. Berková, J. Blažek, R. Lučan, I. Horáček, N. Martínková, J. Pikula, Z. Řehák, and J. Zukal. 2017. Deeply torpid bats can change position without elevation of body temperature. Journal of Thermal Biology, 63:119–123. [bartonic@sci.muni.cz]

Boyles, J. G., L. P. McGuire, E. Boyles, J. P. Reimer, C. A. C. Brooks, R. W. Rutherford, T. A. Rutherford, J. O. Whitaker Jr., and G. F. McCracken. 2016. Physiological and behavioral adaptations in bats living at high latitudes. Physiology & Behavior, 165:322–327. [jgboyles@siu.edu]

Farina, A., L. Fusi, A. Fasano, A. Ceretani, and F. Rosso. 2016. Modeling peristaltic flow in vessels equipped with valves: implications for vasomotion in bat wing venules. International Journal of Engineering Science, 107:1–12. [fusi@math.unifi.it]

TAXONOMY/SYSTEMATICS/ PHYLOGENETICS

Ammerman, L. K., D. N. Lee, and R. S. Pfau. 2016. Patterns of genetic divergence among *Myotis californicus*, *M. ciliolabrum*, and *M. leibii* based on amplified fragment length

polymorphism. Acta Chiropterologia, 18:337–347. [loren.ammerman@angelo.edu]

Benda, P., A. Reiter, M. Uhrin, and Z. Varadínová. 2016. A new species of pipistrelle bat (Chiroptera: Vespertilionidae) from southern Arabia. Acta Chiropterologica, 18:301–323. [petr_benda@nm.cz]

Russell, A. L., V. A. Brown, R. C. B. Utzurrum, A. P. Brooke, L. A. Wolf, and G. F. McCracken. 2016. Comparative phylogeography of *Pteropus samoensis* and *P. tonganus* (Pteropodidae: Chiroptera) in the South Pacific. Acta Chiropterologia, 18:325–335. [russelam@gvsu.edu]

TECHNIQUES FOR STUDY

Fisher-Phelps, M., D. Schwilk, and T. Kingston. 2017. Mobile acoustic transects detect more bat activity than stationary acoustic point counts in a semi-arid and agricultural landscape. Journal of Arid Environments, 136:38–44. [m.fisher-phelps@ttu.edu]

VIROLOGY

Arai, S., S. Taniguchi, K. Aoki, Y. Yoshikawa, S. Kyuwa, K. Tanaka-Taya, J. S. Masangkay, T. Omatsu, R. Puentespina Jr., S. Watanabe, P. Alviola, J. Alvarez, E. Eres, E. Cosico, M. N. R. M. Quibod, S. Morikawa, R. Yanagihara, and K. Oishi. 2016. Molecular phylogeny of a genetically divergent hantavirus harbored by the Geoffroy's Rousette (*Rousettus amplexicaudatus*), a frugivorous bat species in the Philippines. Infection, Genetics and Evolution, 45:26–32. [arais@nih.go.jp]

Bányai, K., G. Kemenesi, I. Budinski, F. Földes, B. Zana, S. Marton, R. Varga-Kugler, M. Oldal, K. Kurucz, and F. Jakab. 2017. Candidate new rotavirus species in Schreiber's bats, Serbia. Infection, Genetics, and Evolution, 48:19–26. [bkrota@hotmail.com]

Góes, L., G., B., A. C. de Almeida Campos, C. de Carvalho, G. Ambar, L. H. Queiroz, A. P. Cruz-Neto, M. Munir, and E. L. Durigon. 2016. Genetic diversity of bats coronaviruses in the Atlantic Forest hotspot biome, Brazil. Infection, Genetics and Evolution, 44:510–513. [lgbgoes@usp.br]

Hassanin, A., N. Nesi, J. Marin, B. Kadjo, X. Pourrut, E. Leroy, G.-C. Gembu, P. Musaba Akawa, C. Ngoagouni, E. Nakouné, M. Ruedi, D. Tshikung, C. Pongombo Shongo, and C. Bonillo. 2016. Comparative phylogeography of African fruit bats (Chiroptera, Pteropodidae) provide new insights into the outbreak of Ebola virus disease in West Africa, 2014–2016. Comptes Rendus Biologies, 339:517–528. [hassanin@mnhn.fr]

Held, J., M. Gmeiner, B. Mordmüller, P.-B. Matsiégui, J. Schaer, I. Eckerle, N. Weber, K. Matuschewski, S. Bletz, and F. Schaumburg. 2017. Bats are rare reservoirs of *Staphylococcus aureus* complex in Gabon. Infection, Genetics, and Evolution, 47:118–120. [frieder.schaumburg@ukmuenster.de]

Lacroix, A., V. Duong, V. Hul, S. San, H. Davun, K. Omaliss, S. Chea, A. Hassanin, W. Theppangna, S. Silithammavong, K. Khammavong, S. Singhalath, Z. Greatorex, A. E. Fine, T. Goldstein, S. Olson, D. O. Joly, L. Keatts, P. Dussart, A. Afelt, R. Frutos, and P. Buchy. 2017. Genetic diversity of coronaviruses in bats in Lao PDR and Cambodia. Infection, Genetics, and Evolution, 48:10–18. [buchyphilippe@hotmail.com]

Li, Q., F. Lu, C. Dai, M. Fan, W. Wang, and K. Wang. 2017. Simulating the potential role of media coverage and infected bats in the

2014 Ebola outbreak. Journal of Theoretical Biology, 412:123–129. [kfwang72@163.com]

Stading, B. R., J. E. Osorio, A. Velasco-Villa, M. Smotherman, B. Kingstad-Bakke, and T. E. Rocke. 2016. Infectivity of attenuated poxvirus vaccine vectors and immunogenicity of a raccoonpox vectored rabies vaccine in the Brazilian Free-tailed Bat (*Tadarida brasiliensis*). Vaccine, 34:5352–5358. [stading@wisc.edu]

ANNOUNCEMENTS

Multidisciplinary Project: Ensemble of the Acoustic Reference Library for Mexican Insectivorous Bats

A group of Mexican researchers, specializing in bats studies, have begun the multidisciplinary project 'Ensemble of the acoustic reference library for Mexican insectivorous bats'. The main objective of this project is to create the first reference library for bat echolocation calls in a megadiverse country and one of the richest on bat species. The project includes a systematic and homogeneous data collection, covering a wide range of intra- and inter-specific call variation of the insectivorous bats distributed in Mexico. The data will also have an adequate representation of the great environmental heterogeneity found in the country. The project also focuses on human resources training about bat sampling techniques, echolocation call recording strategies and sound analysis. The information collected will be free access and will set the foundation to develop an automatic classification tool, also free use. The call library and classification tools will facilitate the development of regional and national acoustic bat monitoring programs. The project is funded by the National Commission for the Knowledge and Use of Biodiversity (CONABIO), and it is administered by the Mexican Association of Mammalogy (AMMAC). For further information on this initiative please contact Dr. Miguel Briones (miguelbrionessalas@hotmail.com), Dr. Cristina Mac Swiney (cmacswiney@uv.mx), or Dr. Verónica Zamora (zamora.gtz@gmail.com).

Reminder—Renewal Time!

Just a reminder that this is the last issue of the 2016 series of *Bat Research News*. That means some of you will be receiving renewal information in the inbox of your e-mail fairly soon. I hope you will continue to support *BRN* for the 2017 volume-year. Regardless, all of us at *Bat Research News* wish you a safe and happy 2017!

Request for News

Please consider submitting news from your lab group, your field work, or any bat-related news. Thank you in advance for considering us as a place for bat, bat worker, and bat lab news items.

Request for Manuscripts — *Bat Research News*

Original research/speculative review articles, short to moderate length, on a bat-related topic would be most welcomed. Please submit manuscripts as .rtf documents to Allen Kurta, Editor for Feature Articles (akurta@emich.edu). Also please consider submitting short articles, notes, or letters on a bat-related topic. If you have questions, please contact Al. Thank you for considering submitting your work to *BRN*.

Change of Address Requested

Will you be moving in the near future? If so, please **send** your **new postal and e-mail addresses** to Margaret Griffiths (margaret.griffiths01@gmail.com), and include the date on which the change will become effective. Thank you in advance for helping us out!

FUTURE MEETINGS and EVENTS

2017

The 14th European Bat Research Symposium will be held 1–5 August 2017, in Donostia – The Basque Country. Please see http://ebrs2017.eus/ for more information.

The 47th Annual NASBR will be held October 18–21, 2017, in Knoxville, Tennessee. Check the NASBR website for future updates — http://www.nasbr.org/.

2018

The 48th Annual NASBR will be held October 24–27, 2018, in Puerto Vallarta, Mexico. Check the NASBR website for future updates — http://www.nasbr.org/.

Australian Bat Conference 2018 venue and dates to be announced.