BAT RESEARCH NEWS

VOLUME 59: NO. 1 SPRING 2018

BAT RESEARCH NEWS

VOLUME 59: NUMBER 1 **SPRING 2018**

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Front Cover

An unidentified small fruit bat feeding on a fig (*Ficus* sp.) under low vegetation during a heavy downpour. The bat shows nicely the natural feeding posture of a roosting frugivore, and the photo was taken at the Firestone Center for Restoration Ecology in Barú, Costa Rica, by Keith Christenson. Thank you once again, Keith!

BAT RESEARCH NEWS

Volume 59: Number 1 Spring 2018

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).

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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 e-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

Meierhofer, M. B., and K. D. Demere. 2017. Leucism in two tri-colored bats (*Perimyotis subflavus*) in Texas. Southeastern Naturalist, 16: N43–N45. [melissa.meierhofer@ag.tamu.edu]

Zortéa, M., and M. C. Silva. 2018. Albinism in the striped spear-nosed bat *Gardnerycteris crenulatum* (Chiroptera: Phyllostomidae) with an updated list of albino bats in the World. Mammalia, 82(1): 78–84. [mzortea@uol.com.br]

BEHAVIOR

Barros, P. A., C. Ribeiro, and J. A. Cabral. 2017. Winter activity of bats in Mediterranean peri-urban deciduous forests. Acta Chiropterologica, 19: 367–377. [pbarros@utad.pt]

Doss D., P. S., and V. Nagarajan-Radha. 2017. Male resource defence behaviour strengthens harem size in promiscuously mating fruit bats. Acta Chiropterologica, 19: 329–336. [chiropteranethology@gmail.com]

Jones, P. L., F. Hämsch, R. A Page, E. K. V. Kalko, and M. T. O'Mara. 2017. Foraging and roosting behaviour of the fringe-lipped bat, *Trachops cirrhosus*, on Barro Colorado Island, Panamá. Acta Chiropterologica, 19: 337–346. [pjones3@bowdoin.edu]

CONSERVATION

Becker, D. J., M. M. Chumchal, H. G. Broders, J. M. Korstian, E. L. Clare, T. R. Rainwater, S. G. Platt, N. B. Simmons, and M. B. Fenton. 2018. Mercury bioaccumulation in bats reflects dietary connectivity to aquatic food webs. Environmental Pollution, 233: 1076–1085. [dbecker@uga.edu]

Braun de Torrez, E. C., H. K. Ober, and R. A. McCleery. 2018. Critically imperiled forest fragment supports bat diversity and activity within a subtropical grassland. Journal of Mammalogy, 99: 273–282. [ecbraun@ufl.edu]

Chételat, J., M. B. C. Hickey, A. J. Poulain, A. Dastoor, A. Ryjkov, D. McAlpine, K. Vanderwolf, T. S. Jung, L. Hale, E. L. L. Cooke, D. Hobson, K. Jonasson, L. Kaupas, S. McCarthy, C. McClelland, D. Morningstar, K. J. O. Norquay, R. Novy, D. Player, T. Redford, A.

Simard, S. Stamler, Q. M. R.Webber, E. Yumvihoze, and M. Zanuttig. 2018. Spatial variation of mercury bioaccumulation in bats of Canada linked to atmospheric mercury deposition. Science of the Total Environment, 626: 668–677. [john.chetelat@canada.ca]

Gottwald, J., T. Appelhans, F. Adorf, J. Hillen, and T. Nauss. 2017. High-resolution MaxEnt modelling of habitat suitability for maternity colonies of the Barbastelle bat *Barbastella barbastellus* (Schreber, 1774) in Rhineland-Palatinate, Germany. Acta Chiropterologica, 19: 389–398. [jannis.gottwald@gmx.de]

Jacomassa, F., S. Pacheco, J. Miranda, and K. P. A. des Oliveira. 2018. Bats found entangled in natural and artificial traps. Mammalia, 82(1): 65–67. [fabioafj@gmail.com]

Kerbiriou, C., C. Azam, J. Touroult, J. Marmet, J.-F. Julien, and V. Pellissier. 2018. Common bats are more abundant within Natura 2000 areas. Biological Conservation, 217: 66–74. [christian.kerbiriou@mnhn.fr]

Kumar, A., T. J. Divoll, P. M. Ganguli, F. A. Trama, and C. H. Lamborg. 2018. Presence of artisanal gold mining predicts mercury bioaccumulation in five genera of bats (Chiroptera). Environmental Pollution, 236: 862–870. [akumar@iie.org]

Monck-Whipp, L., A. E. Martin, C. M. Francis, and L. Fahrig. 2018. Farmland heterogeneity benefits bats in agricultural landscapes. Agriculture, Ecosystems and Environment, 253: 131–139. [liv.monck.whipp@gmail.com]

Torres-Flores, J. W., and A. Santos-Moreno. 2017. Inventory, features, and protection of underground roosts used by bats in Mexico. Acta Chiropterologica, 19: 439–454. [asantosm90@hotmail.com]

DISEASE

Hazeleger, W. C., W. F. Jacobs-Reitsma, P. H. C. Lina, A. G. de Boer, T. Bosch, A. H. A. M. van Hoek, and R. R. Beumer. 2018. Wild, insectivorous bats might be carriers of *Campylobacter* spp. PLoS ONE, 13(1): e0190647. [Wilma.Hazeleger@wur.nl]

DISTRIBUTION/FAUNAL STUDIES

Aulagnier, S., F. Cuzin, and M. Thévenot (Eds.). 2018. Mammiferes Sauvages du Maroc — Peuplement, Repartition, Ecologie. **Book Order** to: S.F.E.P.M., c/o Comportement et Ecologie de la Faune Sauvage I.N.R.A., CS 52627, 31326 Castanet Tolosan cedex, France. [stepm@laposte.net]

Téllez, H. L. A., L. I. Iñiguez-Dávalos, M. Olvera-Vargas, J. A. Vargas-Contreras, and O. A. Herrera-Lizaola. 2018. Bats associated to caves in Jalisco, Mexico. Therya, 9: 29–40. [liniguez@cucsur.udg.mx]

Duya, M. R., J. Fidelino, and P. Ong. 2017. Spatial heterogeneity of fruit bats in a primary tropical lowland evergreen rainforest in northeastern Luzon, Philippines. Acta Chiropterologica, 19: 305–318. [mrduya@gmail.com]

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Pérez-Consuegra, S., J. Patton, E. Vázquez-Domínguez, J. E. López, R. Barahona, E. J. Ordóñez-sayle, and J. A. Nicolle. 2018. Distributional extensions of *Carollia castanea* and *Micronycteris minuta* from Guatemala, Central America. Mammalia, 82(1): 72–77. [sergiogperezc@gmail.com]

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Srinivasulu, C., A. Srinivasulu, B. Srinivasulu, A. Gopi, T. H. Dar, P. J. J. Bates, S. J. Rossiter, and G. Jones. 2017. Recent surveys of bats from the Andaman Islands, India: diversity, distribution, and echolocation characteristics. Acta Chiropterologica, 19: 419–437. [chelmalasrinivasulu@gmail.com]

Widerin, K., and G. Reiter. 2017. Bat activity at high altitudes in the Central Alps, Europe. Acta Chiropterologica, 19: 379–387. [karin.widerin@fledermausschutz.at]

ECHOLOCATION

Mac Aodha, O., R. Gibb, K. E. Barlow, E. Browning, M. Firman, R. Freeman R, B. Harder, L. Kinsey, G. R. Mead, S. E. Newson, I. Pandourski, S. Parsons, J. Russ, A. Szodoray-Paradi, F. Szodoray-Paradi, E. Tilova, M. Girolami, G. Brostow, and K. E. Jones. 2018. Bat detective — Deep learning tools for bat acoustic signal detection. PLoS Computational Biology, 14(3): e1005995. (20 pp.) [o.macaodha@cs.ucl.ac.uk]

ECOLOGY

Morales-Martínez, D. M., M. E. Rodríguez-Posada, C. Fernández-Rodríguez, M. C. Calderón-Capote, and D. R. Gutiérrez-Sanabria. 2018. Spatial variation of bat diversity between three floodplain-savanna ecosystems of the Colombian Llanos. Therya, 9: 41–52. [dmmoralesm@unal.edu.co]

Nkrumah, E. E., E. K. Badu, H. J. Baldwin, P. Anti, S. M. Klose, P. Vallo, C. Drosten, E. K. V. Kalko, S. K. Oppong, and M. Tschapka. 2017. Flight activity of Noack's round-leaf bat (*Hipposideros* cf. *ruber*) at two caves in central Ghana, West Africa. Acta Chiropterologica, 19: 347–355. [evansewald@gmail.com]

Silveira, M., W. M. Tomas, E. Fischer, and M. O. Bordignon. 2018. Habitat occupancy by *Artibeus planirostris* bats in the Pantanal wetland, Brazil. Mammalian Biology 91: 1–6. [mausilv@gmail.com]

Taylor, P. J., E. Matamba, J. N. (K.) Steyn, T. Nangammbi, M. L. Zepeda-Mendoza, and K. Bohmann. 2017. Diet determined by next generation sequencing reveals pest consumption and opportunistic foraging by bats in Macadamia orchards in South Africa. Acta Chiropterologica, 19: 239–254. [Peter.Taylor@univen.ac.za]

Todd, V. L. G., and D. A. Waters. 2017. Small scale habitat preferences of *Myotis daubentonii*, *Pipistrellus pipistrellus*, and potential aerial prey in an upland river valley. Acta Chiropterologica, 19: 255–272. [vt@osc.co.uk]

FLIGHT

Sterbing, S. J., and C. F. Moss. 2018. Comparative analysis of the distribution and morphology of tactile hairs on the wing membrane of four bat species. Journal of Mammalogy, 99: 124–130. [ssterbil@jhu.edu]

IMMUNOLOGY

Hernández-Arciga, U., L. Gerardo-Herrera M., A. Ibáñez-Contreras, R. U. Miranda-Labra, J. J. Flores-Martínez, and M. Königsberg. 2018. Baseline and post-stress seasonal changes in immunocompetence and redox state maintenance in the fishing bat *Myotis vivesi*. PLOS ONE 28 pp.| PLoS ONE, 13(1): e0190047 [herarc_ula9@hotmail.com]

Kacprzyk, J., G. M. Hughes, E. M. Palsson-McDermott, S. R. Quinn, S. J. Puechmaille, L. A. J. O'Neill, and E. C. Teeling. 2018. A potent anti-inflammatory response in bat macrophages may be linked to extended longevity and viral tolerance. Acta Chiropterologica, 19: 219–228. [emma.teeling@ucd.ie]

MIGRATION AND HOMING

Bologna, S., M. V. Mazzamuto, A. Molinari, S. Mazzaracca, M. Spada, L. A. Wauters, D. Preatoni, and A. Martinoli. 2018. Recapture of a banded Bechstein's bat (Chiroptera, Vespertilionidae) after 16 years: An example of high swarming site fidelity. Mammalian Biology, 91: 7–9. [prea@uninsubria.it]

Stumpf, M., F. Meier, L. Grosche, T. K. Halczok, J. Van Schaik, and G. Kerth. 2017. How do young bats find suitable swarming and hibernation sites? Assessing the plausibility of the maternal guidance hypothesis using genetic maternity assignment for two European bat species. Acta Chiropterologica, 19: 319–327. [gerald.kerth@uni-greifswald.de]

NATURAL HISTORY

Cordero-Schmidt, E., E. Barbier, J. C. Vargas-Mena, P. P. Oliveira, F. De Assis R. Santos, R. A. Medellín, B. R. Herrera, and E. M. Venticinque. 2017. Natural history of the Caatinga endemic Vieira's flower bat, *Xeronycteris vieirai*. Acta Chiropterologica, 19: 399–408. [ecordero.s@gmail.com]

PALEONTOLOGY

Hadler, P., E. L. Mayer, F. Motta, and A. M. Ribeiro. 2018. Fossil bats from the Quaternary of Serra da Capivara, northeast Brazil. Quaternary International, 464 (Part B): 411–416. [patricia.hadler@cfh.ufsc.br]

PARASITOLOGY

Falconaro, A. C., R. M. Vega, and G. P. Viozzi. 2018. Helminth communities of two populations of *Myotis chiloensis* (Chiroptera: Vespertilionidae) from Argentinean Patagonia. IJP: Parasites and Wildlife, 7: 27–33. [anto.falconaro@gmail.com]

Lourenço, J. L. M., T. T. C. Minuzzi-Souza, L. R. Silva, A. C. Oliveira, V. J. Mendonça, N. Nitz, L. M. S. Aguiar, and R. Gurgel-Gonçalves. 2018. Morphometric variability in *Artibeus planirostris* (Chiroptera: Phyllostomidae) in environments with different states of conservation in the Atlantic Forest, Brazil. Acta Tropica, 177: 200–206. [rgurgel@unb.br]

Rajemison, F. I., O. S. Noroalintseheno Lalarivoniaina, A. Andrianarimisa, and S. M. Goodman. 2017. Host-parasite relationships between a Malagasy fruit bat (Pteropodidae) and associated bat fly (Diptera: Nycteribiidae): Seasonal variation of host body condition and the possible impact of parasite abundance. Acta Chiropterologica, 19: 229–238. [iharantsoa.faneva@gmail.com]

Salinas-Ramos, V., A. Zaldívar-Riverón, A. Rebollo-Hernández, and L. G. Herrera-M. 2018. Seasonal variation of bat-flies (Diptera: Streblidae) in four bat species from a tropical dry forest. Mammalia, 82(2): 133–143. [airelav2@hotmail.com]

PHYSIOLOGY

Antonova, E., V. Ilyukha, S. Sergina, E. Khizhkin, V. Belkin, A. Yakimova, and A. Morozov. 2017. Antioxidant defenses in three vesper bats (Chiroptera: Vespertilionidae) during hibernation. Turkish Journal of Zoology, 41: 1005–1009. [antonova88ep@mail.ru]

REPRODUCTION

García-Ruiz, I., M. Machado, M. Á. Monsalve, and J. S. Monrós. 2017. Phenology of emergence by Mediterranean sympatric cave-dwelling bats during their breeding period. Acta Chiropterologica, 19: 357–365. [igaru.13@gmail.com]

TAXONOMY/SYSTEMATICS/PHYLOGENETICS

Calderon-Acevedo, C. A., and N. C. Muchhala. 2018. Identification and diagnosis of *Anoura fistulata* with remarks on its presumed presence in Bolivia. Journal of Mammalogy, 99: 131–137. [camilo.calderon@umsl.edu]

Loumassine, H., B. Allegrini, F. Bounaceur, O. Peyre, and S. Aulagnier. 2018. A new mammal species for Algeria, *Rhinopoma microphyllum* (Chiroptera: Rhinopomatidae): morphological and acoustic identification. Mammalia, 82(1): 85–88. [loumassine_bouz@hotmail.fr]

Loureiro, L. O., B. K. Lim, and M. D. Engstrom. 2018. A new species of mastiff bat (Chiroptera, Molossidae, *Molossus*) from Guyana and Ecuador. Mammalian Biology, 90: 10–21. [livia.loureiro@mail.utoronto.ca]

Moras, L. M., R. Gregorin, T. Sattler, and V. da C. Tavares. 2018. Uncovering the diversity of dog-faced bats of the genus *Cynomops* (Chiroptera: Molossidae), with the redescription of *C. milleri* and the description of two new species. Mammalian Biology, 89: 37–51. [ligiane.moras@izabelahendrix.metodista.br]

Ruedi, M., J. L. Eger, B. K. Lim, and G. Csorba. 2018. A new genus and species of vespertilionid bat from the Indomalayan region. Journal of Mammalogy, 99: 209–222. [manuel.ruedi@ville-ge.ch]

TECHNIQUES FOR STUDYING BATS

Silva, C. R., and E. Bernard. 2017. Bioacoustics as an important complementary tool in bat inventories in the Caatinga drylands of Brazil. Acta Chiropterologica, 19: 409–418. [enrico.bernard@ufpe.br]

VIROLOGY

Banerjee, A., V. Misra, T. Schountz, and M. L. Baker. 2018. Tools to study pathogen-host interactions in bats. Virus Research, 248: 5–12. [michelle.baker@csiro.au]

Bourgarel, M., D. M. Pfukenyi, V. Boué, L. Talignani, N. Chiweshe, F. Diop, A. Caron, G. Matope, D. Missé, and F. Liégeois. 2018. Circulation of *Alphacoronavirus*, *Betacoronavirus* and *Paramyxovirus* in *Hipposideros* bat species in Zimbabwe. Infection, Genetics and Evolution, 58: 253–257. [florian.liegeois@ird.fr]

Kohl, C., M. Tachedjian, S. Todd, P. Monaghan, V. Boyd, G. A. Marsh, G. Crameri, H. Field, A. Kurth, I. Smith, and L.-F. Wang. 2018. Hervey virus: Study on co-circulation with Henipaviruses in Pteropid bats within their distribution range from Australia to Africa. PLoS ONE, 13(2): e0191933. [Ina.Smith@csiro.au]

McElhinnery, L. M., D. A. Marston, E. L. Wise, C. M. Freuling, H. Bourhy, R. Zanoni, T. Moldal, E. A. Kooi, A. Neubauer-Juric, T. Nokireki, T. Müller, and A. R. Fooks. 2018. Molecular epidemiology and evolution of European bat Lyssavirus 2. International Journal of Molecular Sciences, 19, 156: doi:10.3390/ijms19010156. [Lorraine.mcelhinney@apha.gsi.gov.uk]

Subudhi, S., N. Rapin, N. Dorville, J. E. Hill, J. Town, C. K. R. Willis, T. K. Bollinger, and V. Misra. 2018. Isolation, characterization and prevalence of a novel Gammaherpesvirus in *Eptesicus fuscus*, the North American big brown bat. Virology, 516: 227–238. [vikram.misra@usask.ca]

BOOKS RECEIVED FOR REVIEW

Please indicate your willingness to review one or more of the following for *Bat Research News* by e-mailing Tom Griffiths at thomas.alan.griffiths@gmail.com.

- Perrow, M. (Ed). 2017. Wildlife and Wind Farms: Conflict and Solutions. Vol. 1 Onshore: Potential Effects. Pelagic Publishing, 298 pp. ISBN 9781784271190.

- Perrow, M. (Ed). 2017. Wildlife and Wind Farms: Conflict and Solutions. Vol. 2 Onshore: Monitoring and Mitigation. Pelagic Publishing, 227 pp. ISBN 9781784271237.

- López-Baucells, A., R. Rocha, P. Bobrowiec, E. Bernard, J. Palmeirim, and C. F. J. Meyer. 2018. Field Guide to the Bats of the Amazon. Pelagic Publishing, 176 pp. ISBN 9781784271657.

Preference will be given for reviewers with experience in the topic, but all reviewers will be considered. The review may be any length (within reason), and should follow the style currently used by the *Journal of Mammalogy* in their book reviews. The review should be sent electronically to me as an attachment (MSWord document) to an e-mail upon completion. I will then edit the review to bring it into the slightly different format used by *Bat Research News*. The review must be completed within four months of receiving the copy of the book, which I will send to you. You may keep the book.

Thank you,

Tom Griffiths, Editor for Recent Literature

CONTRIBUTORS SOUGHT FOR BOOK ON BIOSPELEOLOGY

Contributors are being sought for an upcoming book on biospeleology, tentatively entitled *Cave Life—Drivers of Diversity and Diversification*. The book aims to examine terrestrial and aquatic systems globally and auger into structural and climatic variables that are driving how life assembles and evolves underground. Work dealing with any cavernicolous taxon and ecological community will be considered. This project is on contract with NOVA Science Publishers and is slated to appear sometime in 2019.

If you would like to contribute a chapter, please contact:

Dr. J. Judson Wynne (Jut.Wynne@nau.edu)
Department of Biological Sciences
Merriam-Powell Center for Environmental Research
Northern Arizona University
Flagstaff, AZ 86011

ANNOUNCEMENTS

Reminder—Renewal Time!

Some of you have received renewal information for the 2018 volume-year of *Bat Research News*. I hope you will continue to support *BRN* for another year. Regardless, all of us at *Bat Research News* thank you for reading the 2018 Spring issue.

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

2018

The 2018 North American Joint Bat Working Group Meeting and the 28th Annual Mammal Colloquium will be held March 27–29, 2018, at the Hotel Roanoke, in Roanoke, Virginia. More information may be found at: https://donate.batconservation.org/roanoke/events/north-american-joint-bat-working-group-meeting/e147967.

The 2018 Australasian Bat Society Conference will be held 4–6 April 2018, at the Hawkesbury Institute for the Environment, Western Sydney University, Richmond, NSW, Australia. For information please go to: http://ausbats.org.au/2018-conference-agm/4594056506.

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

2019

The 49th Annual NASBR will be held 23–26 October 2019, in Kalamazoo, Michigan. Check the NASBR website for future updates — http://www.nasbr.org/.

2020

The 15th European Bat Research Symposium will be held 3–7 August 2020, in Turku, Finland. Please see http://www.batlife.info/meetings/ for updates and information.

The 50th Annual NASBR will be held in Tempe, Arizona, dates to be announced. Check the NASBR website for future updates — http://www.nasbr.org/.

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Front Cover

Cluster of hibernating *Myotis austroriparius* in a highway culvert. The photo was taken on 5 January 2018 in Warren County, Mississippi, by Chester Martin (see related article, page 25).

BAT RESEARCH NEWS

Volume 59: Number 2 Summer 2018

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Recent Migratory Movements of Gray Bats (*Myotis grisescens*) in Missouri: Potential to Spread *Pseudogymnoascus destructans*?

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Introduction

Knowledge of migration is critical for understanding conservation needs of a species and the potential impacts of disease on wildlife populations. Migration can lessen the effect of a disease on a population, by reducing exposure of healthy animals to infected individuals or to habitats where the disease vector abounds, or migration can increase the impact of a disease, by burdening an already sick individual with the added energetic costs of traveling. Furthermore, animals might contribute to the transmission of a disease by carrying pathogens with them as they migrate. White-nose syndrome (WNS) is an epizootic disease among North American bats that causes detrimental physiological and behavioral effects, often resulting in death (Verant et al., 2018). *Pseudogymnoascus destructans*, the fungus that causes WNS is transported to new areas mostly by migratory individuals and transferred to previously uninfected bats primarily via bat-to-bat contact (Verant et al., 2018).

The gray bat (*Myotis grisescens*) is an endangered species found in 15 midwestern and southeastern states (U.S. Fish and Wildlife Service, 2011), 14 of which have documented cases of white-nose syndrome (Whitenosesyndrome.org, 2018a). This migratory bat roosts only in caves or cave-like structures, including multiple subterranean locations during summer, transient sites along migration pathways, and typically other caves for hibernation (Elder and Gunier, 1978; Laval and Laval, 1980). Elliott (2008), for example, reported gray bats roosting in 219 caves in Missouri alone. Gray bats share roosts with at least seven other species that have been substantially impacted by WNS (Dzal et al., 2011; Thogmartin et al., 2012), and although the gray bat has shown symptoms of WNS, no mortality has been observed (Whitenosesyndrome.org, 2018b; U.S. Fish and Wildlife Service, 2012; S. Marquardt, in litt.). Herein, we report recent migratory movements of the gray bat in Missouri and adjoining states that suggest that this species is a likely vector for the rapid spread of WNS.

Methods

The Missouri Department of Conservation (MDC) began collecting data from biologists, who were capturing and banding bats in Missouri, as a condition of their state permit in 2011. Banding records prior to 2011 were requested from current and former holders of state permits and placed into a digital database. Information from banded bats that were initially captured in Missouri, but found

in the surrounding states of Arkansas, Illinois, Kansas, and Oklahoma, was supplied by personnel of various governmental agencies, and these records were also included in the database. Most banding was opportunistic and focused on individuals of federally threatened or endangered species that were caught at hibernacula, maternity roosts, and other summer sites. However, Gerdes (2016) conducted a more concentrated study of migratory patterns of gray bats in 2013–2015, banding at two above-ground and six subterranean locations in Missouri and one storm sewer in Kansas, whereas one of the authors (LWR) banded more than 200 gray bats at a site in Adair County, Oklahoma, during 2015–2016; information from these two studies also form part of the database. We used records in the database to determine straight-line migratory distances of gray bats and time between capture and recovery.

Results

From 25 August 2002 through 14 June 2016, 2,036 gray bats were banded at 75 sites (51 above-ground locations and 24 caves, mines, or sewers) in Kansas, Missouri, and Oklahoma. Most gray bats, 1,721 animals, were banded in Missouri; 101, in Kansas; and 214, in Oklahoma. Forty-seven bands (2.3%) were recovered at various sites across Missouri and Arkansas, although only one individual was recovered more than once (Appendix 1). Distance between sites of capture and recapture ranged from 0 to 253 km, with an average of 57 km. Time between banding and recovery ranged from 3 months to 7.4 years, with an average of 2.1 years.

Maximum distance traveled was by two gray bats migrating at least 253 km northeast from winter to summer sites within Missouri (Appendix 1). These bats were banded at the same hibernaculum (Coffin Cave, Laclede County) and recovered at the same maternity roost (Sodalis Nature Preserve, Marion County), about 7 months later. One of these individuals was recaptured a second time, 2.3 years after banding, again at Coffin Cave, where it was first marked.

We documented three interstate migrations. One bat from Greene County, Missouri, was detected 135 km south in Newton County, Arkansas, and another animal, initially marked in Howell County, Missouri, was found 76 km south-southwest in Baxter County, Arkansas; these recaptures occurred 4 months and 2.6 years, respectively, after banding. Another individual, first caught at a maternity site in Pittsburg, Kansas, was recovered 168 km east-northeast, at Coffin Cave, 1.4 years after banding.

Discussion

Previous banding studies for gray bats documented movements between Missouri and four other states: Arkansas, Illinois, Kansas, and Oklahoma (Myers, 1964; Tuttle, 1976; Elder and Gunier, 1978; Robertson, 2003). Average one-way distance during migration was about 200 km, but longer movements of 640 km between Missouri and Illinois (Elder and Gunier, 1978) and 525 km between Tennessee and Florida (Tuttle, 1976) were reported. Recent studies of movement by gray bats in Kentucky and Tennessee showed trends similar to those in Missouri (Fig. 1), with residents of multiple maternity caves populating a few, scattered hibernacula (Lamb and Wyckoff, 2010).

Frick et al. (2017) report evidence of inherent resistance or tolerance to WNS in gray bats. However, other species that are highly affected by the disease also roost in many sites used by gray bats, and many of these locations are suspect or positive for the presence of *P. destructans* (Colatskie, 2017). Although the population of gray bats in Missouri appears stable, declines have occurred for all other cave-roosting species (except Indiana bats), presumably due to WNS (Colatskie, 2017). In Missouri, all hibernacula occupied by gray bats are also

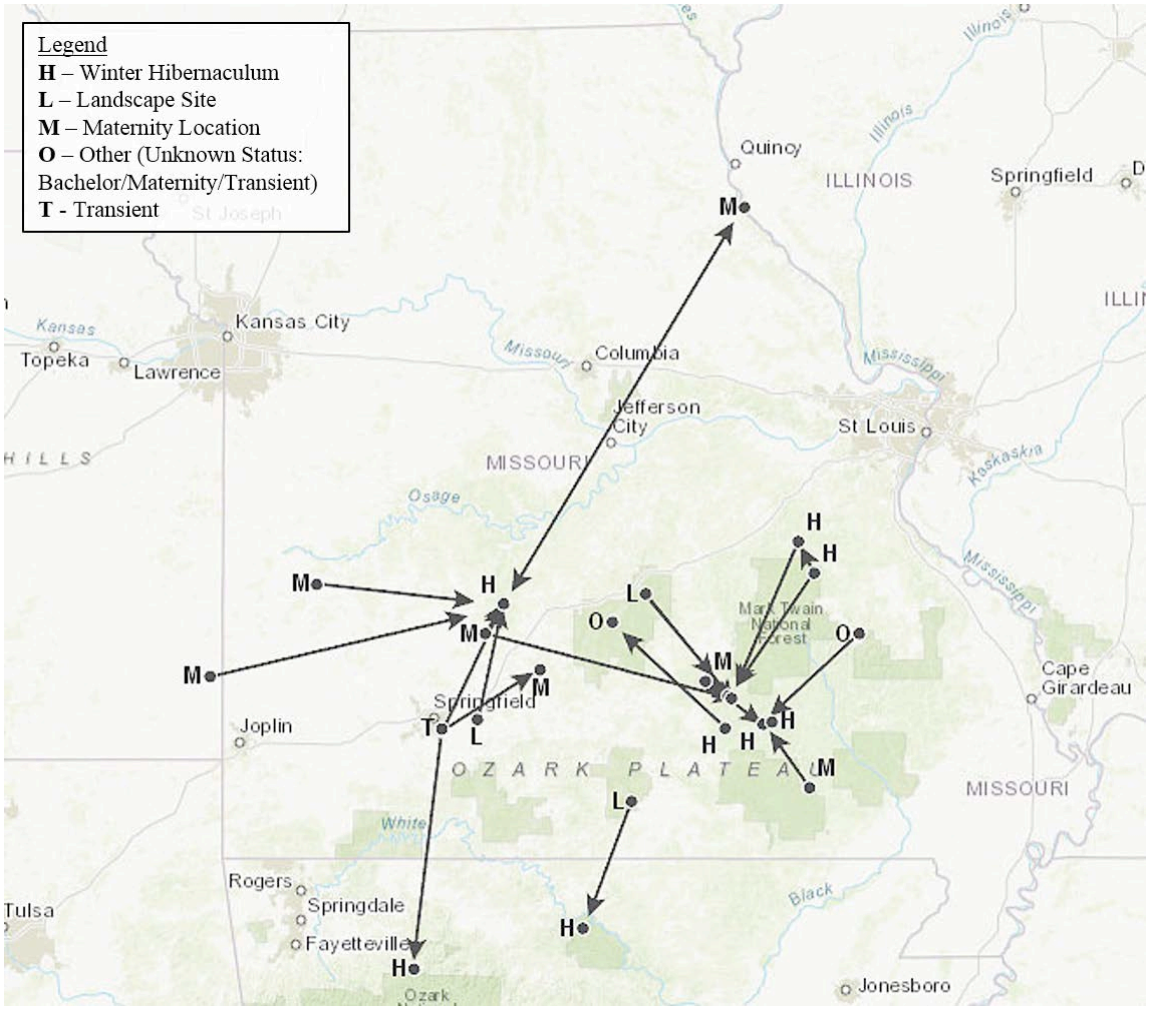

Figure 1. Movements of gray bats in Missouri and nearby states, from 2002 to 2017, as indicated by band returns. Arrows indicate direction from location of initial capture to recovery, and some lines represent multiple band returns.

used by at least one other species of bat. For example, the largest population of wintering Indiana bats, about 200,000 individuals, occurs at the Sodalis Nature Preserve, which also shelters approximately 10,000 gray bats during the maternity season and a smaller number of gray bats during winter. In addition, five gray bats used a rocket box as a transient roost, along with 10 little brown bats, in Iron County, Missouri (MDC, unpublished data). It is likely that gray bats that harbor the fungus are transporting *P. destructans* from cave to cave and/or are transferring fungal spores directly to uninfected individuals of other species of bats.

Migratory patterns of gray bats (Fig. 1), as determined from information in the banding database maintained by MDC, illustrate how gray bats could spread WNS to other caves and other states. Our research, in addition to previous banding studies, shows that gray bats occasionally travel long distances. Although our rate of band returns is low (2.3%), it is within the range of past studies (Ellison, 2008), and our recoveries illustrate an extensive use of the landscape, with many linkages between summer, transient, and

winter sites. Although the number of band returns (Appendix 1) does not allow us to quantify the effect of this connected network on the spread of WNS, we suggest that movement among the nodes contributes to the movement of WNS. In particular, we suggest that gray bats on the western edge of their range may be a conduit for spreading *P. destructans* to previously uninfected species in the West.

Acknowledgments

We thank the numerous bat banders and cave biologists, especially Josh Parris and Patrick Moore, for their assistance; and the Missouri Department of Conservation, U.S. Fish and Wildlife Service (Columbia Field Office), U.S. Forest Service (Rolla and Columbia, Missouri), U.S. National Park Service (Ozark National Scenic Riverways), Missouri Bat Census, Arkansas Game and Fish, the Cave Research Foundation, and the many caving organizations, for helping find these bats.

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Appendix 1. Summary of 48 recoveries of 47 banded gray bats from Missouri and adjacent states. Sites of capture and recapture indicated with only the county are sites not associated with a cave.

Bat	Distance between site of banding and recovery (km)	Years between banding and recovery	Sex	Age at initial capture (A = adult; J = juvenile; U = unknown)	Initial site of capture	Site of recovery
1	0	0.3	M	A	Coffin Cave, Laclede Co.	Coffin Cave, Laclede Co.
2	0	0.4	M	A	Sequiota Cave, Greene Co.	Sequiota Cave, Greene Co.
3	0	0.5	F	A	Bat Cave, Shannon Co.	Bat Cave, Shannon Co.
4	0	4	M	A	Great Scott Cave, Washington Co.	Great Scott Cave, Washington Co.
5	1	4.7	M	A	Shannon Co.	Martin Cave, Shannon Co.
6	2	1.3	M	A	Bat Cave, Shannon Co.	Mose Prater Cave, Shannon Co.
7	2	2.2	F	A	Bat Cave, Shannon Co.	Mose Prater Cave, Shannon Co.
8	2	0.4	M	A	Branson Cave, Shannon Co.	Shannon Co.
9	3	0.7	M	A	Zoe Tract, Shannon Co.	Mose Prater Cave, Shannon Co.
10	5	1.3	M	A	Powder Mill Creek Cave, Shannon Co.	Martin Cave, Shannon Co.
11	5	1.3	M	A	Powder Mill Creek Cave, Shannon Co.	Martin Cave, Shannon Co.

12	9	0.7	M	A	Zoe Tract, Shannon Co.	Martin Cave, Shannon Co.
13	15	0.5	M	A	Medlock Cave, Shannon Co.	Bat Cave, Shannon Co.
14	15	0.5	M	J	Medlock Cave, Shannon Co.	Bat Cave, Shannon Co.
15	15	1.5	M	A	Medlock Cave, Shannon Co.	Bat Cave, Shannon Co.
16	17	6.5	M	A	Medlock Cave, Shannon Co.	Mose Prater Cave, Shannon Co.
17	19	0.4	M	A	Buffalo Quarry, Dallas Co.	Coffin Cave, Laclede Co.
18	19	0.4	M	A	Buffalo Quarry, Dallas Co.	Coffin Cave, Laclede Co.
19	19	1.4	F	A	Buffalo Quarry, Dallas Co.	Coffin Cave, Laclede Co.
20	19	1.4	M	A	Buffalo Quarry, Dallas Co.	Coffin Cave, Laclede Co.
21	20	2.6	M	A	Susan Cave, Washington Co.	Great Scott Cave, Washington Co.
22	40	2.7	M	A	Medlock Cave, Shannon Co.	Martin Cave, Shannon Co.
23	44	2.4	M	A	Panther Spring Cave, Carter Co.	Martin Cave, Shannon Co.
24	44	4.5	M	A	Panther Spring Cave, Carter Co.	Martin Cave, Shannon Co.
25	64	1.4	F	U	Sequiota Cave, Greene Co.	Smittle Cave, Wright Co.
26	66	4.5	M	J	Webster Co.	Coffin Cave, Laclede Co.
27	72	3.7	F	A	Phelps Co.	Bat Cave, Shannon Co.

28	73	0.3	M	A	Pilot Knob Mine, Iron Co.	Martin Cave, Shannon Co.
29	74	5.7	M	A	Phelps Co.	Mose Prater Cave, Shannon Co.
30	76	2.6	F	A	Howell Co.	Bonanza Cave, Baxter Co., AR
31	78	0.5	M	A	Sequiota Cave, Greene Co.	Coffin Cave, Laclede Co.
32	78	1.3	M	A	Sequiota Cave, Greene Co.	Coffin Cave, Laclede Co.
33	78	1.4	M	A	Sequiota Cave, Greene Co.	Coffin Cave, Laclede Co.
34	78	1.4	M	A	Sequiota Cave, Greene Co.	Coffin Cave, Laclede Co.
35	78	1.9	M	A	Sequiota Cave, Greene Co.	Coffin Cave, Laclede Co.
36	83	7.4	M	A	Susan Cave, Washington Co.	Mose Prater Cave, Shannon Co.
37	86	6.2	F	A	Shannon Co.	Ft. Leonard Wood, Pulaski Co.
38	94	0.8	F	A	Great Scott Cave, Washington Co.	Bat Cave Shannon, Shannon Co.
39	94	6.7	M	A	Great Scott Cave, Washington Co.	Bat Cave Shannon, Shannon Co.
40	95	4.8	M	A	Great Scott Cave, Washington Co.	Mose Prater Cave, Shannon Co.
41	104	1.5	F	A	El Dorado Springs, Henry Co.	Coffin Cave, Laclede Co.
42	104	2.3	M	A	El Dorado Springs, Henry Co.	Coffin Cave, Laclede Co.
43	135	0.3	U	U	Sequiota Cave, Greene Co.	Cave Mountain Cave, Newton Co., AR

44	141	0.5	M	A	Buffalo Quarry, Dallas Co.	Mose Prater Cave, Shannon Co.
45	168	1.4	F	A	Pittsburg, Crawford Co., KS	Coffin Cave, Laclede Co.
46	253	0.6	M	A	Coffin Cave, Laclede Co.	Sodalis Nature Preserve, Marion Co.
47	253	0.6	M	A	Coffin Cave, Laclede Co.	Sodalis Nature Preserve, Marion Co.
47	0	2.3	M	A	Coffin Cave, Laclede Co.	Coffin Cave, Laclede Co.

A Three-pulley System for Elevating the Microphone of a Bat Detector on a Meteorological Tower

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Introduction

Acoustic surveys of bats often are conducted within the boundaries of a proposed wind farm, with the microphones of detectors placed 22–30 m above the ground, usually on a tower that has been installed for monitoring weather. In many cases, this meteorological tower has already been erected, and installing the microphone at the desired height requires lowering the entire structure to the ground, which incurs considerable cost. In addition, the microphone most commonly is attached directly to the tower, often near wires or other monitoring instruments, such as anemometers, which produce noises that interfere with recording calls produced by bats.

Here, I propose a method, using the guy wires of the tower, to elevate a microphone and place it away from the main mast. This low-cost system can be easily installed by two people, using minimal tools, with no need to lower the tower. Although this technique can be employed with most styles of bat detector, the system is best used with units having external microphones that can be placed at least 30 m from the rest of the recording unit.

Construction and Operation of the System

Constructing a holder for the microphone.—The initial step is to construct a microphone holder. The one shown in Fig. 1 is suitable for the SMX-US microphone (Wildlife Acoustics, Maynard, Massachusetts) and is made from a piece of 3.8-cm-wide (1.5-inch-wide) plastic (ASM) pipe that is about 30-cm long. The side of the holder has one hole at the top and two at the bottom, for attachment of D-rings or carabineers. The upper D-ring is used to suspend the holder, whereas the lower two rings serve as attachments for ropes that will be tied at ground level; these ropes stabilize the holder and maintain the microphone in a horizontal position. These stabilizing ropes should be at least 30-m long but can be thin (i.e., 19 mm or 3/16 inch) because they are not under a large amount of tension. The holder should also have a clamp or other mechanism (not shown) to fix the position of the microphone cable and minimize tension on the connection between the cable and the microphone. Similar holders can be constructed for other types of microphones, depending on their shape and size.

Assembling a pulley system.—The system requires three articulating pulleys and five additional D-rings. The pulleys must be of sufficient size (typically 3.8 cm or 1.5 inches) to fit the guy wires of the meteorological tower and have a wheel that can be disconnected, usually by removing a pin (Fig. 2), to attach the pulley to the guy wire. If a standard pulley is used, a swivel is also required for each pulley, as well as additional D-rings to connect them.

To begin, connect one pulley to a D-ring and then to a second pulley (Fig. 2). Then attach the third pulley, through a D-ring, to a loop at the end of a coated aircraft cable that is mounted on a winding spool (Figs. 3–4). The diameter of the aircraft cable should be at least 2.4 mm (3/32 inch), and although its minimum length depends on distance between

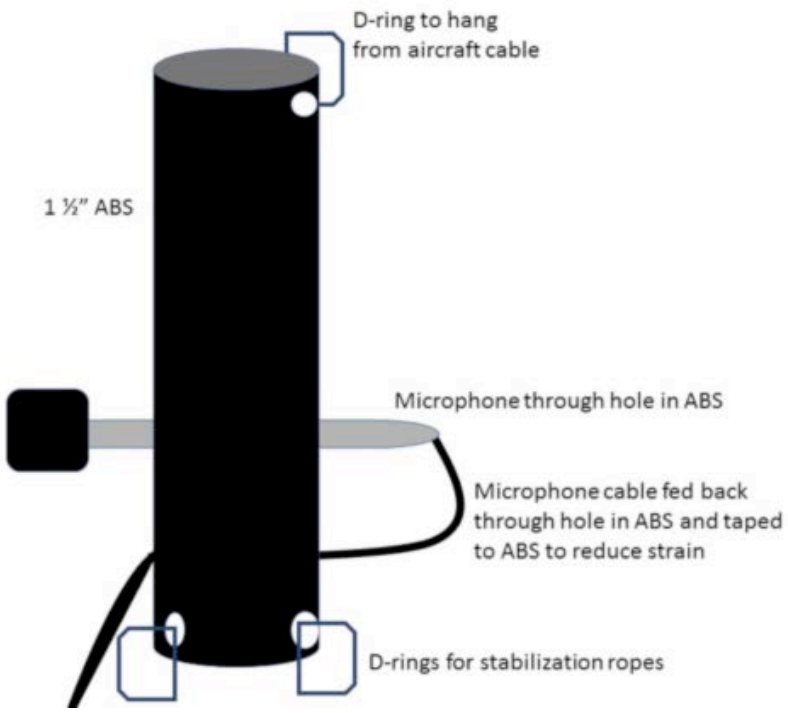

Figure 1. Example of a microphone holder for the SMX-US microphone, which is used with SM4BAT+ detectors (Wildlife Acoustics, Maynard, Massachusetts).

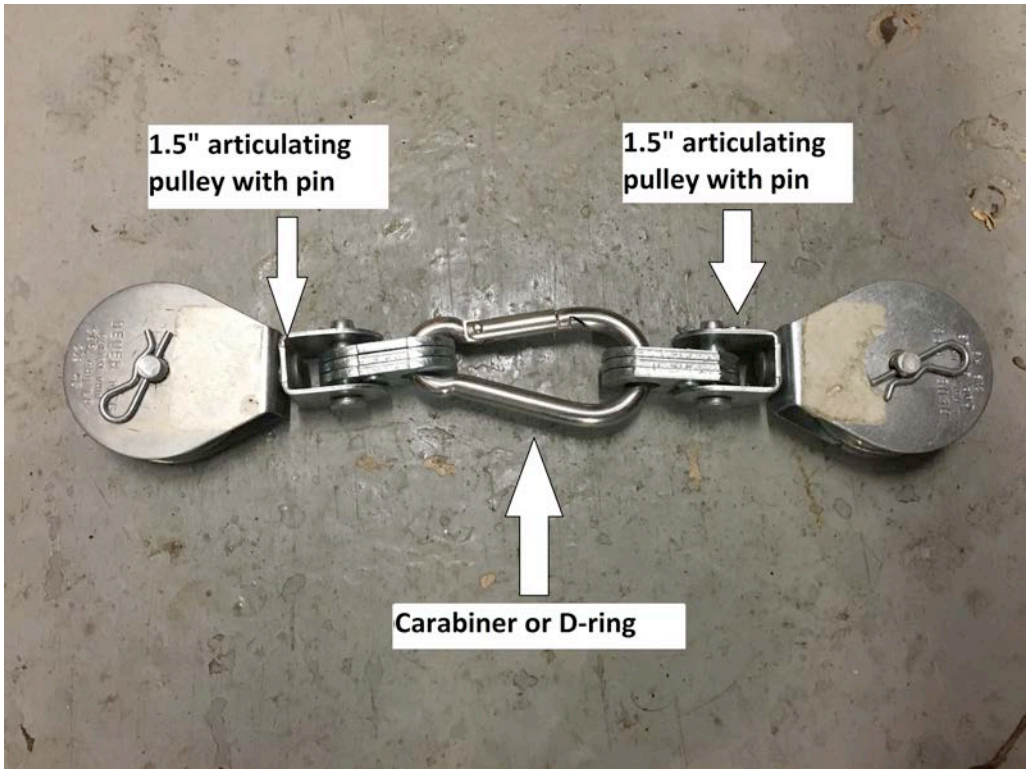

Figure 2. Double-pulley component for a guy wire.

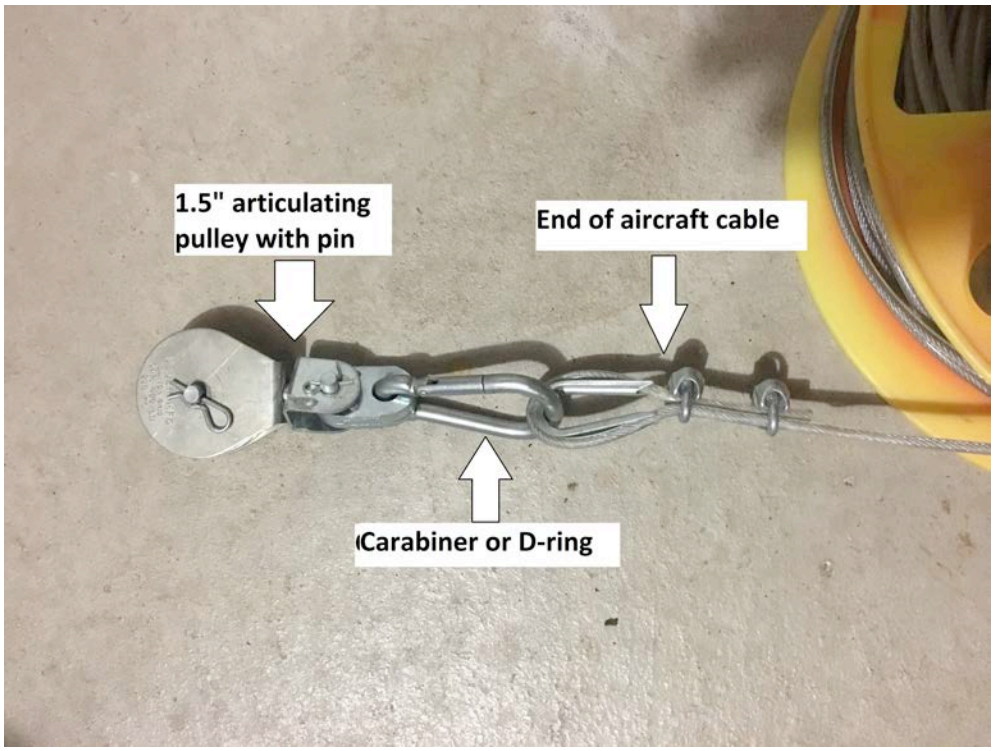

Figure 3. Single pulley for adjacent guy wire.

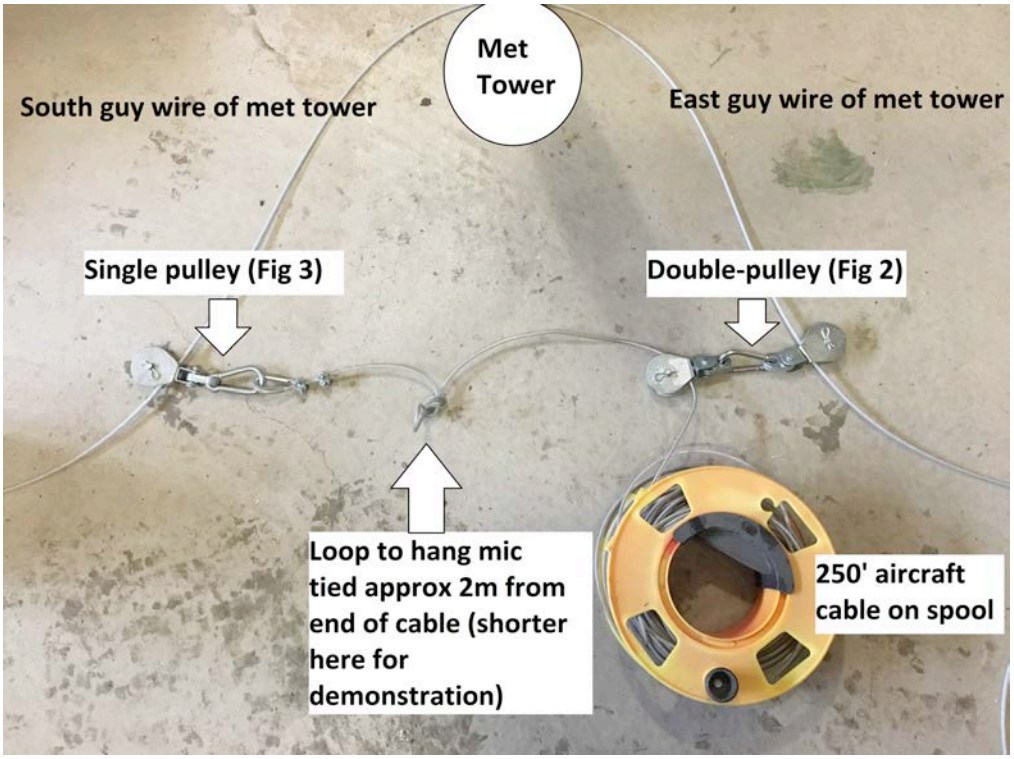

Figure 4. Semi-diagrammatic representation of full system for installation of the microphone (mic) of a bat detector on a meteorological (met) tower.

the guy-wire anchors, 75 m (250 feet) often is sufficient. Finally, make another loop for attachment of the holder about 2 m from the end of the aircraft cable (Fig. 4).

Installing the pulley system.—Installation of the system at the meteorological tower requires use of two adjacent guy wires that do not have any obstructions from the ground to the tower (Fig. 4). I typically use the second set of wires from the top so as not to put strain on the top of the tower and still allow for sufficient elevation of the microphone. For illustration, I refer to the two guy wires that are used as the "south" and "east" wires.

The first step in the field is to connect the pulley at the end of the aircraft cable to the south guy wire (Fig. 4), by removing the wheel and placing it back into the pulley with the guy wire inside. Second, fix the microphone holder to the loop in the aircraft cable with the upper D-ring of the holder. Insert the microphone and microphone cable into the holder and connect a stabilizing rope to each D-ring at the bottom of the holder. Unravel these ropes and the microphone cable toward the tower, in a way that prevents them from becoming entangled with each other or with any other objects as the system is raised. Third, unravel the aircraft cable while walking toward the east guy wire, and then install the double pulley (Figs. 2 and 4). Fourth, one person now pulls the aircraft cable, as he/she walks toward the base of the tower, thus causing the pulleys on both guy wires to move upward along the wires; during this procedure, the second person ensures that no ropes are tangled. Continue pulling until the microphone is at the proper height (typically 22 m or 30 m), as determined with a range finder. Fifth, after attaining the desired height, tie or clamp the aircraft cable and spool to the base of the meteorological tower so that the wire cannot unravel. Lastly, use the stabilizing lines to aim the microphone as needed, and secure them to any ground-based object to prevent the microphone from moving in the wind.

This method provides an easy, low-cost way to deploy the microphone at high elevations, on most types of meteorological towers. The microphone is positioned away from other monitoring devices and away from the guy wires, allowing unobstructed monitoring of echolocation calls in open air. Operation of the detector can be done from the ground, without lowering the microphone, although it can easily be lowered if necessary, and once the study is complete, the system is simple to remove without damaging the tower. This method also could be used with detectors that have fixed microphones; however, such units would need to be housed in an enclosure, which adds considerable weight, and the entire system would have to be lowered and raised every time that the detector is checked or data are downloaded.

A Protocol for Conducting Surveys of Culverts for Winter-roosting Bats

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Several species of bats use concrete culverts as roosting sites, including gray bats (*Myotis grisescens*), southeastern myotis (*M. austroriparius*), tricolored bats (*Perimyotis subflavus*), Rafinesque's big-eared bats (*Corynorhinus rafinesquii*), big brown bats (*Eptesicus fuscus*), and northern long-eared bats (*M. septentrionalis*—Keeley and Tuttle, 1999; R. D. Stevens, pers. comm.). In the South, some species, such as tricolored bats, are found in culverts primarily in winter, whereas other species, such as the southeastern myotis, frequently are encountered year-round (Martin et al., 2005, 2008; Mirowsky et al., 2004; Sandel et al., 2001; Stevens et al., 2017; Walker et al., 1996). Following an initial study of bats and highway culverts in Mississippi in 2015 (Katzenmeyer et al., 2016), the Mississippi Department of Wildlife, Fisheries, and Parks and the U.S. Fish and Wildlife Service, with support from the Mississippi Bat Working Group, initiated an annual survey (termed the Culvert Blitz) to investigate daytime use of these structures during winter.

The first Culvert Blitz was conducted in early January 2017 by small teams of professionals and volunteers, with each team examining 8–12 culverts. Culverts that were inspected were primarily associated with interstate highways and other large (four-lane) roads that were located throughout the state. Team leaders were provided photos and descriptive information of each species that might be encountered and a data sheet to be completed for each culvert. Prior to entering a site, teams recorded pertinent information, such as the names of the observers, date, time, external ambient temperature, geographic coordinates, and a description of the adjacent habitat; additional required data included the specific type of culvert and its height, width, and direction/bearing, as well as the number of subterranean channels. Upon entering, the surveyors recorded the species and location (on walls or in crevices) of roosting bats, noted any visual signs of *Pseudogymnoascus destructans*, and measured ambient temperature at the mid-point of each culvert. Team members were careful not to disturb roosting bats, and all personnel performed appropriate decontamination after leaving a culvert.

During the first Culvert Blitz, on 14 January 2017, 14 routes were completed, and bats were present in 75 of the 157 culverts (48%) that were examined. Number of bats present at each site varied from 0 to 165 animals. A total of 1,011 bats, representing four species, was observed, with the tricolored bat accounting for 64% of the observations (n = 642). Other detected species were the southeastern myotis (160), big brown bat (25), and Rafinesque's big-eared bat (8); we were unable to identify 176 bats to species.

The second annual Culvert Blitz was conducted on 5–7 January 2018 and involved 234 culverts, 116 (50%) of which contained a total of 3,287 bats. Number of bats present at each site varied from 0 to 1,035 animals. Species recorded were the southeastern

myotis (n = 2,009), tricolored bat (1,046), big brown bat (115), Brazilian free-tailed bat (*Tadarida brasiliensis*; 110), and Rafinesque's big-eared bat (5). In 2018, inexperienced observers were paired with experienced biologists, and consequently, only two bats were not identified to species. The discovery of 928 southeastern myotis apparently hibernating in a series of culverts in west-central Mississippi was especially significant, because large clusters of this species had not previously been found using highway culverts in winter.

The team responsible for the Culvert Blitz is working to refine the protocol and furnish more formal training for volunteers. In general, by continuing these annual surveys we hope to provide managers with a recurring account of the species using culverts during winter and ultimately management information on the preferred designs and locations. Annual surveys of culverts by Mississippi and other states also will be specifically useful in monitoring the status of tricolored bats, as they decline over much of their range because of white-nose syndrome (Center for Biological Diversity and Defenders of Wildlife, 2016).

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WHITE-NOSE SYNDROME

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Book Review

Perrow, M.R. (ed.). 2017. **Wildlife and Wind Farms, Conflicts and Solutions. Volume 2 Onshore: Monitoring and Mitigation.** Pelagic Publishing, Exeter, UK, 217 pp. [ISBN 978-1-78427-123-7] Price (soft cover), $53.35 (USD).

The search for clean, renewable energy sources has gained considerable momentum in response to rising concerns over the harmful effects of global warming. As more wind farm projects are designed, concerns over potential impacts to wildlife also continue to rise. This book is part two in a four-part series. It attempts to examine carefully the tools and methodologies currently available to help quantify the pre- and post-construction effects of wind farm projects on two significant wildlife groups, namely birds and bats. It also offers solutions to help mitigate the effects of wind farm placement and operation on these two delicate indicators of environmental health and quality.

The book consists of nine chapters, with the first chapter covering monitoring of birds and current survey methods for wind farm development. Table 1-2 lists the survey methods used for assessing potential impacts to birds from wind farms, including: diurnal use surveys, nocturnal use surveys, behavior surveys, radar, telemetry, nest counts, transect surveys, and thermal imaging. Because of their diurnal activities, birds offer a visual observation advantage over bats, making collection of data much easier and potentially more valuable. To further take advantage of diurnal activities, behavioral surveys may be developed to predict and minimize collision impacts at proposed and existing wind farm projects.

Chapter 2 thoughtfully describes the need to assess wind energy sites prior to and following start-up operations to ensure that potential bat impacts are adequately quantified. In this chapter, detailed assessment of the pros and cons of each various monitoring systems used for documenting bat activity are included in Table 2-1, including: acoustic surveys, radar, infrared imaging, mist-net capture/handling, tagging and tracking, roost surveys and exit monitoring and fatality monitoring (carcass recovery). Each of these methods, except for carcass recovery, may be used for both pre- and post-monitoring efforts, but in all cases, monitoring data are considered more robust when multiple methods are paired together (Kunz et al., 2007).

Chapter 3 provides an overview of predictive modeling using six collision risk models. The Tucker kinematic model published in 1996 was the first model to address collisions between birds and wind turbines. This model is limited in that it looks at collisions from only three directions: upwind, downwind and across wind. Additionally, the model does not address impacts with the tower, hub or nacelle. The Band collision risk model (developed in 2000 and updated in 2007) served as first widely available model and functions by looking at the number of bird flights passing by a rotor and the probability of impacts with the rotors. The Podolsky collision risk model, described in 2005, incorporates the fundamentals of the Tucker model, but also accounts from multiple angles and directions and for bird collisions with the turbine tower itself. The Biosis collision risk model developed in 2002, addresses all possible impacts between a bird and wind turbine; while also accounting for potential avoidance behaviors based on the moving rotors vs. static tower. The Hammer collision risk model (2011), is similar to the Podolsky model, in that it incorporates the fundamentals of the Tucker kinematic model,

except that it also includes all possible flight angles of impact and collisions with the tower itself. The USFWS collision risk model established in 2011 uses prior collision experience instead of developing a kinematic model based on bird rotor interactions. Data are gathered from other wind farms and educated predictions are made. All six models are useful for predicting potential impacts for both birds and bats and are considered essential tools during the drafting of an Environmental Impact Assessment (EIA) necessary to meet regulatory requirements for wind farm projects. Although these mathematical models are based on numerous assumptions that, collectively, may lead to prediction error, recent studies suggest that there may be a correlation between actual post-construction collision results and the predictive ranges estimated by collision risk modeling. This has been especially true for bird impacts, where the available collision data set is more complete (Smales et al., 2013).

Chapter 4 looks at the process of accurately estimating post-construction turbine-related fatalities. Accurate estimates start with solid search and recovery protocols for collecting carcasses paired with an estimated probability of detection for each carcass. Estimated detection rates are impacted by size of search area covered, carcass persistence (remains available for detection) and overall searcher efficiency. Since each of these variables are prone to inherent bias (i.e., searcher efficiency tends to decrease as carcasses decompose), there may be a great deal of subjectivity built into these estimates.

Chapter 5 discusses using GIS-based sensitivity mapping during site selection considerations to reduce potential impacts from wind farms on sensitive wildlife species. Moreover, spatial planning helps to avoid significant impacts by identifying sensitive areas including areas with high densities of wintering or migratory waterfowl habitat, significant raptor activity, flight corridors between breeding, feeding and roosting sites and areas with high densities of migrating or foraging bats or areas including bat roosting sites. Sensitivity mapping allows spatial planners an early opportunity to identify problem areas early in the planning process, thus avoiding significant setbacks during the project development. Sensitivity maps do have limitations, but these may be minimized as available data are continually updated.

Chapter 6 describes strategies for mitigation of bird impacts at wind energy sites. Properly protecting vulnerable bird species requires project planners to implement a mitigation hierarchy that includes: avoiding bird impacts during planning phases, minimizing risks while designing, reducing risks during construction, compensating for potential impacts during operations and restoring site back to original status during decommissioning. Successful mitigation efforts, however, are highly dependent upon the behavior and adaptability of the species of concern and tend to be uniquely site specific.

Chapter 7 details a real-life example where predictive modeling and direct observation were used to site a wind farm operation at the Altamount Pass Wind Resource Area in California. Two species of major concern, Golden Eagle and Red-tailed Hawk, were accurately assessed and predictive models developed, but it was the actual visual observations that proved most beneficial suggesting that behavioral surveys by trained ethologists, familiar with the species of concern, would further improve post-construction assessments by determining how birds alter flight patterns in response to newly installed turbines. For example, initial hypotheses suggested that Golden Eagles were prone to collisions with turbines when focused on prey species on the ground, but visual observations revealed that the majority of collisions occurred when the eagles were

interacting with each other or other bird species.

Chapter 8 reviews methodologies available for mitigating collision impacts of wind farms on bats. Currently, the two leading mitigation methodologies involve modifying turbine operations by either increasing turbine cut-in speed by 1.5-3 meters per second or by feathering the blades to help reduce rotor speed. Increasing the cut-in speed has proven most effective for protecting bats species during migration and other high-risk periods. Other potential mitigation tools, including: acoustic deterrents (i.e., recorded territorial calls from conspecifics), modifying turbine color to make them less attractive to insects and electromagnetic signals all show promise, but more research is needed.

Chapter 9 offers a best management approach to siting new windfarms, focusing on existing policy, guidance and accepted practice. Project success dictates that throughout planning, design, siting, implementation and operations, strict attention is paid to the mitigation hierarchy and its effects on wind energy project development. Table 9-1, provides a nice overview of the various mitigation steps and their effect on the overall project.

Overall, this book provides a comprehensive review of the impacts of wind farms on wildlife while also focusing on monitoring and mitigation steps to help reduce these concerns as much as practical. In this volume, synthesized information from countless workers and field researchers is presented in an effort to provide a singular desk reference that would be valuable to biologists, conservationists, regulatory staff and any other individuals affected by wind energy projects.

Mark A. King
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ANNOUNCEMENTS

Reminder—Renewal Time!

Many thanks to all of you for continuing to support *Bat Research News* for another year! And all of us at *BRN* thank you for reading the 2018 Summer issue.

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 *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

2018

Bat Survey Solutions, LLC will hold a Combined Field Survey Techniques Workshop, July 29–August 5, 2018, at Lava Beds National Monument and Modoc National Forest, Tulelake, California. Registration is required. Please see the Bat Survey Solutions website for information: http://www.batmanagement.com.

The 3rd European Alpine Bat Detector Workshop will be held August 2–6, 2018, at the Nordic Chiroptera Information Center (NIFF), in Askim, Norway (55 km from downtown Oslo and 37 km from the Swedish border). For more information please see: http://www.batlife.info/EABDW-3/.

The 48th Annual NASBR will be held October 24–27, 2018, at the Westin Resort and Spa, in Puerto Vallarta, México. Check the NASBR website for meeting information — http://www.nasbr.org/.

2019

The 49th Annual NASBR will be held 23–26 October 2019, in Kalamazoo, Michigan. Check the NASBR website for future updates — http://www.nasbr.org/.

2020

The 15th European Bat Research Symposium will be held 3–7 August 2020, in Turku, Finland. Please see http://www.batlife.info/meetings/ for updates and information.

The 50th Annual NASBR will be held 28–31 October 2020, in Tempe, Arizona. Check the NASBR website for future updates — http://www.nasbr.org/.

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Gray Bats (*Myotis grisescens*) in storm drain under the city park in Eldorado Springs, Cedar County, Missouri. Photo by Lynn Robbins (see related article in the 2018 Summer issue of *BRN*, Volume 59: No. 2, page 11).

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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).

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ANNOUNCEMENTS

Back Issues

Are you missing any back issues of the print edition of *Bat Research News*? If you would like to replace them, please contact Margaret Griffiths (margaret.griffiths01@gmail.com). Most are available from Volume 45, 2004 to Volume 58, 2017. Depending on what you need, we may ask you to cover postage. Beginning in 2019, we will be reducing the inventory of back issues, beginning with the oldest (i.e., Vol. 45: no. 2, 2004).

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 *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

2018

The 48th Annual NASBR will be held October 24–27, 2018, at the Westin Resort and Spa, in Puerto Vallarta, México. Check the NASBR website for meeting information — http://www.nasbr.org/.

2019

The 2019 NEBWG meeting will be held 16–18 January 2019, in State College, Pennsylvania. The meeting will be held at the Days Inn, 240 South Pugh Street, State College, and will run from 1:00 pm on the 16th to 12:00 pm on the 18th. For more information, please contact the meeting hosts, Pamela Shellenberger (pamela_shellenberger@fws.gov) or Melinda Turner (melinda_turner@fws.gov).

The 49th Annual NASBR will be held 23–26 October 2019, in Kalamazoo, Michigan. Check the NASBR website for future updates — http://www.nasbr.org/.

2020

The 15th European Bat Research Symposium will be held 3–7 August 2020, in Turku, Finland. Please see http://www.batlife.info/meetings/ for updates and information.

The 50th Annual NASBR will be held 28–31 October 2020, in Tempe, Arizona. Check the NASBR website for future updates — http://www.nasbr.org/.

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Hibernating *Perimyotis subflavus* (Tricolored bat). The photo was taken on 5 January 2018 in a highway culvert in Warren County, Mississippi, by Chester Martin.

BAT RESEARCH NEWS

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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).

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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!

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From the Editor

Greetings and Happy 2019!

I apologize for the lateness of the 2018 Winter issue of *Bat Research News*, Volume 59: No. 4. I have been waiting for the abstracts from the 48th Annual NASBR but as yet have not received any responses to my requests. Hopefully, we will hear from the NASBR soon, and if they agree to continue our long-standing tradition, I promise to publish those abstracts in the 2019 series.

It is well worth publishing—or having your collected Abstracts published—in *Bat Research News*. For the past 59 years, *Bat Research News* has built a reputation as a solid, reputable source of research information on bats. Over the past six decades, *BRN* has increased its subscriber base to include people in the major bat research labs in Europe, Asia, the Middle East, Australia, New Zealand, South America, Canada, the United States, and Mexico. Currently, *Bat Research News* reaches multiple subscribers in 43 U.S. states, 3 U.S. territories, and in 30 countries around the world. Our little journal/newsletter goes to numerous university and research libraries as well as to individual and governmental agency subscribers. *BRN* is abstracted in several databases (e.g., BIOSIS).

Al, Tom, and I hope to bring you some interesting articles and news this year, but we need your help in order to do this. Please consider submitting short-to-moderate length, bat-related research or review articles to *Bat Research News*. We'd be happy to receive non-technical articles as well, describing your research or updates in your area of expertise, or some bat educational or conservation projects you are doing. Also send us news from your lab, field work, sabbatical experience, retirement activities, etc.

I am looking to reduce our inventory of back issues of *BRN* during the 2019 calendar year. If you are missing issues or would like to increase your library, please see my announcement on page 59 of this issue. Most back issues are available from Volume 45, 2004 through Volume 59, 2018.

Finally I'm always glad to hear from you and any comments you have, so please consider sending us something. Both positive and negative comments are welcome, although I must admit the former usually make my day!

Best wishes,

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 e-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

Berkovitz, B., and P. Shellis. 2018. Chapter 11 – Chiroptera. Pp. 187-211 in The Teeth of Mammalian Vertebrates. Academic Press, New York, 346 pp. [ISBN 978-0-12-802818-6]

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DISEASE

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Willie, M., E. Rowland, and A. Mullaley. 2018. First documentation of roost use by little brown myotis (*Myotis lucifugus*) on the north coast of British Columbia. Northwestern Naturalist, 99(3): 187-196. [megan.willie@canada.ca]

ECHOLOCATION (special section)

The following 13 citations are the recently-published versions of invited oral contributions to the Second International Symposium on Bat Echolocation Research held in Tucson, AZ, in March of 2017. The symposium was organized by Brock Fenton, Brian Keeley and Janet Debelak Tyburec. Special thanks to Brock for supplying this information.

Bohn, K. M., and E. H. Gillam. 2018. In-flight social calls: a primer for biologists and managers studying echolocation. Canadian Journal of Zoology, 96: 787–800. [erin.gillam@ndsu.edu]

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NEWS

Alfred L. Gardner Retires from the National Museum of Natural History

Congratulations to Al Gardner on his retirement! After more than 45 years as Curator of North American Mammals at the National Museum of Natural History, in Washington, DC (U.S.A.), he decided to retire from the NMNH. Al's work over the past 5 decades has been much appreciated by, and beneficial to all of us. Please wish Al the very best in his retirement, and although he will be missed, we look forward to his future contributions to science and bat biology!

ANNOUNCEMENTS

Reminder—Renewal Time!

Just a reminder that this is the last issue of the 2018 series of *Bat Research News*. That means some of you will be receiving renewal information in your e-mail inbox fairly soon. I hope you will continue to support *BRN* for the 2019 volume-year. Regardless, all of us at *Bat Research News* wish you a safe and happy 2019!

Back Issues

Are you missing any back issues of the print edition of *Bat Research News*? If you would like to replace them, please contact Margaret Griffiths (margaret.griffiths01@gmail.com). Most issues are available from Volume 45, 2004 to Volume 59, 2018. Depending on what you need, we may ask you to cover postage. Beginning in 2019, we will be reducing the inventory of back issues, beginning with the oldest (i.e., Vol. 45: no. 2, 2004).

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 *BRN*.

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.

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

2019

The 2019 NEBWG meeting will be held 16–18 January 2019, in State College, Pennsylvania. The meeting will be held at the Days Inn, 240 South Pugh Street, State College, and will run from 1:00 pm on the 16th to 12:00 pm on the 18th. For more information, please contact the meeting hosts, Pamela Shellenberger (pamela_shellenberger@fws.gov) or Melinda Turner (melinda_turner@fws.gov).

The 18th International Bat Research Conference (IBRC) will be held 28 July–2 August 2019, in Phuket, Thailand , at the Slate. Registration and abstract submission are open. Please visit the IBRC website for information — https://www.ibrc2019.com/.

The 49th Annual NASBR will be held 23–26 October 2019, in Kalamazoo, Michigan, at the Radisson Plaza Hotel & Suites. Check the NASBR website for future updates — http://www.nasbr.org/.

2020

The 15th European Bat Research Symposium will be held 3–7 August 2020, in Turku, Finland. Please visit https://www.ebrs2020.fi/ for updates and information.

The NASBR will celebrate their 50th anniversary where it all began, in Arizona. The annual meeting will be held 28–31 October 2020, in Tempe, Arizona. The NASBR also plans to publish an edited volume that highlights bat biology research to coincide with their 50th annual meeting. Check the NASBR website for more information and future updates — http://www.nasbr.org/.

2021

The 51st Annual NASBR will be held in Winnipeg, Manitoba, Canada, dates and venue to be announced at a later time. Check the NASBR website for future updates — http://www.nasbr.org/.