

NSRL NEWS

Natural Science Research Laboratory
Museum of Texas Tech University

Volume 7, Fall 2018



***Research Highlight:* Urban Wildlife in Lubbock? It's Not Just for the Birds....**

by Warren Conway, PhD, and Chris Carter, graduate student, TTU Department of Natural Resources Management

Most suburban and urban areas within the U.S. often have many more permanent mammalian residents than just the humans who live there. Even if they are not obvious nor observed, urban wildlife populations are burgeoning in many areas, including in the Southern High Plains of Texas. Wildlife are often in our yards, at our doorstep, and many times, even within our homes or attics. Commonly, people are often surprised that “wild” animals exist in urban areas, and sometimes that surprise turns into fear or anxiety for residents. However, as interest in urban wildlife ecology and management science continues to expand, and become more refined, so does our understanding of how wildlife exist within our midst, and how certain species seem to thrive in these “non-traditional” urban habitats.

Of particular interest, and concern in some cases, is that many mesocarnivore species have become widely established in urban areas throughout North America. A mesocarnivore is defined as an animal whose diet consists of 50–70% meat, with the balance consisting of non-vertebrate foods such as fungi, fruits, and other plant material. They are typically small to medium-sized species and highly adaptable to life in human-impacted environments. For example, red foxes (*Vulpes vulpes*), gray foxes (*Urocyon cinereoargenteus*), raccoons (*Procyon lotor*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), and Virginia opossums (*Didelphis virginianus*) are all considered mesocarnivores, and these species are now quite common in urban settings and frequently coexist with well-established populations of feral cats (*Felis catus*) and feral dogs (*Canis familiaris*).

Throughout much of the U.S., professional wildlife scientists and researchers are gaining more and better knowledge on mesocarnivore presence, habitat use, movements, home range sizes, and foraging/feeding behaviors in urban areas. Interestingly, the impetus for much of this work is deeply-rooted to linkages and concerns about human health, risks of disease transmission to humans and pets, and human conflicts with wildlife. Such human-wildlife conflicts—whether real, anticipated, or feared—are a growing concern for residents,

which become foci for city and urban planners, as potential zoonotic diseases may pose serious health and financial threats to both people and their pets – if transmission risks are real. The surprising close-proximity in which we live our lives near these animals can be a real issue, and as the study of urban wildlife ecology grows, so does the need for understanding how these environments influence wildlife occurrence and presence in these urban systems. Consequently, identifying and recognizing what environmental and urban habitat features influence mesocarnivore presence within urban areas are key to both proactive management and public outreach efforts to minimize conflicts and concerns about coexistence within urban settings.

With this as a background, we have been performing a camera-based research project in Lubbock, Texas, as a means by which to provide some of the first formal research into urban mesocarnivore presence and occupancy patterns in the Southern Great Plains of Texas. Ideally, this research will provide insights regarding mesocarnivore affinities for certain portions of the city, and help to inform city managers and neighborhoods as to how to minimize potential human-wildlife conflicts.



A gray fox near a den associated with the Ranching Heritage Center, Lubbock, Texas.

During 2016–2017, 121 1-km² cells were overlaid onto Lubbock city limits, and 24 of these cells were randomly selected in an adaptive sampling structure to deploy infrared triggered cameras in alleys. This 1 km² cell size was selected to mirror previously published estimates of urban gray fox home range size, as gray fox were identified as a focal species of interest for this research. We coordinated permission to place cameras in neighborhood alleys with private homeowners, via flyers and house to house visits. Interestingly, there was overwhelming support and interest from Lubbock residents about our work, and many had anecdotal stories about wildlife they had observed in their yards and neighborhoods. Once we secured permission, we deployed cameras for 14 day sampling periods to photographically “capture” gray fox and other mesocarnivores using cameras. Presence and location of any mesocarnivores were documented and noted, and these data are forming the basis for Chris Carter’s Master of Science thesis research in the Department of Natural Resources Management at Texas Tech University. During the field data collection, >750,000 individual images were captured. Of those, ~75,000 were of focal mesocarnivores, including red and gray fox, raccoons, coyotes, Virginia opossums, and feral dogs and cats, the latter of which were captured nearly 37,000 times in individual images during this study. The remainder of the images were of vehicles traveling the alleys, pedestrians or homeowners walking in the alleys, or images of vegetation



Chris Carter, M.S. Graduate Student in the Department of Natural Resources Management at Texas Tech, deploying a camera as part of his research on urban mammals in Lubbock, Texas.

moving in the wind that triggered the cameras. Although a 10% “capture” rate of focal species perhaps seems like a low success rate, this is not uncommon, and there are plenty of images to use in this research project.

A number of variables are being analyzed to explain species-specific presence and occupancy patterns. These variables include both traditional “wildlife habitat” features, such as land cover type, proximity to water and green-space, canopy

cover, and presence/absence of other mesocarnivores, as well as more anthropogenically driven variables such as neighborhood age, local home prices, and human density. These variables are being used to develop computer models that are most useful and informative in explaining occurrence and occupancy of these species within Lubbock. Analyses are currently underway, and the various models will be further analyzed to determine which are best at explaining focal species presence. Ideally, these models will be useful in identifying areas within Lubbock that might be more likely to be attractive for these focal species, and perhaps assist neighborhoods and city planners in minimizing potential conflicts in the future.

Preliminary analyses suggest coyote presence is related to open space as well as grass and croplands in the area: they tend to be associated with more native habitat-like areas, which are more commonly found in the northern portions of the study area. This is in contrast to coyote studies conducted in larger metroplexes like Chicago, New York, and Los Angeles, where coyotes are growing more habituated to cities and are commonly observed in highly developed locations. In contrast, both gray foxes and feral cats were ubiquitous in our study, where feral cats were the most commonly photographed focal species, and were detected in all 24 study area cells. To date, no strong, definitive habitat associations with have emerged for gray fox, as they were common and photographed in 21 of 24 cells during the study. However, gray fox presence was correlated with residential developments, as was feral cat presence. For gray fox, this is a bit unusual, as other urban studies where gray foxes were focal species, they tended to be less associated with human presence than other more common urban denizens like raccoons in most urban settings. However, in our study, so far, opossums and raccoons were negatively associated with a lack of canopy cover and open development, which indicates that both species are commonly associated with tree cover within Lubbock city limits.

Although preliminary, this research does suggest some finer-scale partitioning of Lubbock by these species, and more sophisticated modeling approaches will hopefully illustrate more clear associations related to occupancy of these species. Ideally, these data and this research can help city planners and managers identify “hotspots” of mesocarnivore presence in Lubbock and assist in the development of educational and outreach materials for concerned citizens. Moreover, this preliminary research project stands to form the basis for more detailed urban wildlife research in Lubbock—where future efforts to capture, mark, and collar foxes, raccoons, and even feral cats will provide a unique opportunity to more closely examine movements, home ranges, and resource selection patterns within this urban landscape.

For more information, please contact Chris Carter (christopherrcart@gmail.com) or Dr. Warren Conway (warren.conway@ttu.edu).

NSRL COLLECTIONS - SUMMARY AND STATISTICS

The Natural Science Research Laboratory (NSRL) is a division of the Museum of Texas Tech University that archives biological samples and their associated data. These collections serve as a library of our natural heritage for education and research purposes. Natural history collections provide the foundation for our understanding of biodiversity. They serve as a historical reference for documenting changes in our environment and the effects of those changes on wildlife and, ultimately, on humans.

The collections maintained by the NSRL are available to researchers at academic, scientific, and government institutions around the world for scientific investigation, discovery, and problem-solving in the natural sciences. The causes and/or effects of animal-borne diseases, environmental pollutants, parasites, climate change, habitat loss, geographic isolation, and natural evolutionary processes and speciation are just a few examples of the investigations that can be conducted utilizing specimens and tissues archived in a natural history collection. Further, the resources of the NSRL are utilized by the academic and scientific communities to train and educate students at the undergraduate and graduate levels for careers in the natural sciences as well as museum science.

Mammal Collection



The Mammal Collection currently contains 140,583 cataloged specimens of an estimated 1,441 species. Specimen preparation types include preserved skins, skeletal materials, alcohol-preserved specimens, and taxidermy mounts. From January through June 2018, the Mammal Collection cataloged 4,374 specimens and granted 10 loans totaling 134 specimens.

Bird Collection



The Bird Collection currently contains 5,528 cataloged bird specimens, as well as eggs and nests, of approximately 890 species. From January through June 2018, the Bird Collection cataloged 11 new specimens and granted 7 loans totaling 187 specimens.

Invertebrate Zoology Collection



The Invertebrate Zoology Collection contains an estimated 4.5 million specimens. These include insects, crustacea, endo- and ecto-parasites, and arachnids. Specimen preservation methods include dried, fluid (ethanol or formalin), slide-mounted, and frozen.

Genetic Resources Collection



The Genetic Resources Collection contains >375,000 samples of tissues, blood, and extracted DNA from >100,000 specimens of mammals and other taxa. From January through June 2018, the GRC granted 19 loans totaling 343 samples. The Collection incorporated 6,035 new samples obtained from 1,139 individuals.

As a whole, the NSRL hosted 232 visitors and volunteers from January through June, including researchers utilizing the collections, students taking classes, individuals and groups on tours, and volunteers assisting in the collections. The NSRL also filled 85 data requests by researchers. Twelve students (6 graduate, 6 undergraduate) were employed by the NSRL during all or part of the January through June time period.

NSRL FACULTY CURATORS



Dr. Robert D. Bradley is Director of the NSRL, Curator of Mammals, and Professor of Biological Sciences. Dr. Bradley's research foci are systematics and molecular evolution of New World rodents; hybridization; infectious zoonotic diseases; and natural history of mammals. He has been a faculty member since 1994. He is currently advising 2 PhD, 2 MS, and 3 undergraduate students. He has graduated 19 MS, 2 MA, and 11 PhD students, and he has published 1 book and 172 peer-reviewed articles.

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Dr. Nancy McIntyre is the NSRL Curator of Birds and a Professor of Biological Sciences. She is a landscape ecologist whose research focuses on how land conversion and climate change are fragmenting migratory habitats for wildlife in the Great Plains of North America. Dr. McIntyre has served as Curator of Birds since 2006. She is currently advising or co-advising 1 MS, 3 PhD, and 1 undergraduate students.

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Dr. Caleb D. Phillips is the Curator of Genetic Resources of the NSRL and an Assistant Professor of Biological Sciences. The Phillips' lab studies how gene expression and microbiome communities evolve in support of mammalian life histories; bioinformatics; and the evolutionary/developmental process of mammalian divergence. He is currently advising 3 PhD, 2 MS, and 1 undergraduate students.

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Dr. Richard Stevens was appointed as Assistant Curator of Mammals in 2018 and is an Associate Professor of Natural Resources Management. He is a bat and rodent community ecologist, macroecologist, and biogeographer. His lab conducts collections-based ecological work in Paraguay, Colombia, Mojave Desert, and Texas. He is currently advising 8 PhD, 1 MS, and 4 undergraduate students.

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NSRL CURATORIAL AND SUPPORT STAFF



Heath Garner is the NSRL Curator of Collections. His role is to facilitate the daily operations and maintenance of the NSRL collections. His duties include specimen processing, cataloging, and tracking, loan processing, student worker and volunteer training and supervision, documentation, and collections preventative conservation.

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Kathy MacDonald is the Collections Manager for the Genetic Resources Collection. Her primary duties include the organization and processing of incoming samples and the subsampling and processing of loans. Other duties include maintaining the NSRL website, assisting with specimen tracking in the collections, and data management and design.

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Lisa Bradley is the Production Editor for Occasional Papers and Special Publications. Her duties include coordinating the review and revision process, copy editing, and final layout and design. She also assists in the writing and editing of scientific articles published by NSRL staff, the preparation of grant proposals, and the development of NSRL exhibits for the Museum.

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The position of **Curator of Invertebrate Zoology** is currently vacant. Due to a state-mandated hiring freeze and a subsequent budget cut, we unfortunately are unable to fill this position at this time. The Invertebrate Zoology Collection therefore is temporarily closed, and we are unable to accept research requests, collection visits, or donations of new material. Current NSRL staff are maintaining the collection. We hope to resolve these funding issues and fill this position in the near future.

OCCASIONAL PAPERS AND SPECIAL PUBLICATIONS OF THE MUSEUM OF TEXAS TECH UNIVERSITY

The NSRL produces two peer-reviewed publication series, Occasional Papers and Special Publications, both of which are edited by Dr. Robert D. Bradley, Director of the NSRL. These series provide outlets for scholarly works resulting from museum-based natural history research. Relevant topics include, but are not limited to, taxonomic studies, faunal lists, species descriptions, zoonoses research, distributional records, and field and museum techniques and methodology, including molecular methods that are applicable to field or museum research. Publication in these series is available to all authors without regard to their association with Texas Tech University. Authors who plan to submit manuscripts to these series should refer to both the Museum Publications Policy and the Guidelines and Procedures for Authors, available at our website, www.nsrl.ttu.edu/publications, for more information.

Lisa Bradley serves as the Production Editor for both series. Our goal is to produce 10–12 Occasional Papers and 1–2 Special Publications per year. Feel free to contact Lisa, lisa.bradley@ttu.edu, if you are interested in submitting manuscripts or monographs to the Occasional Papers or Special Publications series.

Publications produced January–June 2018:

Occasional Paper 353. Bats of Sint Eustatius, Caribbean Netherlands. Scott C. Pedersen, Peter A. Larsen, Sil A. Westra, Ellen van Norren, Wesley Overman, Gary G. Kwiecinski, and Hugh H. Genoways.

Occasional Paper 354. New distributional records of mammals in Texas: Orders Chiroptera, Carnivora, and Rodentia. Michaela K. Halsey, John D. Stuhler, Macy A.

Madden, Erin E. Bohlender, S. Chase Brothers, Ashlyn N. Kildow, Sylvia C. de la Piedra, Carlos J. Garcia, Dondi S. Camp, Cristina Rios-Blanco, and Richard D. Stevens.

Occasional Paper 355. Bats in the Bear Lodge Mountains and surrounding areas in northeastern Wyoming. Keith Geluso and Michael A. Bogan.

View and download Occasional Papers and Special Publications at the NSRL website:
www.nsrl.ttu.edu/publications

FACULTY AND STAFF GRANTS (active January–June 2018)

Bradley, R.D. “Natural History: Development of a liquid nitrogen system for the Genetic Resources Collection, Natural Science Research Laboratory, Museum of Texas Tech University”. NSF (Collections in Support of Biological Research).

Conway, W., R.D. Bradley, C.D. Phillips, and S. Cunningham. “Status of bighorn sheep in Texas: Translocation history, disease risk potential, and establishment of archival tissue collection for range-wide disease surveillance.” Wild Sheep Foundation.

Conway, W., R.D. Bradley, C.D. Phillips, and S. Cunningham. “Funding for a PhD student.” Texas Bighorn Sheep Foundation.

Farmer, M., **T. Kingston,** R. Verble, S. Fritts. “Sustainable development of a tropical agroforestry program in the rural Borneo Highlands.” NSF-IRES.

Johnson, E. and **R.D. Bradley.** “From the African Savannah to the North American Grassland - an Up From the Basement Exhibit.” The Helen Jones Foundation.

Kingston, T. “Southeast Asian Bat Conservation Research Unit.” NSF-Research Coordination Networks.

Kingston, T., and C.D. Phillips. “Community processes structuring assembly and disassembly of bat gut-microbial communities across a gradient of habitat degradation.” NSF.

Longing, S., R. Cox, **N.E. McIntyre,** C. McKenney, and C. West. “Demonstration of pollinator conservation practices and a framework for regional implementation on the Southern High Plains.” USDA Natural Resources Conservation Service - Conservation Innovation Grants.

McGuire, L.P., J.G. Boyles, and W.F. Frick. “Manipulating microclimates to reduce disease severity from white-nose syndrome”. National Fish and Wildlife Foundation.

McIntyre, N.E., and K. Hayhoe. “Collaborative proposal: Climatic and anthropogenic forcing of wetland landscape connectivity in the Great Plains.” NSF-Macrosystems Biology.

Morgan, G. and **R.D. Bradley.** “West Texas Garden (Stage I)—a landscaped learning experience.” The CH Foundation.

Morgan, G., E. Johnson, J. Hoffman, and **R.D. Bradley.** “Biodiversity of the Llano Estacado.” The Helen Jones Foundation.

Olson, S.H., **L.P. McGuire,** R.K. Plowright, D.T.S. Hayman, B.G. Dickson, and C.L. Lausen. “Assessing white-nose syndrome in the context of non-stationary conditions in an advancing continental epidemic.” Department of Defense-Strategic Environmental Research and Development Program.

Phillips, C.D. “Status, distribution, morphology and genetics of *Sigmodon fulviventer dalquesti* in the Chihuahuan Desert Ecoregion.” Texas Parks and Wildlife Department.

Phillips, C.D. “Genetic species identification of *Cicurina* sp.” Zara Environmental LLC.

Kingston, T., and C.D. Phillips. “Community processes structuring assembly and disassembly of bat gut-microbial communities across a gradient of habitat degradation.” NSF.

Plowright, R.K., O. Restif, **L.P. McGuire,** N. Bharti, E. Shanahan, P. Eby, M. Taylor, H. McCallum, and A. Peel. “Dynamics of zoonotic systems: Human-bat-pathogen interactions.” National Science Foundation, Dynamics of Coupled Natural and Human Systems.

Ray, D., R.D. Stevens, and **R.D. Bradley.** “Population and conservation status of Texas pocket gophers (*Geomys* and *Thomomys*) in Texas with a focus on the subspecific status of *Thomomys bottae* via populations genomic tools.” Texas Parks and Wildlife Department.

Ray, D.A. and **R.D. Stevens.** “Comparing genetic diversity of the threatened northern long-eared bat across their range using whole-genome and RADSeq approaches.” U.S. Forest Service.

Rico-Cernohorska, A., **J. Salazar-Bravo,** et al. “Generación de fortalezas para la determinación de enfermedades zoonóticas en el norte de La Paz (PBE4 - Phase II).” Proyectos Concursables De Investigacion E Interaccion Social (IDH), Bolivia.

Stevens, R.D. “Habitat affinities and day roost characteristics of the Northern Long-eared Bat (*Myotis septentrionalis*) in Louisiana.” USFWS/Louisiana Department of Wildlife and Fisheries.

FACULTY AND STAFF GRANTS (continued)

Stevens, R.D. “Winter day-roost characteristics of the Northern Long-eared Bat (*Myotis septentrionalis*) in Louisiana.” U.S. Forest Service.

Stevens, R.D. and S. Fritts. “Fort Wolters bat surveys.” Texas Army National Guard.

Stevens, R.D. and S. Fritts. “Camp Maxey herpetofauna surveys.” Texas Military Department.

Stevens, R.D. “Interactions between bats and highway structures on the Trans Pecos of Texas.” Texas Department of Transportation.

Stevens, R.D. and **D.A. Ray**. “Distribution and conservation genetics of *Myotis* and other critically imperiled bats in Louisiana.” United States Fish and Wildlife Service/ Louisiana Department of Wildlife and Fisheries.

Stevens, R.D. and **L. McGuire**. “Winter site-occupancy and foraging activity of bats on the coastal plain of the southeastern United States with particular focus on Northern Long-Eared Bats (*Myotis septentrionalis*).” National Council for Air and Stream Improvements, Inc.

Stevens, R.D., D. Ray, R.N. Platt, and R.D. Bradley. “RFP No. 209f for endangered species research projects for the Texas Kangaroo Rat.” Texas State Comptroller.

Varela, R., **J. Salazar-Bravo**, et al. “Identification of peptides isolated from the slime of the Giant African snail (*Achatina fulica*) and their antimicrobial activity”. COLCIENCIAS, Colombia

STUDENT GRANTS AND RESEARCH AWARDS

Ezra Auerbach, graduate student, Nancy McIntyre. TTU Graduate Recruitment Fellowship/The CH Foundation Graduate Fellowship.

Lucas Heintzman, graduate student, Nancy McIntyre. Elo and Olga Urbanovsky Assistantship; TTU Water Conservation Research Scholarship.

Macy Madden, graduate student, Tigga Kingston. TTU Association of Biologists, Grants in Aid.

Nicole Paulat, graduate student, David Ray. TTU Association of Biologists, Grants in Aid.

Jeff Clerc, graduate student, Liam McGuire. TTU Association of Biologists, Grants in Aid.

Beth Rogers, graduate student, Liam McGuire. TTU Association of Biologists, Grants in Aid.

FACULTY AND STAFF AWARDS

Robert Bradley and **Lisa Bradley** were both awarded honorary membership in the Texas Society of Mammalogists.

Liam McGuire was presented with the New Faculty Award from the Texas Tech Alumni Association.

Nancy McIntyre was recognized with the Distinguished Service Award from the U.S. Chapter of the International Association for Landscape Ecology.

Richard Stevens was recognized with the Bernie E. Rushing Jr. Faculty Outstanding Researcher award and was awarded with the President’s Excellence in Research Professorship.

RECENT PUBLICATIONS BY NSRL FACULTY, STAFF, AND STUDENTS

- Bohlender, E.E., N. Borray-Escalante, J. Perez-Torres, and **R.D. Stevens**. Dietary variation during reproduction in Seba's short-tailed fruit bat. *Journal of Mammalogy* 99:440-449.
- Davy, C.M., M.E. Donaldson, C.K.R. Willis, B. Saville, **L.P. McGuire**, H. Mayberry, A. Wilcox, G. Wibbelt, V. Misra, T. Bollinger, and C.J. Kyle. Environmentally persistent pathogens present particular challenges for studies of host-pathogen interactions: Reply to Field (2018). *Ecology and Evolution* 8:5238–5241.
- Delgado, E., L.F. Pacheco, **J. Salazar-Bravo**, and O. Rocha. Rediscovery of the chinchilla in Bolivia. *Oryx* 52:13-14.
- Delgado, E., L.F. Pacheco, **J. Salazar-Bravo**, and O. Rocha. Chinchilla real (*Chinchilla chinchilla*) en Bolivia: comentarios sobre localidades reportadas y bases para su conservación. *Ecología en Bolivia* 53:31-38.
- Halsey, M.K., J.D. Stuhler, M.A. Madden, E.E. Bohlender, S.C. Brothers, A. Kildow, S.C. de la Piedra, C.J. Garcia, D.S. Camp, C. Rios-Blanco and **R.D. Stevens**. New distributional records of mammals in Texas: Orders Carnivora, Chiroptera and Rodentia. *Occasional Papers, Museum of Texas Tech University* 354:1-6.
- McIntyre, N.E.**, S.D. Collins, L.J. Heintzman, S.M. Starr, and N. van Gestel. The challenge of assaying landscape connectivity in a changing world: A 27-year case study in the southern Great Plains (USA) playsa network. *Ecological Indicators* 91:607-616.
- Liechti F., and **L.P. McGuire**. Facing the wind: aeroecology of vertebrate migrants. Pp. 179–198 in *Aeroecology* (P Chilson, WF Frick, J Kelly, and F Liechti, eds.). Springer International Publishing.
- Phelps, K., and **T. Kingston**. Environmental and biological context modulates the physiological stress response of bats to human disturbance. *Oecologia* 1-12. DOI: 10.1007/s00442-018-4179-2.
- Phelps, K., R. Jose, M. Labonite, and **T. Kingston**. Assemblage and species threshold responses to environmental and disturbance gradients shape bat diversity in disturbed cave landscapes. *Diversity* 10(3):55.
- Platt II, R.N., M.W. Vandewege, and **D.A. Ray**. Mammalian transposable elements and their impacts on genome evolution. *Chromosome Research* 26:25-43.
- Snegovaya, N. Yu., **J. C. Cokendolpher**, and F. Mozaffarian. The Opiliones of Iran with a description of a new genus and two new species. *Journal of Arachnology* 46:69–80.
- Stevens, R.D.**, and J. Sebastian Tello. A latitudinal gradient in dimensionality of biodiversity. *Ecography*, In Press.
- Stukenholtz, E.E., J. Pérez-Torres, and **R.D. Stevens**. Variation of vaginal cytology, progesterone and estradiol metabolites in Seba's short-tailed fruit bat during the estrous cycle and gestation. Variación de la citología vaginal y los metabolitos de progesterona y estradiol en el murciélago frutero común durante el ciclo estral y la gestación. *Mastozoología Neotropical*, In Press.
- Teeling, E., S. Vernes, L. Davalos, **D.A. Ray**, M.T.P. Gilbert, E. Myers, and Bat1K Consortium. Bat1K: A proposal to generate chromosome-level genomes for all living bat species. *Annual Review of Animal Biosciences* 6:23-46.
- Thomson, S., R. Pyle, S. Ahyong, M. Alonso-Zarazaga, et al. (**J. Salazar-Bravo**). Taxonomy based on science is necessary for global conservation. *PLoS Biol* 16(3): e2005075. <https://doi.org/10.1371/journal.pbio.2005075>



This June, Dr. Richard Stevens's "Techniques in Bat Ecology" course visited several sites in Texas and New Mexico. At a site in Lincoln National Forest, New Mexico, a Spotted Bat (*Euderma maculatum*) was caught and released (left). This unique and beautiful bat (right) is considered by the state wildlife agencies of New Mexico and Texas to be a threatened species.



Photo by National Park Service (public domain).

In Memoriam: Robert J. Baker, 1942–2018



On 30 March 2018, the NSRL and the field of mammalogy suffered a grievous loss when Robert J. Baker, Ph.D., passed away after several months of declining health. Robert was a key founder of the NSRL, and served as its director from 1976 until his retirement in 2015. He was a Horn Professor, which is the highest faculty honor bestowed by Texas Tech University. Robert chaired the graduate committees of 48 Master's students and 50 Ph.D. students. His bibliography of publications is currently at 438, and still growing. The list of his accomplishments goes on, and it is too long and complex to fully describe here.

But Robert's impact on the NSRL, education, mammalogy, and so many of us as individuals truly cannot be described in a title, or a list of publications, or any other data point that is commonly used to measure a career in science. His loss is profound and has been felt deeply by his students, colleagues, friends, and of course his family. Many of these individuals have contributed to efforts to honor Robert's memory and his influence on mammalogy, education, and the NSRL. On June 2nd, the Museum hosted a Celebration of Life event. This event was very well attended and featured several speakers as

well as PowerPoint presentations of photographs and memory statements that had been submitted by Robert's former students and colleagues. A professional obituary, published in the August issue of the *Journal of Mammalogy*, was authored by Hugh Genoways, Robert Bradley, David Schmidly, Lisa Bradley, James Bull, Karen McBee, Meredith Hamilton, and Peter Larsen. And finally, a memorial volume of papers is being developed that will be published in the NSRL's *Special Publications* series in 2019.

As Director of the NSRL and Curator of Mammals and the Genetic Resources Collection, Robert was the driving force in building the NSRL into a world-class resource for research and education.

The NSRL would not exist today if it had not been for the passion and dedication that Robert committed to its development throughout the years. We sincerely hope that we can do justice to his memory and demonstrate our gratitude to Robert by carrying on that devotion to science, fieldwork, students, and the future of natural history collections and research.



Student Profiles



Erin Stukenholtz, Ph.D. student, Department of Natural Resources Management. Advisor: Richard D. Stevens.

Erin is currently studying the ecology of pigeons on campus, movements with GPS transmitters, nest site selection, fledgling success, and population size. Her doctoral research is focusing on the effects of urbanization on avian community structure, and the interactions between native and invasive bird species.



Holly Wilson, Ph.D. student, Department of Natural Resources Management. Advisor: Richard D. Stevens.

Holly's interests lie in wildlife conservation and applied ecology. Her dissertation research focuses on bats roosting under bridges and in culverts in the Trans-Pecos ecoregion and how their occurrence relates to the surrounding habitat and structural characteristics of the roosts.

Collection Activities: Notable Taxidermy Acquisition

The NSRL recently acquired an impressive collection of 18 taxidermy mounts of African game mammals to enhance our existing collection. In a cooperative agreement with Angelo State University's Natural History Collection, that institution also acquired full-body mounts of a crocodile and a male African lion.



The collection came to us and Angelo State from a single donor. The mounts were being stored in a warehouse in Florida and were destined for the home of the donor's uncle. However, the uncle moved to Costa Rica, the warehouse was placed on the market, and the taxidermied specimens no longer had a home. At that point, the donor determined that the specimens would be better served at a museum with a research and/or educational institution. After approaching a few other museums, the donor approached Angelo State University, and ASU shared the opportunity for acquisition with the NSRL.

The collection includes head mounts of a waterbuck, hartebeest, zebra, and hippo, and full-body mounts of two warthogs, an African bush pig, nyala, sitatunga, sable antelope, Thomson's gazelle, Grant's gazelle, Robert's gazelle, impala, southern reedbuck, Bohor reedbuck, springbok, and lesser kudu. All are in pristine condition. Pending funding, the NSRL plans to create a taxidermy display in our atrium area. A mounting system will utilize the two-story atrium walls for display of many of the new taxidermy mounts, as well as the best examples from our existing collection. Our hope is to make the atrium exhibit available for public viewing via scheduled, docent-led tours.



Current Exhibit Highlights the Mammals of North American and African Grasslands

An exhibit recently developed by the curators and staff of the NSRL is on display at the Museum through December 2018. This exhibit examines the biodiversity of North American and African grasslands and features several of the underutilized taxidermy specimens of the NSRL, including the showpiece African Elephant head that was donated to the Museum in 1983 by William C. McMillan, Jr. That elephant had been collected by his father on a safari in Kenya in 1947. Among the other taxidermy on display are a warthog and a hippo head, both recently donated to the NSRL (see accompanying article). The impressive giraffe that greets visitors as they enter the exhibit is on temporary loan from the Angelo State Natural History Collection of Angelo State University.



The exhibit is about much more than just seeing these amazing animals, however. It is about engaging visitors and educating them about the biological value of grasslands, the importance of conservation, and the ways in which urbanization, agricultural practices, hunting, and other factors affect wildlife diversity. Come visit the Museum soon to see this exhibit, and so much more!

This exhibit was funded by the Helen Jones Foundation, Inc.

In Memoriam: Stephen L. Williams (1948-2018)



Stephen L. Williams, Ph.D., passed away in Waco, Texas, on 31 July 2018. Steve received his Master's degree in Biology under the direction of Dr. Robert J. Baker at Texas Tech, as well as his Master's in Museum Science under the direction of Dr. Hugh H. Genoways. He earned his doctorate in Conservation from the University of Gothenburg in Gothenburg, Sweden.

Steve served as Collection Data Analyst for the Museum of Texas Tech in 1975–1976, before accepting a position as a Collection Manager at the Carnegie Museum. He returned to Texas Tech in 1990 as Collections Manager for the NSRL and Adjunct Professor of Museum Sciences. In 1995, Williams left Texas Tech for a faculty position in Museum Studies at Baylor University, where he remained until his retirement in 2007.

Steve was an outstanding scientist and an even better person. He combined the best of field research, mammalian systematics and taxonomy, and forward thinking research pertaining to collections care and archival methods. Steve was a central part of collections activities at the NSRL, Carnegie Museum, and Mayborn Museum (formerly Strecker Museum) at Baylor. As Robert Bradley recalls: “When Steve wasn't in the field or measuring gopher skulls, he was testing the latest ink, paper, trays, and other archival materials. He was the prototypical Collection Manager. On many occasions I would enter the NSRL to find dozens of jars containing either water or ethanol lined up in the prep lab. Each jar would contain a piece of a skin tag with a number written on it, and Steve would be evaluating effectiveness of the latest permanent ink pens that hit the market. Everyone affiliated with systematic collections should review Steve's publications associated with collections care.” Some of his most notable publications include *A Guide to the Management of Recent Mammal Collections* (1977), *Destructive Preservation* (1999), and *Museum Studies: Perspectives and Innovations* (2006).

Steve made many contributions to mammalogy and systematic collections, but he made even more friends. He will be missed.

STUDENT PRESENTATIONS

During January through June 2018, at least 33 graduate students and 5 undergraduate students gave 45 oral and 14 poster presentations of their research at 5 national, 4 state or regional, and 2 local conferences and society meetings. The following students won presentation awards.

Jeff Clerc, graduate student, Liam McGuire. 1st place, Ecology, Texas Tech 9th Annual Biological Sciences Symposium.

Elizabeth Rogers, graduate student, Liam McGuire. 1st place, Evolution, Texas Tech 9th Annual Biological Sciences Symposium.

Michaela Halsey, graduate student, Richard Stevens/David Ray. 2nd place, Conservation, Texas Tech 9th Annual Biological Sciences Symposium.

Oscar Sandate, graduate student, Caleb Phillips. 1st place, Genetics, Texas Tech 9th Annual Biological Sciences Symposium.

Ashlyn Kildow, undergraduate student, Richard Stevens. 2nd place, undergraduate oral, Texas Tech 9th Annual Biological Sciences Symposium.

Iroro Tanshi, graduate student, Tigga Kingston. 2nd place, Ecology, Texas Tech 9th Annual Biological Sciences Symposium.

Jennifer Korstian, graduate student, David Ray. 2nd place, Genetics, Texas Tech 9th Annual Biological Sciences Symposium.

Craig Tipton, graduate student, Caleb Phillips. 1st place, Microbiology, Texas Tech 9th Annual Biological Sciences Symposium.

STUDENT HIGHLIGHT

This spring, Laramie Lindsey and Emma Roberts, both PhD candidates under the direction of Dr. Robert Bradley in the Department of Biological Sciences, were announced as 2018–2019 recipients of Doctoral Dissertation Completion Fellowships from the TTU Graduate School. This one-year award matches a teaching assistant salary, for the purpose of allowing PhD students to devote their time to research and writing as they complete their dissertation. This award also allows the department to recruit a new graduate student by utilizing the funding previously committed to the award winner. Students must be nominated by their major advisor and/or departmental faculty. As a university-wide annual award, this is a highly competitive fellowship. Congratulations to Laramie and Emma!



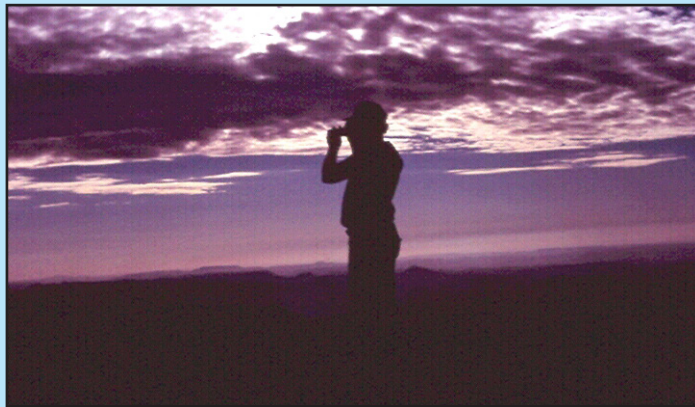
Laramie Lindsey: “My dissertation focuses on the implementation of bioinformatics and genomics in mammalian systems. The first chapter of my dissertation compares testes transcriptomes of taxa sampled across the *Peromyscus*

phylogeny to identify genes with putative reproductive functions that may have played a role in speciation and the adaptive radiation of *Peromyscus*. The next two chapters of my dissertation include custom building an exome array for *Peromyscus* using the annotated genome of *P. maniculatus bairdii* and sequencing exomes of as many species of *Peromyscus* as possible to reconstruct the phylogeny.”



Emma Roberts: “My dissertation research focuses on the process of gamete recognition in fertilization. I am working with the protein zonadhesin, which is species-specific and inhibits cross-species fertilization. This molecule

might be a crucial reproductive isolation mechanism in mammals, ensuring only species-specific fertilization and successful formation of non-hybrid offspring. I am exploring molecular evolution of zonadhesin in three experimental approaches. First, I am determining the role of zonadhesin in mammalian evolution at the ordinal and super-ordinal level by constructing phylogenies of all mammalian orders. Second, I am examining rodent species that are known to hybridize, including pocket gophers (*Geomys*), wood rats (*Neotoma*), and ground squirrels (*Ictidomys*). Lastly, I am investigating the process of alternative mRNA splicing in zonadhesin, which may contribute to the rapid molecular evolution and radiation events seen in rodents.”



Looking for good students! Bradley in Davis Mountains, Texas.

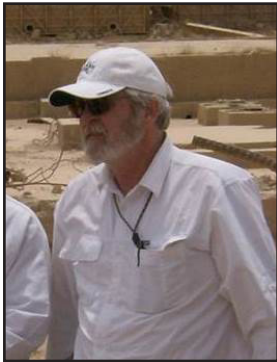
A Message to Prospective Students:

Faculty and staff associated with the NSRL are very active in field- and specimen-based research. Our faculty and students have interests in mammalogy, ornithology, invertebrate zoology, molecular systematics, genomics, ecology, and museum science. Most of the undergraduate and graduate students that are affiliated with the NSRL receive degrees in the Department of Biological Sciences or the Department of Natural Resources Management. We

also have students who are part of the Museum Science program. Together, we have a strong core of faculty and undergraduate and graduate students, and we are always on the look-out for potential new students. If you are interested in pursuing a graduate degree or undergraduate research opportunities, please contact any of the faculty members highlighted in this newsletter.

TTU FACULTY ASSOCIATES OF THE NATURAL SCIENCE RESEARCH LABORATORY

The following faculty at Texas Tech University have research programs that both contribute to and benefit from a working relationship with the Natural Science Research Laboratory. Graduate and undergraduate students of these faculty members, as well as those of the faculty Curators of the NSRL, conduct field-based research studies that result in growth of the NSRL collections and conduct laboratory-based research utilizing the resources of the NSRL to advance the sciences of mammalogy, ornithology, invertebrate zoology, wildlife ecology, and many other disciplines. The NSRL's strong history of field-based and organismal research, and continued commitment to such endeavors, set us apart from many other natural history programs.



Dr. Ron Chesser is a Professor of Biological Sciences. His research program focuses on assessing radioactive contamination, reconstructing flow of radioactive materials into the environment, and modeling the impacts and recovery of mammal populations affected by radiation. He has conducted research at Chernobyl, Ukraine, since 1992. He worked in Iraq for eight years (2005–2013) dismantling the former nuclear infrastructure, and he has contracted with the US Department of State, Department of Energy, International Atomic Energy Agency, Great Britain Ministry of Industry, US Civilian Research & Development Foundation, and the European Commission.

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<http://www.faculty.biol.ttu.edu/chesser/homepage/>



Dr. Warren Conway is the Bricker Endowed Chair in Wildlife Management within the Department of Natural Resources Management. He and his students are involved in a variety of research projects in Texas, New Mexico, and Oklahoma with common themes of wildlife-habitat relationships, population and community dynamics, population management, restoration, and conservation, and toxicology and disease prevalence. Current projects include mule deer and pronghorn survival and habitat selection; urban mesocarnivore community ecology; elk response to prescribed fire and thinning; wildlife genetics; and disease and toxicology of populations of bighorn sheep, axis deer, and American woodcock.

warren.conway@ttu.edu

https://www.depts.ttu.edu/nrm/people/faculty/faculty_pages/warrenconway/conway.php



Dr. Tigga Kingston is an Associate Professor of Biological Sciences. Her research and activities are dedicated to the conservation ecology of Paleotropical bats. She has been working on the conservation ecology of bats of Southeast Asia for more than 20 years, with projects in Malaysia, Indonesia, Myanmar, Philippines, and Vietnam. More recently, she has student projects and collaborations in Africa, specifically Nigeria, Kenya, and South Africa.

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Dr. Joseph D. Manthey is an Assistant Professor of Biological Sciences. His research group uses a combination of fieldwork, specimens, ecological data, genomics, and bioinformatics to study how organisms (mostly birds) evolve across both geographic and genomic landscapes. Major research themes include: (1) how and why species' genomes change through evolutionary time, (2) diversification at different spatial and temporal scales in sky islands, and (3) impacts of fragmentation on population connectivity in sky islands.

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Dr. Liam McGuire is an Assistant Professor of Biological Sciences. His research focuses on the ecology and physiology of bats and birds in situations of energy limitation (e.g., migration, hibernation) and the strategies these animals use to cope with environmental variation, often in the context of conservation issues. He takes an integrative approach using techniques ranging from molecular biology and biochemistry, to whole animal physiology, behavioral and movement ecology. Current research foci include the physiological ecology of bat migration, and the physiological ecology and pathophysiology of hibernating bats affected by white-nose syndrome, a devastating fungal disease responsible for killing millions of North American bats.

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<https://www.depts.ttu.edu/biology/people/Faculty/McGuire/>



Dr. David A. Ray is an Associate Professor of Biological Sciences. The Ray laboratory focuses on the study of genomes and genome evolution with an emphasis on transposable elements and their role in the diversification of species. Model organisms include bats, several other mammals, and crocodylians.

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<http://www.davidraylab.com/>



Dr. Brenda Rodgers is an Associate Professor of Biological Sciences. Her research centers on the impacts of radiation on small mammals, mechanisms of adaptation to low dose radiation in pregnant females and fetuses, and human health issues in contaminated environments. She has worked on mammal population impacts at Chernobyl, Ukraine, since 1997. She worked for eight years in Iraq evaluating human impacts in contaminated regions and training scientists on laboratory practices, and she has contracted with the US Department of Energy (Low-dose Program), US Department of State, and the Civilian Research & Development Foundation.

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Dr. Jorge Salazar-Bravo is an Associate Professor of Biological Sciences. His research revolves around two basic themes: developing and testing phylogenetic hypotheses for mammalian taxa at various hierarchical levels; and using first principles in ecology and evolution to understand the triggers for disease emergence. Research topics he has pursued, as represented in his publications, include: systematics, biogeography, evolution, and conservation of Neotropical mammals; the ecology and evolution of virus/host co-evolution; and the interplay between ecology and disease.

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<http://www.depts.ttu.edu/biology/people/Faculty/Salazar-Bravo/>

MAY 2018 GRADUATES

Arnab Ghosh, Ph.D. Chair: David Ray. Dissertation title: Gene Annotation and Small RNA Characterization in the Saltwater Crocodile: *Crocodylus porosus*. Current position: Postdoctoral Associate, Biological Sciences, Texas Tech.

UNDERGRADUATE RESEARCH

During the period January through June 2018, at least 18 undergraduate students were conducting research under the direction of 6 NSRL faculty associates.



PLEASE SUPPORT THE NSRL

Dear Former Students, Colleagues, and Friends:

In 2015, a fund-raising initiative for the NSRL was established. The NSRL Fund for Excellence is designed to help support the many collections activities of the NSRL. Our goal is to use these funds to establish a student curatorial position. This position would enable the NSRL to improve curatorial and collection management activities, as well as help support students with a professional interest in natural history collections. As this fund grows, we envision that we will be able to financially support multiple students.

Your contribution to the Natural Science Research Laboratory Fund for Excellence is very important to the future of the NSRL. With limited, and often declining, funding from state and federal sources, the NSRL needs your help to ensure our continued service to the academic and scientific communities. We appreciate your consideration in giving a tax deductible donation in support of the NSRL's operations and research. Many of you benefited from the resources provided by the NSRL, now we ask that you help the NSRL continue its quest to be among the premier natural history collections in the world.

Donations to the NSRL Fund for Excellence may be made through the Texas Tech Foundation, Inc. To donate by check, please make the check payable to Texas Tech Foundation, designate NSRL Fund for Excellence on the memo line, and mail to: Texas Tech University System, Financial Services, Box 45025, Lubbock, TX, 79409-5025. To give by phone, call toll free: 1-866-448-3888. To donate online, visit the website of TTU Institutional Advancement at <http://donate.give2tech.com/> and enter Natural Science Research Laboratory Fund for Excellence in the search box.

YOUR SUPPORT IS APPRECIATED! THANK YOU!

NSRL News is produced biannually by Lisa Bradley with assistance from the staff, research scientists, and graduate students of the NSRL. Please contact Lisa to request a hard copy or to submit comments or contributions for upcoming issues of *NSRL News*.

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