

NSRL NEWS

Natural Science Research Laboratory
Museum of Texas Tech University

Volume 10, Spring 2023



NSRL Celebrates 50th Anniversary in 2023

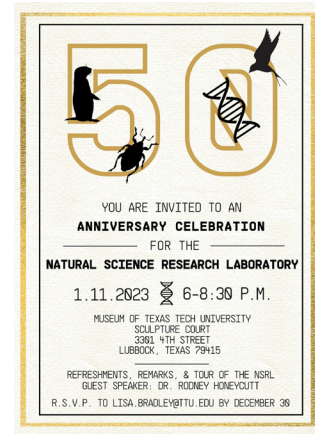
On 11 January 2023, the NSRL marked its 50-year anniversary (1973–2023) with a celebration at the Museum. The event included a presentation by Dr. Robert D. Bradley, Director of the NSRL, who provided an overview of the NSRL, its history, and its goals for the future. Guest speaker Dr. Rodney L. Honeycutt, Professor Emeritus at Pepperdine University, then presented his perspective on changes over time at the NSRL, as well as changes in Texas' human population, landscapes, natural resources, and biodiversity. Dr. Honeycutt discussed the critical role of the NSRL and other natural history museums in addressing the needs for field research, laboratory research, teaching, and educational outreach, with the objective of enhancing knowledge-based environmental stewardship and conservation of biodiversity in Texas and beyond.

In recognition of this milestone anniversary, the current staff of the NSRL prepared an in-depth report about the NSRL's history and its 50 years of accomplishments and contributions to Texas Tech University, the State of Texas, and to society through advancements in scientific research, graduate and undergraduate education, scholarly publication, leadership in natural history collections growth and curatorial management, and public engagement through exhibits and outreach activities. The 72-page report was made available to all attendees of the celebratory event and was provided to

the TTU administrative leadership. The report is available for free download from the NSRL's website at <https://www.depts.ttu.edu/nsrl/about/downloads/NSRLReport2023.pdf>. Finally, an illustrated timeline of the history of the NSRL was prepared and displayed during the event. The timeline is available on the NSRL website at <https://www.depts.ttu.edu/nsrl/about/downloads/NSRLHistoryTimeline.pdf>.

In looking toward the future, the inherent value of preserving and archiving representative voucher specimens and genetic samples from wild populations will become even more important as society wrestles with the biodiversity crisis, climate change, zoonotic outbreaks, and many other complex environmental challenges. The NSRL is committed to meeting the increasing needs of society for natural science research, education of students, collections growth and care, and public awareness, all with the ultimate goal of addressing these biodiversity questions and challenges and contributing to informed solutions.

The NSRL extends a warm thank you to our former staff and students, as well as our friends, supporters, and colleagues at other institutions, who have helped make the NSRL a successful and productive program since 1973. Here's to the next 50 years!



The Giant is Fully Awake: Recent Developments at the Invertebrate Zoology Collection of the NSRL

by Jennifer C. Girón

With an estimated 4.6 million specimens, the Invertebrate Zoology Collection at the Natural Science Research Laboratory, Museum of Texas Tech University, is the largest collection of the TTU Museum. Since its reactivation during the Fall of 2018, there has been a lot of activity. We have had student workers, volunteers, and collaborators who have contributed to several tasks throughout the collection. Our activities have revolved around four main axes, as detailed below.

Research.—We continue to study invertebrate biodiversity. Between 2021 and 2022, Acting Curator Dr. Jennifer Girón has coauthored ten peer-reviewed papers, two of them involving the descriptions of new species of beetles from the Neotropical region (Girón and Short 2021; Atencio et al. 2022). Specimens from the Invertebrate Zoology Collection have been used in at least three publications (Chatzimanolis 2022; Manthey et al. 2022; McDonald et al. 2022). In addition, Shelby Hernandez, an undergraduate student in the Plant and Soil Science Department, has been digitizing the leaf beetles in the collection, and she has begun gathering information for her research project on the leaf beetles of national parks in Texas. We also have loaned about 100 specimens to researchers across the country, which has improved the identification levels of the Collection when the specimens are returned with appropriate species identifications. We also are open for visiting researchers; recently, María Tocora, doctoral aspirant from the University of Alberta, came to the NSRL to work on our ant collection.

Teaching.—The Invertebrate Zoology Collection supports teaching activities at Texas Tech University. At the Department of Biological Sciences, students enrolled in the Insect Diversity class during the Spring of 2022 had the opportunity to use specimens from the Collection to learn hands-on how to identify some insect families. Students in the Introductory Entomology class (Fall 2022) and the elective course on Native Bee Biodiversity (Spring 2022) of the Plant and Soil Science Department attended a lecture and received training on best practices for specimen preparation. Alyssa DeWaele, a graduate student in the Heritage Management and Museum Sciences program of the Museum, learned

the basics of biological specimen curation and databasing, as well as basics of biodiversity informatics.

Outreach.—The Collection also has reached the public in several ways. We created an exhibit entitled “Tiny and Mighty Creatures” that has been available in the Museum galleries since March 2022. The physical exhibit contains 100 individual specimens including beetles, true bugs, butterflies, flies, bees, moths, and more, from all around the world. The exhibit is accompanied by online content available at: https://www.depts.ttu.edu/nsrl/collections/Invertebrate_Zoology/insect-exhibit.php. We also have interacted with young audiences. Dr. Girón was invited to talk to a group of 6–8-year-old STEAM campers at the TTU Child Development Research Center. We also worked with the team at the Lubbock Lake Landmark to bring insect specimens and information to the Conservation Academy during the summer of 2022, and then Dr. Girón told “Tiny Horror Stories” during their Harvest Hike in October. One of our volunteers set up a project on [iNaturalist to document invertebrates around the Museum building](#); feel free to join and help us documenting the diversity of invertebrates around the Museum! Our website got a lift, and now includes more details about the Collection and additional resources for everyone to use. Check it out at https://www.depts.ttu.edu/nsrl/collections/Invertebrate_Zoology/index.php. We have also interacted with the international community: Dr. Girón was invited during the summer of 2022 to the Museum of Insects of the University of Costa Rica to develop research on weevils and to provide guidance about specimen digitization. Dr. Girón offered online talks in Spanish for both topics.

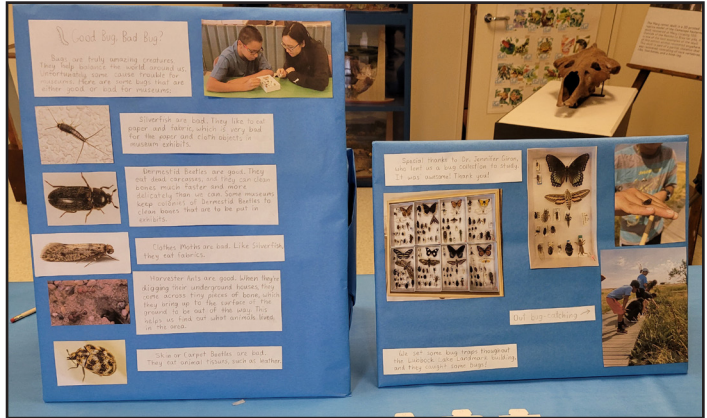
Collections stewardship.—We continue to grow and improve the collection as well as our specimen database. For the past two years, thanks to the efforts of the Acting Curator, students, and volunteers, we have digitized and georeferenced nearly 5,000 specimen records. We also continue to improve the quality of the data that we serve online via SCAN ([Symbiota Collections of Arthropods Network](#)) and GBIF ([Global Biodiversity Information Facility](#)). We also have been funded by a grant from the Texas Parks and Wildlife

Department to digitize and accession more than 17,000 bee specimens that were collected between 2018 and 2021 across the High Plains region of western Texas in projects led by Dr. Scott Longing in the Department of Soil and Plant Science.

The Invertebrate Zoology Collection at the NSRL is open to a variety of uses, including availability of research specimens and materials for faculty and students, work-study opportunities for both graduate and undergraduate students, as a repository of voucher specimens used in research, as an avenue to develop



Camper of the Summer STEAM Camp at the TTU Child Development Research Center observing specimens from the Invertebrate Zoology Collection.



Summer conservation Academy at the Lubbock Lake Landmark participants learned about insects, both good and bad, using specimens from the Invertebrate Zoology Collection. The participants then prepared presentations discussing what they learned about insects.

volunteer work, as a resource for teaching and learning, and potentially for using specimens in artistic endeavors. Feel free to contact our Acting Curator at Jennifer.Giron@TTU.edu with any inquiries about access to the Collection, or simply to get a tour!

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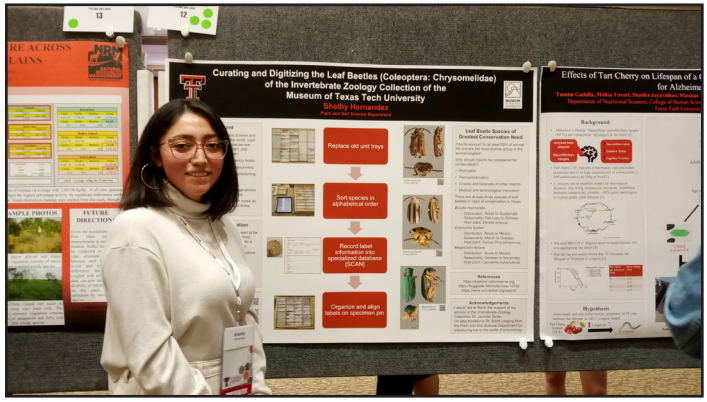
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Undergraduate student Shelby Hernandez from the Plant and Soil Sciences Department, presenting her work curating and digitizing leaf beetle specimens from the Invertebrate Zoology Collection, at the TTU Undergraduate Research Conference in the spring of 2022. The poster is available at https://www.depts.ttu.edu/nsrl/collections/Invertebrate_Zoology/invert_files/Shelby_Hernandez_poster2022.pdf.

NSRL 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 currently is advising 4 PhD, 1 MS, and 7 undergraduate students. He has graduated 21 MS, 2 MA, and 13 PhD students, and he has authored or coauthored 2 books and 208 peer-reviewed articles, all pertaining to mammals.

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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 currently is advising 1 PhD and 4 MS students.

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Dr. Jennifer Girón is Acting Curator of the Invertebrate Zoology Collection. She handles loan and data requests, organizes and processes incoming specimen donations, and manages the specimen database hosted in SCAN (<https://scan-bugs.org/portal/collections/misc/collprofiles.php?collid=7>). She also works with students and volunteers and does research

on beetle biodiversity.

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Dr. Richard Stevens is a Curator of Mammals and 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 currently is advising 8 PhD, 3 MS, and 3

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 currently is

advising 3 PhD, 2 MS, and 2 undergraduate students.

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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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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 157,269 cataloged specimens of an estimated 1,441 species. Specimen preparation types include preserved skins, skeletal materials, alcohol-preserved specimens, and taxidermy mounts. In 2022, the Mammal Collection cataloged 2,238 specimens and granted 21 loans totaling 541 specimens.

Bird Collection



The Bird Collection currently contains 6,347 cataloged specimens, as well as eggs and nests, of approximately 890 species. In 2022, the Bird Collection cataloged 16 newly acquired specimens, and 539 specimens from the “Austin Collection” that were not previously cataloged. The Bird Collection granted 6 loans totaling 123 specimens.

Invertebrate Zoology Collection



The Invertebrate Zoology Collection contains an estimated 4.6 million specimens. These include insects, crustacea, endo- and ecto-parasites, and arachnids. Specimen preservation methods include dried, fluid, slide-mounted, and frozen. In 2022, the collection cataloged 3,315 specimens and granted 4 loans totaling 274 specimens.

Genetic Resources Collection



The Genetic Resources Collection contains ~470,000 samples of tissues, blood, and extracted DNA from >100,000 specimens of mammals and other taxa. In 2022, the GRC granted 38 loans totaling 1,113 samples. The Collection incorporated 9,331 new samples obtained from 2,504 individuals.

As a whole, the NSRL hosted 242 visitors and volunteers in 2022, including researchers utilizing the collections, students taking classes, individuals and groups on tours, and volunteers assisting in the collections. The NSRL also filled 92 information requests. The NSRL employed 25 students (6 graduate, 19 undergraduate) during 2022.

The Bat Cave

by Robert D. Bradley

Well, the old adage “Everything is bigger in Texas” just came true this Spring with the completion of the Bat Cave at the old “Adam’s Ranch”. The property, now designated as the El Carmen Land and Conservation Company (ECLCC), is owned by CEMEX USA and Mr. Josiah Austin (Arizona). The ECLCC is located southeast of Marathon in the heart of the Trans-Pecos region of West Texas. To set the stage, in July of 2022 I was visiting with Bonnie and Billy Pat McKinney (Wildlife & Operations Coordinator and Manager at the ECLCC, respectively) about research projects that could be initiated on the ECLCC. We discussed a number of topics, ranging from wildlife diseases and rodent genetics to bat and bear conservation, that would match our research skills with the sustainability and conservation interests of ECLCC. I proposed an idea of constructing bat houses with cement board exteriors to cut down on heat absorption. This portion of the Chihuahuan Desert gets extremely hot (often >100° F) during the summer months, making bat houses resemble an oven. My idea was to use a cement board product (perfect PR for a cement company like CEMEX) to help deflect the heat as opposed to traditional wooden bat houses. As I was running through my proposed plan, Billy Pat interrupted by saying “Doc, why don’t we build a Bat Cave?” There you have it, think big or go home!

What an idea! Hundreds of bats use the veranda at the old ranch house as a night roost, and hundreds if not thousands use the wetlands habitat created by the McKinney’s as part of their wetland restoration projects. Based on the large number of resident bats, we selected a hillside site near the traditional night roost and feeding site to take advantage of the existing bat population. So, the project began!

Since sustainability was a goal of ECLCC, we discussed a number of items that could be used as the cave room and for a tunnel and entrance way. Billy Pat suggested burying an old shipping container—and we had our concept for the main cave room. To overcome the smooth ceiling (thus, no “toe holds” for bats) we decided to place wooden slats (2 x 4s) about an inch apart to act as cervices for roosting. I thought about using concrete culverts (again, cement company PR) for the tunnel until the design engineer (Mr. Billy Pat)

informed me that concrete culverts large enough for our purpose were *very* heavy.... so a metal culvert served as our pseudo-tunnel. We spent considerable time thinking about the entrance. We did not want cool or cold winds to blow straight down the tunnel into our cave room, nor did we want to create the world’s largest rattlesnake resort...so we elevated the tunnel a little, designed a 90° turn in the tunnel, and built a doorway that could be adjusted in response to seasonal temperature changes. Now all we had to do was to convince the Wildlife & Operations Coordinator (Bonnie) and the CEMEX folks in charge that this was a bona fide research project worthy of their support. Needless to say, the idea passed with flying colors!

Billy Pat visited with fabricators at the CEMEX headquarters and got the prototype Bat Cave built. It was trucked to the ECLCC and then the work really began. Armed with only a dozer, backhoe, and his signature sunglasses, Billy Pat dug a trench into the hillside, slid the bat cave into place, and backfilled the trench. Old railroad ties were placed on top of the roof to keep it from collapsing from the weight of the backfill. Massive rock slabs were quarried onsite by to serve as a “natural cave entrance” and to prevent erosion. Despite being summarized in a single paragraph, this was not a trivial undertaking!

This project would not have been possible without the support and involvement of many individuals and divisions of CEMEX. These include the Balcones Quarry, Lance Griffin (CEMEX Director of Aggregate Operations for Texas), Dennis Batey, and several other employees who did the prep work on the cave, built the roosts inside, and provided and assembled the culvert for the flyway.

Now that the Bat Cave is operational, we will begin collecting bat guano from a nearby source and christen the site with a smell that only bats enjoy. Our idea was that if an artificial cave could serve as a night roost and even an over-winter hibernation site, this model could be adapted in places where roosting sites are rare and bat conservation is crucial. Many thanks to the CEMEX folks who helped make this project possible! Special thanks to Bonnie McKinney for inviting us to

the ECLCC in the first place and offering to partner with TTU and the NSRL in the many research endeavors we have! Finally, hats off to Billy Pat McKinney! This project grew from his idea, engineering feats, common sense construction knowledge, and was pushed across the finish line by his many hours on the dozer and back-hoe! The Bat Cave, how cool! Stay tuned for updates!



A view inside the artificial cave under construction, showing the slatted roof that will provide roosting sites.



The assembled structure before burial, showing the metal culvert that serves as the entry tunnel, the shipping container that serves as the cave, and the entry door that can be adjusted depending on the season.



General Manager Billy Pat McKinney at the entrance of the completed bat cave on the property of the El Carmen Land and Conservation Company.

NSRL STAFF



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 assisting with specimen tracking in the collections and data management and design.

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Heidi Amarilla-Stevens is Collections Manager for the Mammal Collection. Her duties include assisting in all aspects of the specimen curation process, as well as preparing loans, student training, and databasing. She also conducts research on improving curatorial practices for the long-term care of collections of natural history specimens and tissues.

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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, preparation of grant proposals, development of NSRL exhibits for the Museum, and maintenance of the NSRL website.

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STUDENT SCHOLARSHIPS, GRANTS, AND RESEARCH AWARDS 2022

Touseef Ahmed, graduate student, Tigga Kingston. Graduate Student Research Support Award, Texas Tech University.

Shelby Hernandez, undergraduate student, Jennifer Girón. Undergraduate Travel Award, The Coleopterists Society.

Abigail Rutrough, graduate student, Tigga Kingston. Graduate Research Fellowship, National Science Foundation; Helen Jones Fellowship.

Emily Wright, graduate student, Robert D. Bradley. Bobby Baker Memorial Scholarship Award, Texas Tech University.

2022 GRADUATES

Matthew Fox, PhD. Chair: Caleb D. Phillips. Dissertation title: The RNA-binding protein musashi-2 regulates sonic hedgehog signaling in the developing mammalian palate.

Jennifer Korstian, PhD. Chair: David A. Ray. Dissertation title: Unraveling the *Myotis* morass: Genomic analysis reveals introgression, cryptic diversity, and taxonomic trouble in the most species rich bat genus.

Brandon Meadows, MS. Chair: Dr. Joseph Manthey. Thesis title: Detecting signatures of discordant structure and local adaptation in a codiversifying host-obligate endosymbiont mutualism.

Sufia A. Neha, MS. Chair: Dr. Jorge Salazar-Bravo. Thesis title: Fine-scale spatial variation shape fecal microbiome diversity and composition in black-tailed prairie dogs (*Cynomys ludovicianus*).

Erin Stukenholtz, PhD. Chair: Dr. Richard D. Stevens. Dissertation title: Avian metacommunity structure and influence of Grinnellian and Eltonian niche characteristics on geographic distribution.

NSRL is Experimenting with Various Hide Preservation Techniques

by Heidi Amarilla-Stevens

The NSRL received a series of mountain lion specimens collected in New Mexico from 2019 to 2022. Undergraduate and graduate students from the Departments of Natural Resources Management and Biological Sciences at TTU participated in processing these specimens as vouchers. Tissue samples from each specimen were taken and deposited into the Genetic Resources Collection. The skulls of the mountain lions were cleaned of flesh before being incorporated into the main mammal collection of the NSRL.

In addition to preparing the skeletal material and tissues, the hides were removed and frozen until an informed decision could be made with regard to their long-term archival storage. A challenge to preserving large hides is that the traditional method of preservation (i.e., tanning) is expensive and it probably does not preserve DNA quality sufficient to be useful for the current needs of the scientific community. In addition, large hides preserved by tanning require ample space for storage, which generally is at a premium in natural history collection facilities.

To assist in developing viable and appropriate collections-based answers to the NSRL's preservation dilemma of this large number of mammalian hides, NSRL staff members currently are conducting an experiment wherein several different treatment methods for long-term preservation are being assessed. Those involved in this project include Heidi Amarilla-Stevens, Heath Garner, Kathy MacDonald, Richard Stevens, Robert Bradley, Caleb Phillips, and students Catherine Sparks and Sergio Castro.

The goal of this research initiative is to establish the most effective procedures for the preservation and storage of large hides, in terms of both cost and space, while also retaining high quality DNA for future research. Hide swatches (2 cm X 2 cm) from 7 mountain lions were obtained and treated with different preservation methods (dehydration, submersion in isopropyl alcohol, ethanol, formalin, or glycol, and untreated controls). Hide samples were subjected to these treatments for 6 months, after which the samples were removed and DNA was isolated. Currently, DNA fragment analyses are being conducted to determine which preservation method is most suitable for preservation of high quality DNA.

It is our hope that this experiment will determine the most efficient storage practices for large mammalian hides and assist decision-making by museums, allowing them to maximize and prioritize space, but also to provide guidance on best preservation methods to retain the highest quality DNA in voucher materials housed in a collection. This assessment builds upon results and ideas generated in the NSRL's previous collections-based studies, which were published in the *Journal of Mammalogy* (Soniati et al. 2021; Amarilla-Stevens et al. 2023), and continues our long-term efforts to be a leader in the development and use of innovative methodologies for natural history collections care.

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- Amarilla-Stevens, H. N., R. D. Stevens, C. D. Phillips, and R. D. Bradley. 2023. Temporal rate of postmortem DNA degradation in archived tissue samples: evidence from liver and muscle. *Journal of Mammalogy* 104(1):194–202.



Photographs by Sergio Castro

NSRL Conducts Research on Post-mortem Degradation of DNA and RNA for Determining Best Archival Practices

by Heidi Amarilla-Stevens

The role of genetic resource collections (GRCs) is to archive biological samples from organisms (typically at ultra-cold temperatures) and to make them accessible for genetic and genomic research. In the 21st century, it is increasingly critical that these genetic samples be collected and maintained by methods that yield the highest quality of molecular material possible, for three primary reasons. First, declines in both natural habitats and biodiversity are increasing at a rapid pace around the world; second, scientific collecting is decreasing among researchers, due to monetary, logistic, safety, and international constraints, at a time when demand for high-quality genetic materials is expanding rapidly; and third, current genomic methodologies require genetic samples at the highest levels of molecular integrity.

The goal of long-term storage of samples at ultra-cold temperatures is to significantly slow down or halt the degradation process to ensure their utility for future research, but it is known that degradation can continue even after tissue samples are frozen at ultra-cold temperatures of -80°C , which is typical for most GRCs. However, the rate of this degradation and its quantitative impact on DNA and RNA quality for future research previously had not been assessed. A recent NSRL-based project by Soniat et al. (2021) assessed the quality of DNA obtained from samples that had been stored at -80°C for various lengths of time (30, 20, 10, or 1 years). All tissue samples were collected from the same genus (*Peromyscus*), were prepared by the same individual, were obtained within 5 minutes postmortem, and were placed in liquid nitrogen for transport to the GRC, whereupon they were transferred to -80°C freezers for long-term storage. The results of that study clearly demonstrated that storage of tissue samples at ultra-cold temperatures of -80°C does not halt DNA degradation, as evidenced by declines over time in both molecular weight yield and fragment length. These results reinforce the concept that, under ideal circumstances, genetic samples should be maintained long-term at cryogenic temperatures of -196°C (i.e., in vapor-phase liquid nitrogen) to halt degradation and thus ensure the highest quality of molecular material for research.

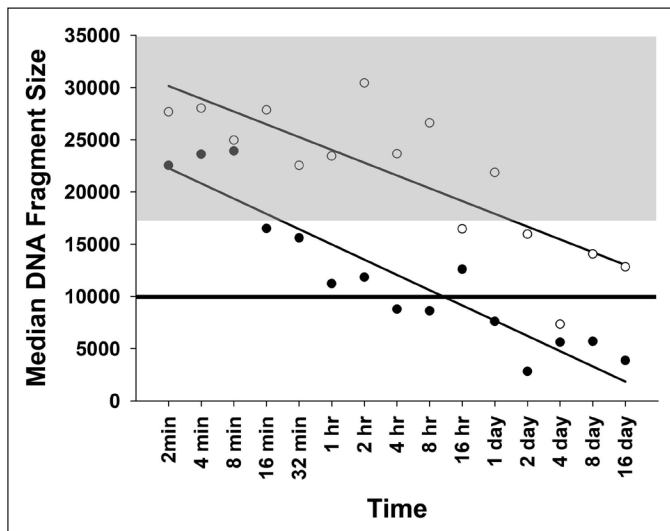
The degradation process in biological samples, however, begins as soon as the specimen or source material is dead. Although the work of Soniat et al. (2021) addressed the rate of degradation of tissue samples while frozen at -80°C , still unknown was the impact of time elapsed from the moment of death of an organism to the post-mortem collection and freezing of samples on the yield and quality of DNA and RNA. Although the extraction of samples within 5 minutes postmortem and placement directly into liquid nitrogen is a best-case scenario, the realities of field collecting often do not allow for these conditions to be met, and tissue samples often are obtained from long-dead (e.g., road killed) individuals. To address this question, Heidi Amarilla-Stevens, Collection Manager, engaged in a research project to evaluate the post-mortem degradation rate of DNA and RNA molecules in samples obtained at various intervals from death of an individual until preservation in cold storage. The goal was to provide guidance for best sample procurement methodologies to optimize the quality of DNA and RNA molecules available from samples that are collected and destined for a GRC facility for archival preservation and future research.

For this study, samples of liver and muscle tissue were obtained from field-caught cotton rats (*Sigmodon hispidus*) with known times of death. Tissue samples were sectioned in portions of approximately the same sizes, encapsulated in vials, and maintained at room temperature (25°C) at different time intervals after death of the specimen, prior to their preservation in liquid nitrogen. The time intervals at which samples were maintained at room temperature ranged from 2 minutes to 16 days post-mortem.

Results from the analysis of DNA degradation in these samples were published in a recent *Journal of Mammalogy* article (Amarilla-Stevens et al. 2023). DNA was extracted from subsamples of the tissues and quality was evaluated based on DNA strand lengths; that is, shorter strands indicate higher rates of degradation and lower quality. Analyses revealed that postmortem DNA degradation was continuous and dependent on time. DNA fragments of $\geq 10,000$ base pairs in length

were present in muscle samples across all time intervals postmortem, whereas DNA fragments of this size in liver samples were no longer present after 8–16 h postmortem. DNA molecular mass profiles showed that muscle samples retained 80% of their longest fragments ($\geq 10,000$ base pairs) until 1 day postmortem, whereas liver samples retained the same percentage only until 8 min after death. Although rates of decay were measured from samples obtained in a laboratory (not field) setting, the rates of decay presented here can guide field and museum workers in best practices. Considerations of differences in rates of degradation between liver and muscle samples also may guide selection of tissue types housed in genetic resource collections.

Currently, subsamples of the same tissues that were used in the DNA portion of the study are undergoing



Median DNA fragment size in liver and muscle samples obtained from cotton rats. Liver samples are represented by the bottom regression line and closed circles. Muscle samples are represented by the upper regression line and open circles. The gray shaded area denotes the upper half of DNA fragments in the samples, and its intersection with liver and muscle regression lines indicates the critical time when 50% of DNA fragments are lost to degradation. The horizontal black line indicates 10,000 base pair fragments, one criterion of high-quality DNA.

extraction of RNA for analysis and comparison of their quality. The integrity of RNA molecules in the samples will be evaluated based on levels of detectable organic compounds produced during decomposition. This portion of the research is being carried out in collaboration with undergraduate students from the Department of Natural Resources Management: Jayme Czap, Jerzi Deatherage, Hanna McKay, and Samantha Stuhr.

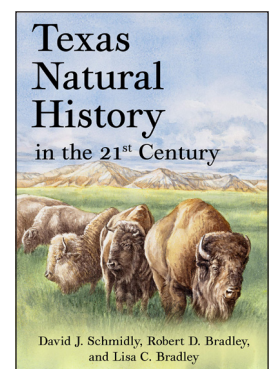
We expect results of both studies to have multiple implications for collectors, researchers borrowing genetic materials, and GRC curators/managers. First, establishing best field practices for postmortem tissue harvesting is a curatorial concern that needs to be addressed from a collection management perspective. Second, characterizing postmortem degradation behavior, especially long after death, can contribute to the decision-making process of harvesting a particular tissue type for certain types of genetic analyses. Third, considering that space is a limited resource in many cryogenic collections, a better understanding of degradation rates will help prioritize field harvesting of tissues and inform best practices when field conditions do not allow rapid cryopreservation. Finally, established expectations about DNA and RNA degradation rates, paired with recorded information about postmortem collection time, can guide borrowers and collectors of material for genetic studies. We look forward to providing additional perspectives for the long-term storage and management of genetic resource collections. Stay tuned!

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BOOK ANNOUNCEMENT

Texas Natural History in the 21st Century, a second edition to *Texas Natural History: A Century of Change* (2002), was released in May 2022. Authored by David J. Schmidly, Robert D. Bradley, and Lisa C. Bradley, this edition chronicles the changes to Texas’s biology and biota during the 20th century and into the first two decades of the 21st century. The book includes a discussion of the present-day conservation challenges facing the state of Texas and offers potential solutions to those issues. Books can be ordered from TTU Press here: <https://www.tupress.org/9781682830703/texas-natural-history-in-the-21st-century/>.



FACULTY AND STAFF GRANTS (active 2022)

Boal, C. W., **R. D. Stevens**, and C. Villalobos. TCU 432: Assessing Texas Kangaroo Rat habitat connectivity, management, and monitoring protocols. Texas Parks and Wildlife Department.

Chelikani, P, M. C. Penn, and **C. D. Phillips**. Dietary Inulin Fiber supplementation for protection against obesity, hypertension and stroke. American Heart Association.

Conway, W., R. D. Stevens, R. D. Bradley, M. Barnes, and P. Gipson. Canid tortoise predation study at Marine Corps Air Ground Combat Center. Department of Defense.

Griffis-Kyle, K., and **N. McIntyre**. Sonoran Desert Tortoise Monitoring. Department of Interior, National Park Service.

Jimenez-Ferbans, L., and **J. C. Girón Duque**. Data mobilization for key entomological groups across Caribbean Colombia. European Union, GBIF (Global Biodiversity Information Facility).

Kingston, T. North American Society for Bat Research. Hosting the 50th Annual Symposium of the North American Society for Bat Research as a joint meeting with the 19th International Bat Research Conference.

Kingston, T., L. Davalos, A. Rasmussen, and S. Anthony. Collaborative Research: Integrated mechanisms of environment host-virome interactions. National Science Foundation.

Kingston, T., L. Davalos, N. Simmons, and S. Tsang. Collaborative: AccelNet: The Global Union of Bat Diversity Networks (GBatNet): Bats as a model for understanding global vertebrate diversification and sustainability. National Science Foundation.

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

Longing, S., J. C. Girón Duque, and J. D. Manthey. Digitization of the bee (Hymenoptera: Anthophila) holdings at Texas Tech University with DNA barcoding for species of interest. Texas Parks and Wildlife Department.

Manthey, J., B. Marks, and M. Yonas. Comparative and temporal biodiversity genomics of Ethiopian Highland montane forest passerine birds. National Science Foundation.

Manthey, J., C. D. Phillips, and R. D. Bradley. Morphology, landscape genomics and effective population size of the Palo Duro Mouse, *Peromyscus truei comanche*. Texas Parks and Wildlife Department.

Phillips, C. D. Patient Genetic Determinants of Chronic Wound Microbiome Composition. National Institutes of Health.

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

Stevens, R. D. Interagency contract for endangered species research for the continued study of the plains spotted skunk. Texas Comptroller of Public Accounts.

Stevens, R. D. Spatial ecology of the Texas Kangaroo Rat (*Dipodomys elator*). Texas Comptroller of Public Accounts.

Stevens, R. D. Survey of tri-colored bat winter roost sites and associated white-nose syndrome in east and central Texas. US Fish and Wildlife Service/Texas Parks and Wildlife Department.

Stevens, R. D. and R. D. Bradley. Digitation PEN: BatPEN! - A partnership to facilitate scientific inquiry into the vast functional trait diversity of phyllostomid bats. National Science Foundation.

FACULTY AND STAFF AWARDS AND HONORS 2022

Jennifer Girón - Jean Theodore Lacordaire Prize, The Coleopterists Society

Tigga Kingston - Global Vision: Faculty International Scholarship Award, Texas Tech University

Joe Manthey - New Faculty Award for the College of Arts and Sciences, Texas Tech Alumni Association

David Ray - President's Academic Achievement Award, Texas Tech University

Richard Stevens - Davis College Research Award, Davis College of Agricultural Science and Natural Resources, TTU

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 www.depts.ttu.edu/nsrl/publications/authors.php, for more information.

Lisa Bradley serves as the Production Editor for both series. 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 in 2022:

Occasional Paper 385. Significant Range Expansion in Eight Species of North American Mammals. Emily F. Barnes and Justin D. Hoffman.

Occasional Paper 384. Noteworthy Records, Range Extensions, and Conservation Status of Skunk Species in Texas. Kamren P. Jefferson, S. Leigh Ann Garcia, Dianna M. Krejsa, J. Clint Perkins, Skyler Stevens, Raymond S. Matlack, and Robert C. Dowler.

Occasional Paper 383. Noteworthy County Records of Mammals in Texas. Richard M. Pitts.

Occasional Paper 382. Evidence from Owl Pellets Indicate that Prairie Voles (*Microtus ochrogaster*) are Broadly Distributed in the Texas Panhandle.

Emily R. Turpen, Sarah C. Vrla, Raymond S. Matlack, and Robert D. Bradley.

Occasional Paper 381. Mitochondrial Perspective on Species Identification and Delimitation for Troglotic *Cicurina* (Arachnida: Araneae: Hahniidae) from Central Texas. Preston J. McDonald, Julie A. Parlos, James C. Cokendolpher, Stirling J. Robertson, Jean K. Krejca, Jennifer C. Girón, Robert J. Baker, and Caleb D. Phillips.

Occasional Paper 380. Landscape Level Patterns of Genetic Diversity of Bat Species of Greatest Conservation Need in Louisiana. Jenna R. Grimshaw, Joseph D. Manthey, Nicole S. Paulat, Richard D. Stevens, and David A. Ray.

View and download Occasional Papers and Special Publications at the NSRL website:

www.depts.ttu.edu/nsrl/publications

STUDENT PRESENTATIONS 2022

During 2022, at least 26 graduate students and 10 undergraduate students gave 30 oral and 26 poster presentations of their research at 16 local, 15 state or regional, 12 national, and 14 international conferences and society meetings.

UNDERGRADUATE RESEARCH 2022

During 2022, at least 55 undergraduate students conducted research under the direction of 9 NSRL faculty and staff associates.

STUDENT PRESENTATION AWARDS 2022

Danielle Husband, graduate student. 1st place, Ecology division, TTU Biology Graduate Symposium.

Sean Sutor, graduate student. 2nd place, 3-minute Thesis Presentation, TTU Department of Natural Resources Management Research Day.

Vivienne Lacey, undergraduate student. LEDA Award, 1st place, outstanding presenter, TTU Undergraduate Research Conference.

2022 PUBLICATIONS BY NSRL FACULTY, STAFF, AND STUDENTS

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- Atencio, R., A. Barba, R. Collantes, J. Pittí, J. Muñoz, B. A. S. De Medeiros, and J. C. Girón. 2022. A new species of *Epicaerus* Pascoe, 1881 (Coleoptera: Curculionidae: Entiminae: Geonemini) associated with potato cultivars in Tierras Altas de Chiriquí, Panama. *Zootaxa* 5115(1):103–121. doi:10.11646/zootaxa.5115.1.7.
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- Langlois, G. D., R. D. Cox, P. S. Gipson, and R. D. Stevens. 2022. The North American beaver (*Castor canadensis*) is recolonizing the Llano Estacado. *Western North American Naturalist* 82:190–195.
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- Marsh, C. J., et al. 2022. Expert range maps of global mammal distributions harmonised to three taxonomic authorities. *Journal of Biogeography* 49:979–992. <https://doi.org/10.1111/jbi.14330>
- McDonald, P. J., and C. D. Phillips. 2022. *Urosaurus ornatus* (Ornate Tree Lizard). Interspecific Kleptoparasitism. *Herpetological Review* 53(3):503.
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- Stevens, R. D., and E. E. Guest. 2022. Wings of fringed fruit-eating bats (*Artibeus fimbriatus*) from eastern Paraguay are highly integrated biological airfoils from perspectives of secondary sexual dimorphism, allometry and modularity. *Biological Journal of the Linnean Society* 137:711–719.
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Student Profiles

The NSRL contributes significantly to the education and research experiences of graduate and undergraduate students. Since 1970, more than 250 graduate students and at least 500 undergraduate students have used the NSRL for their thesis, dissertation, and undergraduate research projects. In each issue of NSRL News, we will highlight some of these outstanding students.



Sufia Neha, Ph.D. student, Department of Biological Sciences. Advisor: Robert Bradley.

Sufia's doctoral dissertation focuses on structural and functional variations in gut microbiota in wild mammals and explores drivers that shape the patterns of molecular evolution and disease transmission. These ideas have implications for making management decisions, as well as maintaining biodiversity and the functioning of ecosystems at a larger scale. With her ongoing and future research, she intends to combine molecular, ecological, and spatial data with various methods for understanding genetic viability, disease transmission, and prevention of biological invasions that have broader implications for human, environmental, and animal health.



Touseef Ahmed, DVM, MPH, Ph.D. student, Department of Biological Sciences. Advisor: Tigga Kingston.

Touseef is passionate about exploring ecology and epidemiology of infectious zoonotic diseases. He has been examining die-offs of *Pteropus medius* (Indian Flying Fox) related to Extreme Heat Events and developing bat habitat vulnerability models to predict zoonotic diseases spillovers in Pakistan. His research interests lie at the nexus of conservation biology, disturbance ecology, disease ecology, infectious disease epidemiology, and wildlife-human interactions.



Shelby Hernandez, undergraduate student, Department of Plant and Soil Science. NSRL supervisor: Jennifer Girón.

Shelby is pursuing a B.S. in Horticulture and Animal Science as a double major. She has been digitizing and organizing the leaf beetle specimens in the Invertebrae Zoology Collection since September 2021. She presented a poster about her work with the leaf beetle collection at the Undergraduate Research Conference at TTU in the spring of 2022. She was awarded the 2022 Undergraduate Travel Award by The Coleopterists Society and presented her research project at their annual virtual meeting in December 2022.

Outreach

It isn't just students (see page 9) that present their work at scientific meetings! In August 2022, **Caleb Phillips** presented at paper at the International Bat Conference entitled "Gut microbiome variation explains a large amount of variation in digestive efficiency in Mexican free-tailed bats." In June 2022, **Robert Bradley** co-presented a poster at the meeting of the American Society of Mammalogists entitled "A taxonomic catalog of mammals exclusively from Texas," regarding the soon to be published Special Publication #77. **Richard Stevens** presented two talks in 2022: "Use of bridges as night roosts by bats in the Trans-Pecos of Texas" at the TxDOT Environmental Conference, Fort Worth; and "Reflections of Grinnellian and Eltonian niches on the distribution of phyllostomid bats in the Atlantic Forest" at the meeting of the American Society of Mammalogists. **Jorge Salazar-Bravo** was a keynote speaker for a Bolivian symposium on molecular biology; a keynote speaker at Universidad Tecnológica de Honduras Research Week, in Honduras; an invited speaker for the Texas Tech University 54th Comparative Literature Symposium: Perspectives on Water on the Llano Estacado; an oral presenter at the 8th Chronic Hypoxia Symposium in Bolivia; and seminar presenter (virtual) at the Educational Water Pact Forum.

Tigga Kingston and **Liam McGuire** hosted the joint meeting of the 19th International Bat Research Conference and 50th North American Symposium for Bat Research, 8–12th August, 2022, in Austin. The meeting was attended by about 600 bat researchers from more than 50 countries.

For a summary of the recent outreach activities of the **Invertebrate Zoology Collection**, see the article on Page 2!

NIH-funded Research Based on the GRC and Local Collaboration Investigates the Genetics of Infections

by Caleb Phillips

Millions of Americans from all walks of life suffer from chronic wounds. Chronic wounds are a major humanistic burden that lowers patient quality of life, increases mortality rates, and is an economic burden costing \$3 billion annually. These non-healing wounds can begin innocuously, sometimes by an unnoticed nick or simply wearing ill-fitting shoes, only to stay open for weeks to years. Due to the multifactorial causes of chronic wounds, patients seek treatment from a variety of medical specialists in an effort to improve wound healing success, but challenges still remain. One reason that chronic wounds display poor healing is due to the microbial composition of the wound, which often causes recurrent infections. These collective microorganisms, including bacteria and fungi, are termed the wound microbiome. Over the past several years, researchers around the world have made great efforts to identify the members of the wound microbiome using next generation sequencing technologies. However, the rich diversity of the microbiome suggests that each wound may be as unique as ourselves.

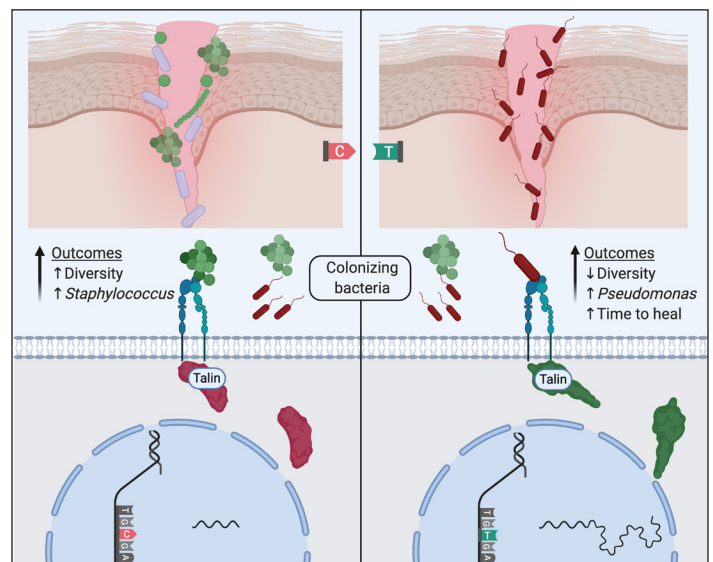
To investigate the poorly understood reasons for interpatient wound microbiome variability, TTU researchers are interested in linking the markers within human genes and the wound microbiome to determine if peoples' genetics predispose them to specific bacteria within wounds. To further push the envelope, the team is using statistical and modelling approaches to explore whether the wound microbiome can be used as a clinical biomarker to predict wound healing time. The team, consisting of TTU and TTUHSC graduate students Rebecca Gabriliska, Jacob Anicra, and Kalid Omeir, Dr. Craig Tipton of RTL Genomics, Dr. Todd Little of TTU, Dr. Nicole Phillips of University of North Texas Health Sciences Center, Dr. Joe Wolcott, MD, of the Southwest Regional Wound Care Center, Dr. Kendra Rumbaugh of TTUHSC, and Dr. Caleb Phillips, Curator of the NSRL's Genetic Resources Collection, is leading this translational approach by collaborating across these departments, institutions, and facilities. For this research, the team is utilizing the Wolcott Wound

Care Collection (~2,400 wound and tissue samples), a specialized collection of the NSRL's Genetic Resources Collection that preserves and curates patient tissues for later study and discovery.

The team's goal is to identify human genetic variants and expressed genes associated with increased risk of developing specific wound bacterial communities, which in turn may predict healing times as well as risk for infection. An example of findings that may emerge from this work is shown in the figure below, which illustrates a hypothesis developed from the previous findings presented in Tipton et al. (2020). Ultimately, the motivation is to provide preventative and management tools for clinicians to anticipate disease risk and heal wounds.

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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. Tigga Kingston is a Professor of Biological Sciences. Her research and activities are dedicated to the conservation ecology of Palearctic 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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mantheylab.org



Dr. David A. Ray is a 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. 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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IN MEMORY OF STIRLING J. ROBERTSON 1969 – 2023

It is with great sadness that we note the sudden loss of NSRL Research Associate Stirling Robertson of Lubbock. We extend our sincerest condolences to Stirling's family, especially his wife Dee Asbury-Roberston, who has been a devoted volunteer in the Mammal Collection of the NSRL since 2022.

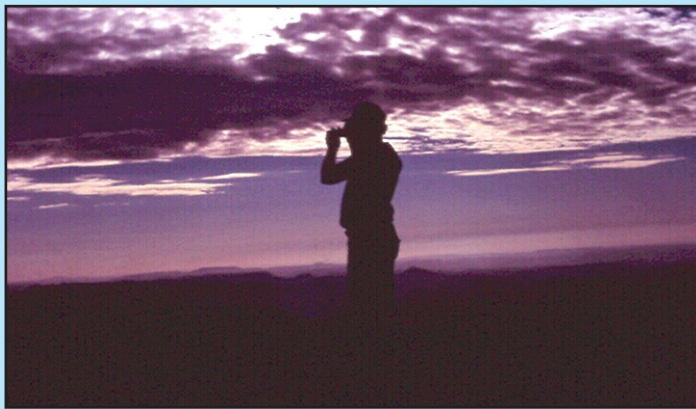
Stirling served as the Biology Team Lead of the Natural Resource Management division of the Texas Department of Transportation (TxDOT) since 2007. His role was to mediate sensitive natural history issues between TxDOT, developers, consultants, and regulatory agencies, including those involving protected species. Stirling was named as a Research Associate of the NSRL in 2021, after collaborating on two TxDOT-funded research projects with NSRL personnel. The first project involved work by the late Dr. Robert Baker, James Cokendolpher (retired), Dr. Caleb Phillips of the NSRL, and students, as well as Jean Krejca of the consulting firm Zara Environmental, LLC, to examine the genetic and morphological [identification of *Cicurina* cave spiders](#) that occur in the karsts of the Texas Hill Country (McDonald et al. 2022). Stirling also collaborated with Dr. Richard Stevens and others on a TxDOT-funded project investigating the [interactions of bats with highway bridges and culverts in Trans-Pecos Texas](#) (Stevens et al. 2021).



Stirling was a wonderful friend, colleague, and supporter of the NSRL. In addition to Dee, Stirling is survived by a son, a daughter, and his parents. He will be greatly missed.

References:

- McDonald, P. J., et al. 2022. Mitochondrial Perspective on Species Identification and Delimitation for Troglotic *Cicurina* (Arachnida: Araneae: Hahniidae) from Central Texas. *Occasional Papers, Museum of Texas Tech University* 381:1–19.
- Stevens, R. D., et al. 2021. Seasonal use of bridges as day-roosts by bats in the Trans-Pecos of Texas. *Therya* 12:207–212.



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.

NSRL News is produced by Lisa Bradley with assistance from the staff, students, and associates 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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NSRL, Museum of Texas Tech University, Lubbock, TX 79409

From the TTU Development Office

2023 marks a significant year of celebration for Texas Tech University. Our University campus is celebrating its Centennial. At the Museum, our Natural Science Research Laboratory (NSRL) is celebrating its Golden Jubilee. 50 years of research, scientific discoveries, and accomplishments that have improved this great state and the world!

Reflecting on the accomplishments of the NSRL is quite an undertaking. In the last 50 years, society has gone through so many advancements in science and research. Along the way we have not missed a beat. As a matter of fact, the NSRL is now a global leader in biodiversity research and education. It can be proud in the following:

- A significant scientific community of curators, faculty and students who have engaged in major research endeavors bringing in more than \$25 million in external research awards and endowments
- While not a degree granting entity, the NSRL has enabled and facilitated a multitude of research projects and the education of more than 250 TTU graduate students and more than 500 undergraduate students.
- The generation of more than 2,000 peer reviewed scholarly publications.
- Recognition, nationally and internationally, as a leader in curatorial science and collections management practices.
- Housing the largest biological collection in Texas, 2nd largest natural history collection in Texas, 2nd largest genetic resources collection in the western hemisphere, 3rd largest invertebrate collection in Texas, and 4th largest mammal collection in an academic institution in the US.

Impressive doesn't begin to describe the Natural Science Research Laboratory. As our growth continues and the momentum builds, we are always looking to cultivate additional partnerships that will help to build the connection between conservation, biodiversity, research, education, and stewardship. Preservation and knowledge of this great State of Texas is vital and the biodiversity, essential beauty, and iconic wildlife it provides us should be cared for and used to educate and enrich future generations.


It is with sincere gratitude, I thank YOU for your consideration and support of our great institution. We welcome the opportunity for YOU to join us in making a difference as we build our next 50 years!




Assistant Director of Development

NATURAL SCIENCE RESEARCH & EDUCATION


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