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2018

2018 Annual Report

Christopher C. Witt

University of New Mexico

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Museum of Southwestern Biology
2018 Annual Report

Christopher C. Witt, Director

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Hundreds of visitors lined up at the CERIA building for MSB's annual open-collections event.

Overview

UNM's Museum of Southwestern Biology in 2018

In 2018, the Museum of Southwestern Biology (MSB) has continued to improve its profile and impacts, both on the University of New Mexico campus and in the international scientific community. Its collections serve as scientific infrastructure that enhances research, teaching, community service, and public outreach. The MSB is part of the UNM Department of Biology, and the missions of the MSB and the Department are synergistic. MSB houses extensive and rapidly growing collections representing biodiversity of world, primarily from the last half-century. MSB has outstanding collections from New Mexico and western North America, but it also has substantial holdings from five other continents around the world. MSB consists of eight divisions, and one special program (the Natural Heritage Program New Mexico). MSB also manages the large federal collection of the US Geological Survey collection, second only the Smithsonian Institution in size among federal collections. The collections enrich education by allowing for scientists, educators, public health professionals, and natural resource managers to investigate climate change, environmental quality, emerging diseases, invasive species, ecology, genomics, and evolution. The databases associated with the MSB's eight collections constitute a significant, accessible informatics resource that grows in value each time scientific research is done using the collections. In these ways, MSB contributes to understanding life on earth, its origins, diversity, function, and relationships with human society and public health. MSB annual reports are archived and accessible via UNM's internet repository:

(<http://repository.unm.edu/handle/1928/24433>).

The MSB Director works with division curators to align MSB's activities with UNM's missions in teaching, undergraduate and graduate education, basic and applied scientific research, and public service. In 2018, MSB showed high productivity in research, teaching, and curation. These specimens are used in diverse projects primarily in environmental and biomedical research, but they are also used by in other fields such as anthropology and art. **Our collections formed the basis of 169 scientific publications in 2018.** MSB personnel authored 59 scientific publications, including several in high impact-factor journals. The three-year average number of loans of physical specimens and their data to researchers and students is as high as it has ever been, reflecting the valuable collections growth that has occurred over the past few decades. MSB personnel also continue to bring in substantial extramural funding, with ~\$1.8 million in grants and contracts that were active during 2018. Outside grants and contracts support basic research in ecology, genetics, and evolution, as well as applied research on conservation of rare species and the functioning of ecosystems on local, regional, and global scales. Our current MSB curators who have active research programs continue to build the collections as permanent scientific infrastructure, comprising an irreplaceable record of earth's environment at a particular moment in time. The research of our successful curators is

synergistic with these collecting activities, enhancing the reputation of MSB and UNM as sources of both scientific materials and new knowledge.

The Museum of Southwestern Biology enriches education for UNM students at the multiple levels. UNM students who have been involved at MSB experienced high-quality training and mentorship in data management, natural history specimen preparation, collections curation, and specimen-based research. 2018 was a productive year for student training. MSB personnel engage in hands-on, experiential teaching and learning, typically with credit hours flowing through the Department of Biology; however, we have been increasingly participating in the curriculum of the new Museum Studies Program, including providing *practicum* experiences. We also have many other collaborative relationships across campus. MSB staff members (eight full-time Collection Managers and eight faculty-curators) teach courses, provide specimens to other courses, and offer many opportunities for active learning. MSB is one of the fastest growing university-based natural history museums worldwide, and one of the biggest for certain collection types, such as mammals, parasites, and frozen tissues.

The infrastructure being established by MSB provides a unique educational resource that is marked by quality. These provide New Mexico students with opportunities to excel in biodiversity science, and our past students have demonstrated how they can use this as a springboard to success. MSB provides immersive training in biodiversity sciences and museum curation for UNM undergraduate and graduate students. This is reflected in successful employment outcomes for MSB Ph.D. graduates, and outstanding placement of MSB-affiliated undergraduate and M.S. students in high caliber Ph.D. programs. MSB-affiliated undergraduate and graduate students frequently go on to leadership positions in varied fields, from healthcare, veterinary science, high-tech industries, conservation, and resource management, to basic research. Active MSB Curators mentor high numbers of graduate students and our unit regularly leads the Biology Department in the number of students receiving doctorate or masters degrees. MSB Curators also mentor undergraduates in research. MSB-affiliated undergraduates win the department's outstanding graduating senior award in most years (including in 2017 and 2018).

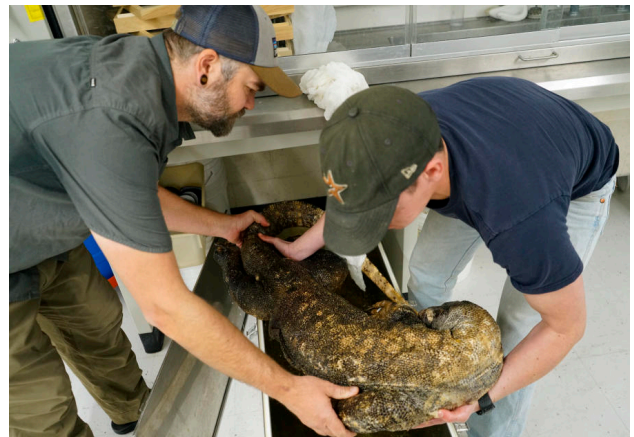
In 2018, MSB continued to exhibit leadership in public service and outreach, at UNM and in the New Mexico and global communities. MSB contributes to science-based management of natural resources in New Mexico and elsewhere through collaborations with government agencies (see active funded projects, pages 74–75). Through these funded projects, MSB supports municipal, county, state and federal environmental management agencies in various parts of the country. Many outreach efforts are related to developing effective management plans for state and federal resource agencies. International organizations also rely on our specimens, data and expertise to help them design and implement public health initiatives. MSB has built a strong tradition of identifying zoonotic pathogens (e.g., hantavirus) and discovering the life cycles, hosts, and transmission dynamics of zoonotic diseases and wildlife diseases in the western US and around the world. Vast spatial and temporal biodiversity data and one of the world's largest frozen tissue collections make MSB an important and well-known resource for genomic and environmental bioinformatics.

This activity is recorded in the utilization statistics, contained in this report, for MSB's online databases, specimen loans, and resulting scientific publications. MSB faculty and staff engage in collaborations with faculty in other UNM departments and colleges. For example, we have ongoing and long-term collaborative efforts with the School of Medicine and with the Arts and Ecology Program (College of Fine Arts), and Anthropology, Geography, History, and other disciplines. In 2018, for example, we joined an interdisciplinary team led by HSC investigators to study the impacts of concussion on woodpecker brains. Furthermore, in 2018, we took part in the proposal and planning stages for the renovation of a central UNM Main Campus building, the Bio Annex, as the Natural History Science Center, an effort that will continue in 2019 and is targeted for completion in 2020. This newly renovated building will house UNM's Paleontology Collections in a large collections room, a fossil preparation lab, a specimen analysis lab, a museum-themed teaching and learning lab, and displays to communicate museum research. It will also house a staff office, a conference room, and dedicated graduate student office space. We participated in the design of this space with an eye toward spurring inter-museum and inter-departmental collaborations.

MSB personnel serve on national boards including the Board of Directors of American Society of Mammalogists, Flora of North America, Society of Ichthyologists and Herpetologists, Entomological Society of America, the American Ornithological Society, the New Mexico Ornithological Society, and the National Systematic Collections Alliance. The latter group, NSCA, is the primary advocacy group for administrators who oversee research-oriented natural history museums. NSCA is closely tied to American Institute for Biological Sciences in Washington, DC. MSB staff also serve on Steering Committees for several national initiatives, including VertNet, Arctosdb.org, Aim-Up!, and the Biodiversity Collections Network, a NSF sponsored Research Coordinating Network focused on translating the vast digital resources of natural history museums into a catalyst for greater research productivity and educational transformation in the US. In this way, MSB is the face of UNM for the global communities of biodiversity researchers, conservation biologists, and educators.

The staff of MSB provide its vital energy and are essential to its success. These include our eight Collection Managers. They also include our graduate assistants in each division, an administrative assistant, as well as extramurally funded staff, student employees, and volunteers. Faculty curators are responsible for staff management, performance evaluations, providing oversight, obtaining funding, and setting the vision, agenda, and goals to operate their respective divisions of MSB. In 2018, MSB, in collaboration with the College of Arts and Sciences, took positive steps to plan and advocate for improvements in compensation, work load equity, a promotion tiers for its Collection Managers and faculty curators; however, this work is still in progress, and serious issues remain to be solved in 2019.

Looking forward, 2019 is filled with potential for MSB, as we anticipate hiring a new Collection Manager for Fishes, searching for two new faculty curators (for the Herbarium, and Division of Amphibians and Reptiles, respectively), working toward improvements in our infrastructure, and continuing our groundbreaking research programs as they relate to biodiversity and global change.



Photos of the Museum of Southwestern Biology featured in the Albuquerque Journal, by Adolphe Pierre-Louis, featuring the MSB collections of mammals, amphibians and reptiles, the herbarium, and birds (<https://www.abqjournal.com/1297414/hidden-treasure-revealed.html>).

MSB Division of Amphibians & Reptiles 2018 Annual Report



1. DIVISION HIGHLIGHTS

By the end of 2018, the collection has increased by 481 specimens to a total of 100,066 cataloged specimens. The majority of specimens added in 2018 came from collaborators and students, with notable additions of tortoises from Arizona Game and Fish and material from the Albuquerque Biopark, thanks to a newly established formal repository relationship. The division's website was visited 1,374 times to access information and we served over 12 million records via aggregator websites. The collection manager handled nearly 160 data requests in person and hosted several research visitors in the collection. Our outreach activities, in addition to general tours of the collection, included a variety of presentations and consultations. We presented on amphibians and reptiles to a varied public audience on several occasions. In addition, we gave presentations on ongoing research projects at regional meetings. This is in addition to a short-term project on Gila Monsters and a new collaboration with Western New Mexico University.

2. TABLE OF COLLECTION ACTIVITY

Metric	Number
Collection Growth	481
Loans (outgoing(no. of specimens)/incoming (no. of specimens)	5/1
Specimen Records served via electronic databases	12,342,231
Publications using the collection	16
Citations of publications using the collection	770

3. EDUCATIONAL IMPACTS OF THE COLLECTION

3a. COURSES USING THE COLLECTIONS

BIOL 204, Animal Form and Function, spring and fall semesters, 277 students

BIOL 386, General Vertebrate Zoology, spring and fall semesters, 51 students

BIOL 488, Herpetology, spring, 14 students

3b. COURSES TAUGHT BY MSB PERSONNEL

INSTRUCTOR(S)	SEMESTER	COURSE	TITLE	ENROLLMENT
SNELL	Spring	BIOL 402 U 022	T: Conservation Biology	34
POE	Spring	BIOL 386L U 002	General Vertebrate Zoology	14
POE	Spring	BIOL 488L U 001	Herpetology	14
POE	Spring	BIOL 551 M 024	Research Problems	1
POE	Spring	BIOL 699 P 024	Dissertation	1
POE	Fall	BIOL 409 U 003	Phylogenetics	3
POE	Fall	BIOL 519 M 009	Phylogenetics	13
POE	Fall	BIOL 551 M 004	Research Problems	1

4. COLLECTION MANAGEMENT

During 2018 we continued our efforts to fully digitize the collection in the ARCTOS database, where over a third of our records are now directly available. In addition, we cataloged specimens from mostly New Mexico and bordering states that were deposited by personnel and close collaborators, notably those associated with Western New Mexico University and Arizona Department of Game and Fish. We focused our efforts on frozen tissues and curating the collection of now nearly 3,000 vials that store valuable material from corresponding specimens in the main collection. In addition to direct curation efforts (switching containers, labeling and shelving), students in the division have also digitized hand-written field notes from several collectors and matched digitized records and field numbers to catalogued specimens, thus greatly enhancing the associated data and utility of those specimens. Finally, efforts to georeference records from Texas and Arizona, which were not completed during the previous HerpNet project, occupied the time of staff and students in 2018.

5. SCIENTIFIC PRODUCTS AUTHORED BY DIVISION PERSONNEL

1. Anderson, C. G., and S. Poe. 2018. Phylogeny, biogeography and island effect drive differential evolutionary signals in mainland and island lizard assemblages. *Zoological Journal of the Linnean Society* **185**:301-311.
2. Poe, S., A. N.-M. de Oca, O. Torres-Carvajal, K. de Queiroz, J. A. Velasco, B. Truett, L. N. Gray, M. J. Ryan, G. Köhler, and F. Ayala-Varela. 2018. Comparative evolution of an archetypal adaptive radiation: innovation and opportunity in *Anolis* lizards. *The American Naturalist* **191**:E185-E194.
3. Poe, S., and I. M. Latella. 2018. Empirical test of the native–nonnative distinction: Native and nonnative assemblages of *Anolis* lizards are similar in morphology and phylogeny. *Functional ecology* **32**:2553-2561.
4. Tracy, J. L., A. Trabucco, A. M. Lawing, J. T. Giermakowski, M. Tchakerian, G. M. Drus, and R. N. Coulson. 2018. Random subset feature selection for ecological niche models of wildfire activity in Western North America. *Ecological modelling* **383**:52-68.
5. Giermakowski, J., M. Ryan, and I. Latella. 2018. Evaluation of the distribution and conservation status of the Gila Monster (*Heloderma suspectum*) in southwestern New Mexico. Report to the New Mexico Department of Game and Fish.
6. Stuart, J., J. Giermakowski, and L. Pierce. 2018. Checklist of Amphibians and Reptiles of New Mexico, USA: Corrigenda and Addenda.

6. SCIENTIFIC PRODUCTS BASED ON THE COLLECTION

1. Caten, C. T. 2018. Padrões de variação de tamanho corporal e de distribuição geográfica são métodos-dependente em serpentes viperídeas do Novo Mundo.
2. Cox, C. L., A. R. Davis Rabosky, I. A. Holmes, J. Reyes-Velasco, C. E. Roelke, E. N. Smith, O. Flores-Villela, J. A. McGuire, and J. A. Campbell. 2018. Synopsis and taxonomic revision of three genera in the snake tribe Sonorini. *Journal of Natural History* **52**:945-988.
3. Filz, K. J., A. Bohr, and S. Lötters. 2018. Abandoned Foreigners: is the stage set for exotic pet reptiles to invade Central Europe? *Biodiversity and Conservation* **27**:417-435.
4. Griffis-Kyle, K. L., K. Mougey, M. Vanlandeghem, S. Swain, and J. C. Drake. 2018. Comparison of climate vulnerability among desert herpetofauna. *Biological conservation* **225**:164-175.
5. Inman, R. 2018. Improving Species Distribution Models with Bias Correction and Geographically Weighted Regression: Tests of Virtual Species and Past and Present Distributions in North American Deserts. Arizona State University.
6. Lin, L.-H., X.-M. ZHU, Y. Du, M.-C. Fang, and X. Ji. 2018. Global, regional and cladistic patterns of variation in climatic niche breadths in terrestrial elapid snakes. *Current Zoology*.
7. Loc-Barragán, J. A., and D. Lazcano. 2018. Notes on the Herpetofauna of Nayarit, Mexico 1: Amphibians and Reptiles of the Municipality of Tecuala. *Bulletin of the Chicago Herpetological Society* **53**:73-80.
8. Loc-Barragán, J. A., D. Lazcano, and G. A. Woolrich-Piña. 2018. Notes on the Herpetofauna of Nayarit, Mexico 2: Amphibians and Reptiles of the Municipality of Compostela. *Bulletin of the Chicago Herpetological Society* **53**:205-212.
9. Meik, J. M., S. Schaack, O. Flores-Villela, and J. W. Streicher. 2018. Integrative taxonomy at the nexus of population divergence and speciation in insular speckled rattlesnakes. *Journal of Natural History* **52**:989-1016.
10. Palacios-Aguilar, R., and O. Flores-Villela. 2018. An updated checklist of the herpetofauna from Guerrero, Mexico. *Zootaxa* **4422**:1-24.

11. Smith, J. R., A. D. Letten, P.-J. Ke, C. B. Anderson, J. N. Hendershot, M. K. Dhimi, G. A. Dlott, T. N. Grainger, M. E. Howard, and B. M. Morrison. 2018. A global test of ecoregions. *Nature ecology & evolution* **2**:1889.
12. Spear, M. J., A. K. Elgin, and E. K. Grey. 2018. Current and Projected Distribution of the Red-Eared Slider Turtle, *Trachemys scripta elegans*, in the Great Lakes Basin. *The American Midland Naturalist* **179**:191-221.
13. Title, P. O., and J. B. Bemmels. 2018. ENVIREM: an expanded set of bioclimatic and topographic variables increases flexibility and improves performance of ecological niche modeling. *Ecography* **41**:291-307.
14. Ureta, C., A. P. Cuervo-Robayo, E. Calixto-Pérez, C. González-Salazar, and E. Fuentes-Conde. 2018. A first approach to evaluate the vulnerability of islands' vertebrates to climate change in Mexico. *Atmósfera* **31**:221-254.
15. Velasco, J. A., E. Martínez-Meyer, and O. Flores-Villela. 2018. Climatic niche dynamics and its role in the insular endemism of *Anolis* lizards. *Evolutionary Biology* **45**:345-357.
16. Wood, D. A., I. D. Emmons, E. M. Nowak, B. L. Christman, A. T. Holycross, and A. G. Vandergast. 2018. Conservation Genomics of the Mogollon Narrow-Headed Gartersnake (*Thamnophis rufipunctatus*) and Northern Mexican Gartersnake (*Thamnophis eques megalops*). 2331-1258, US Geological Survey.

7. SERVICE AND OUTREACH

- J.T. Giermakowski gave invited professional presentations on museum techniques (lecture to UNM class), careers in herpetology (Cibola High School), and current turtle research (New Mexico Turtle and Tortoise Club).
- Howard Snell served as a member of New Mexico Department of Game and Fish Species Recovery Team for Boreal Toads and Gila Monsters.
- Howard Snell served as an Elected Board Member, Tierra Grande Improvement Association (organization that administers 15,000 acres of protected areas in southern Manzano Mountains, Valencia County).
- J.T. Giermakowski served as a Member of New Mexico Department of Game & Fish Species Recovery Board.
- J.T. Giermakowski served as a member of the University of New Mexico Institutional Animal Care and Use Committee. 2016-2018.

8. AFFILIATED PERSONNEL

A. Faculty & Staff

H.L. Snell, Curator

W.H. Degenhardt, Curator Emeritus

Poe, S., Associate Professor and Associate Curator

J.T. Giermakowski, Senior Collection Manager

I.M. Latella, Research Scientist

B. Graduate students

Anderson, C., Ph.D. /Poe

Gray, L.N., Ph.D. /Poe

Latella, I.M., M.Sc./Poe

Loughran, C.L., Ph.D/Wolf

C. Undergraduate Students

Castillo, Shelby, Student employee.

Cruz, Paxton. Student employee.

Duran, Jonathan. Student employee

Griego, Tylee. Student employee.

Isom, Kaylee. Student employee.

D. Research Associates

Pierce, L.J.S., New Mexico Dept. of Game & Fish

Stuart, J.N., New Mexico Dept. of Game & Fish

Fitzgerald, L., Texas A&M University



Division of Amphibians and Reptiles on display at the MSB's annual open collections event.

MSB Division of Arthropods

2018 Annual Report

1. DIVISION HIGHLIGHTS

MSB Arthropods continued with a number of exciting activities during 2018. Research activities included everything from the evolution of ant-mimicking spiders to using arthropods to study flooding regimes in the Rio Grande bosque, from grasshopper food habits to discovery of new species in beetles and moths. Teaching efforts supported by the collection ranged from foundational courses in Entomology to a novel course in Art and Biodiversity taught in cooperation between Biology and the MSBA and the UNM Department of Art in the College of Fine Arts. We continue to train and support both undergraduate and graduate students specific to the study of arthropods, but also many students across the department since arthropods factor into so many areas of biology. Collection growth for the past 10 years or so has been dramatic and the sheer number of specimens coming into our collection has outstripped our ability to formally accession them, so our focus has shifted somewhat to getting those specimens prepared and formally accessioned rather than field work to acquire large numbers of new specimens. To that end, we have focused on activities such as databasing previous projects such as those in White Sands, Bandelier, the Sevilleta and Cuatrociénegas as well as the excellent bee collection. We have also continued focus on getting identifications in several groups and inventorying special donated collections such as the Marc Rowland scarab collection and the Mark Romero tiger beetle collection. Even so, field work to acquire new specimens continues to be an important component of the MSBA's activities this year including locally in the Southwest, such as at the Sevilleta and elsewhere, but also nationally, such as in the Southeast and the Pacific Northwest, and also internationally in Peru.

2. TABLE OF COLLECTION ACTIVITY

Metric	Number
Collection Growth	5,353 specimens added
Loans: outgoing(no. of specimens)/incoming (no. specimens)	Outgoing 4 (186)
Specimen Records served via electronic databases	45,000 for all of SCAN
Publications using the collection	10
Citations of publications using the collection	10

3. EDUCATIONAL IMPACTS OF THE COLLECTION

Kelly Miller taught Entomology (BIOL485/585) to 12 students and Art and Biodiversity (BIOL419/ARTS429) to 15 students. Each of these courses emphasized arthropods heavily and used specimens from the collection extensively.

Karen Wright successfully defended her PhD dissertation and finish her graduate program in 2018 focusing on bee phylogenetics and the evolution of diet breadth (specialization vs generalization).

Undergraduate Marlo McCarter finished work on arthropod samples from Valles Caldera National Preserve fire recovery study. To increase her experience with additional arthropod groups, she and Sandy worked on specimen backlog from the western US and from Nicaragua. Marlo also worked on specimen identifications. She will be starting grad school next fall with a broad background in arthropod taxonomy.

Matthew Leister has both used the collection and contributed to it from his Master's work on spider phylogeny. He has made determinations on unidentified material for scorpions as well as spiders.

Ray Holland, a grad student of Tom Kennedy, is using ground-dwelling arthropods in part of his research on changes in the Rio Grande river channel through management efforts to bring about more flooding in the bosque. He is looking at changes in vegetation and arthropod diversity as a result of these treatments. He and Sandy have been working on identification methods and sources, as he tackles several disparate groups of arthropods.

Nick Homziak, former MSB Arthropods undergraduate student and museum assistant on the National Park Service, White Sands/Cuatrocieneegas arthropod inventory project, and now graduate student at the University of Florida, prepared a manuscript describing a new species of moth in the genus *Callistege* (Lepidoptera, Erebidae), that he found during our collecting trips to Cuatrocieneegas, Mexico. The type and paratype specimens are housed in the MSB. Eric Metzler, Dave Lightfoot, and Kelly Miller assisted with the manuscript and are co-authors. The manuscript was completed and submitted to the Journal of the Lepidopterist's Society in 2018.

Dave Lightfoot served as mentor for UNM undergraduate student Marlo McCarter on her Research Experience for undergraduate students, research project; diet selection in desert grasshoppers, during the summer of 2018. This as part of the Sevilleta Long-Term Ecological Research Program (UNM; Sevilleta National Wildlife Refuge, NM), Research Experience for Undergraduate students. Activities included research project design, field and lab sampling design and implementation of protocols, microscopic preparation and analysis of hundreds of grasshopper guts and plant species reference slides. Marlo completed all field and lab work. She is writing her Senior Honors Thesis based on this research, and plans to submit her manuscript for publication in a peer-reviewed journal in 2019. Dave is coauthor.

Dave Lightfoot served as mentor for Highlands University (Las Vegas, NM) undergraduate student Anabella Miller, on a research project to inventory and to initiate long-term monitoring of grasshoppers, of the Rio Mora National Wildlife Refuge, NM, during the summer of 2018 . Dave traveled to the Rio Mora NWR several times to teach and assist Anabella with the project. Anabella completed a report that she submitted to New Mexico Highlands University in 2018.

Dave Lightfoot served as mentor for UNM undergraduate (graduated May, 2018) student Wesley Noe, to analyze data for ground-dwelling arthropods, created from the Sevilleta LTER (Lightfoot and Brantley) during the 1990's, and to write a manuscript on how annual variation in rainfall affects ground-arthropod communities across the Sevilleta NWR. Wesley completed data analyses, and Dave and Wesley are currently working on the manuscript. Voucher arthropod specimens are housed in the MSB. Wesley and Dave also worked on an arthropod reference collection for the Pueblo of Sandia, see below.

3a. COURSES USING THE COLLECTIONS

BIOL 406 Museum Studies, Natural History Collections, 18 students

3b. COURSES TAUGHT BY MSB PERSONNEL

Instructor(s)	Semester	Course	Title	Enrollment
Brantley, Lightfoot	Spring	BIOL 406	Museum Studies	18
Miller, Kelly	Spring	BIOL485/585	Entomology	12
Miller, Kelly	Fall	BIOL419/519 ARTS429/529	Art and Biodiversity	15

4. COLLECTION MANAGEMENT

Sandy completed the return of all outstanding alcohol specimens on loan to Mark Rowland. Sandy and undergraduate assistant Marlo McCarter prepared, labeled, and databased 600+ specimens donated by Mark Romero over the last 10 years. In SCAN there are now 731 specimens from Mark, 160 of which are tiger beetles, which are his specialty. Mark's specimens are mostly from NM and other southwestern states. He also contributed specimens to the teaching collection, which Catherine Cumberland is upgrading.

Rick Buss identified many beetle specimens from the Main Collection, and from the Sevilleta National Wildlife Refuge, Grand Canyon National Park, and Sandia National Laboratories collections that are housed in the MSB. Jens Esser, a German specialist on the Cryptophagidae visited the collection and borrowed some specimens. Three papers came out on the family (see publications section below).

Matthew Leister and Sandy worked with an archeological consulting firm that was working on the excavation of a burned pit house. Attached to one of the wooden beams was a mud-dauber wasp's nest, with several charred spiders inside. Matthew made images of the spiders, which could be identified to family; they were perfectly preserved but extremely fragile. A few of the spiders were used for carbon dating, corroborating dates from the pit house itself. The structure was burned around 800AD. The archeologists will be presenting a talk in spring 2019 about the excavation, including the unusual finding of the wasp nest. Matthew and Sandy used specimens from the collection to introduce the archeologists to the spider families they found.

Mark Ward, entomologist on the Valles Caldera project, finished up samples and identifications in August and returned to Maine. He left many identified specimens and database records for the Museum collection. Sandy received more money from the project to identify and count spiders from the Valles Caldera Thompson Ridge fire samples.

Catherine Cumberland (graduate museum assistant) and Dave Lightfoot continued with the organization and databasing of the Main Collection bee collection for SCAN. Graduate students Karen Wright and Julieta Bettinelli assisted with taxonomic identifications.

Marlo McCarter (undergraduate museum assistant) and Dave Lightfoot worked on incorporating identified, labeled and databased (SCAN) specimens from the Grand Canyon and White Sands/Cuatociengas, National Park Service inventory projects collections, into the dry specimen Main Collection.

Dave Lightfoot worked with personnel from the Sevilleta Long-Term Ecological Research program (Biology Dept., Dr.s Jennifer Rudgers and Ken Whitney, LTER staff Jade McLaughlin, graduate student Melanie Kazenel) to initiate the development of extensive reference and voucher specimen collections for the bees of the Sevilleta NWR. The reference bee collection is a special research collection within the Division of Arthropods. Dave provided training on specimen curation and collection classification/organization. The bee reference collection is being constructed from bee specimens collected in long-term monitoring bee traps in 2017 and 2018, and will continue for years to come. The Sevilleta bee trap monitoring study was initiated by graduate student Karen Wright, and is being continued by the Sevilleta LTER program. Specimens will be added over the years until all taxa are well represented. This is a working collection for students and other researchers to use for the identification of regional native bees. This reference/voucher bee collection will reduce the use and possible damage of bee specimens from the Sevilleta that are housed in the Main Collection.

Dave Lightfoot and Marlo McCarter enhanced the MSB, *Sevilleta* grasshopper reference collection, including the addition of several hundred new specimens that were collected by them during the summer of 2018, for Marlo's research project (see above). Several hundred leg tissue samples for DNA of all of the taxa were prepared and stored in the lab freezer. An array of morphometric measurements were taken from all grasshopper specimens in the *Sevilleta* grasshopper reference collection by museum assistant Alison Verhaagen. The morphometric data will be used to characterize morphological evolutionary traits of *Sevilleta* grasshopper species.

Dave Lightfoot and Sandra Brantley completed sorting and tabulating hundreds of arthropod pitfall trap samples from Bandelier National Monument for a long-term research project monitoring ground arthropod communities across an elevation gradient in the Jemez Mountains, relative to climate change. That study has been funded by the USGS and the NPS. The study has been ongoing since 1992. Dave set aside thousands of specimens of arthropods across all taxonomic groups, to be curated and added to the Main Collection. That process will be accomplished over coming years, and will provide the MSB with a very thorough collection of arthropod taxa from the Jemez Mountains, along with other specimens and taxa obtained from Robert Parmenter's arthropod research at the Valles Caldera National Monument. The MSB houses special arthropod research collections for both Bandelier National Monument and for the Valles Caldera National Monument.

Dave Lightfoot obtained a contract from Sandia National Laboratories to identify insects from long-term monitoring sticky traps (flying insects) and pitfall traps (ground-dwelling arthropods) from locations across Kirtland Air Force Base. Dave obtained hundreds of arthropod specimens for the MSB collection. Sandra Brantley and Rick Buss helped to identify specimens.

Dave Lightfoot and Wesley Noe provided arthropod identification services for several hundred arthropod specimens collected from reptile pitfall traps by the Pueblo of Sandia. Dave is building a special research collection of arthropods of the Pueblo of Sandia, and the MSB is housing the collection.

Dave Lightfoot made several collecting trips across the Southwest and the Pacific Northwest to obtain specimens and DNA tissue samples of Oedipodinae grasshoppers as part of his taxonomic research. Specimens and tissue samples are housed in the MSB.

Kelly Miller made collecting trips to Florida and Peru for general collecting and to collect water beetles for specific research projects. Specimens are housed in the MSB.

5. SCIENTIFIC PRODUCTS AUTHORED BY DIVISION PERSONNEL

1. **Alfaro, RE**, CE Griswold, and **KB Miller**. 2018. Comparative spigot ontogeny across the spider tree of life. *PeerJ* 6: e4233.
2. **Alfaro, RE**, CE Griswold, and **KB Miller**. 2018. The ontogeny of the spinning apparatus of *Tengella perfuga* (Araneae: Zoropsidae). *Invertebrate Biology* 137(3): 187-204.
3. Correa-Garhwal, SM, RC Chew, TH Clarke, LG AlaniZ, FS Chan, **RE Alfaro**, and CY Hayashi. 2018. Silk genes and silk gene expression in the spider *Tengella perfuga* (Zoropsidae), including a potential cribellar spidroin (CrSp). *PLOS One* 13(9): e0203563; doi10.1371/journal.pone.0203563.
4. Desamore, A, B. Laenen, **KB Miller**, and J. Bergsten. 2018. Early burst in body size evolution is uncoupled from species diversification in diving beetles (Dytiscidae). *Molecular Ecology* 27(4): 979-993.
5. Guimaraes, BAC, N Ferreira, Jr., and **KB Miller**. 2018. On *Hydrocanthus* Say, 1823 (Coleoptera: Noteridae): description of a new species, two new synonyms and a key to Brazilian species. *Zootaxa* 4508(2): 288-300.
6. Johnson, P.J. and **D.C. Lightfoot**. 2018. New species and records of Elateridae (Coleoptera) from Cuatrocienegas, Coahuila, Mexico. *Insecta Mundi* 0678:1-15.
7. **Lightfoot, DC**. 2018. The effects of livestock grazing and climate variation on vegetation and grasshopper communities in the northern Chihuahuan Desert. *Journal of Orthoptera Research* 27(1): 35-51.
8. **Miller, KB**, and GW Wolfe. 2018. Nine new species in the *Desmopachria nitida* species-group of the neotropical genus *Desmopachria* Babington, 1841 (Coleoptera: Adephaga: Dytiscidae: Hydroporinae: Hyphydrini). *Coleopterists Bulletin* 72(1): 97-112.
9. **Wright, K**. Evolution of diet breadth of *Melissodes* Latreille. Ph.D. dissertation.

6. SCIENTIFIC PRODUCTS BASED ON THE COLLECTION

1. Esser, J. 2018. New *Cryptophagus* Herbst, 1792 (Coleoptera: Cryptophagidae) from Arizona (United States of America). *Linzer Biologische Beiträge* 50(2): 1067-1071.
2. Esser, J. 2018. New *Cryptophagus* Herbst, 1792 (Coleoptera: Cryptophagidae) from New Mexico (United States of America). *Linzer Biologische Beiträge* 50(2): 1073-1078.
3. Esser, J. 2018. New genera and new species of Cryptophagidae (Coleoptera) from USA and Mexico. *Linzer Biologische Beiträge* 50(2): 1079-1083.
4. Huang, J-P, and L.L. Knowles. 2018. Testing the impact of oceanic barriers on population subdivision, speciation and zoogeographical community assembly in *Xylotrupes* beetles across the Indo-Australian Archipelago. *Biological Journal of the Linnean Society* 20:1-13.
5. Johnson, P.J. and **D.C. Lightfoot**. 2018. New species and records of Elateridae (Coleoptera) from Cuatrocienegas, Coahuila, Mexico. *Insecta Mundi* 0678:1-15.
6. **Lightfoot, DC**. 2018. The effects of livestock grazing and climate variation on vegetation and grasshopper communities in the northern Chihuahuan Desert. *Journal of Orthoptera Research* 27(1): 35-51.

7. **Metzler, E.H.** and S.B. Porter. 2018. The Lepidoptera in White Sands National Monument, Otero County, New Mexico, USA 13. The description of another white species (Tortricidae: Olethreutinae: Eucosmini: *Eucosma* Hubner). *Journal of the Lepidopterists' Society* 72(4): 314-319.
8. Sierwald, P., R. Bieler, E.K. Shea, and G. Rosenberg. 2018. Mobilizing mollusks: status update on mollusk collections in the U.S.A. and Canada. *American Malacological Bulletin* 36(2): 177-214.

7. SERVICE AND OUTREACH

- **Brantley, S.L.** Lecture and field day with the Master Naturalists Program (Bernalillo County Open Space), 20 students, July.
- **Brantley, S.L.** Strength in Numbers: how spiders and insects make a living. Presentation and display table at the EPSCoR Science fiesta for STEM fields, May.
- **Brantley, S.L.** and **R. Alfaro**. Guests on KUNM's Children's Hour for Q and A program on spiders, September.
- **Brantley, S.L.** and **C. Cumberland**. Presentation to the UNM Staff Council on the roles of academic staff in the Biology Dept., March, 20 people.
- **Tours: 28 students** from East Mountains HS, presentation on professions involving animals, May.
- **Dave Lightfoot**; served as solicited peer reviewer for submitted articles to the journals: *Journal of Orthoptera Research*, *Insect Systematics and Evolution*, *ZooTaxa*, *Western North American Naturalist*, *US Forest Service*, *Rocky Mountain Research Station*.
- **Dave Lightfoot**; served as a member of the International Union for Conservation of Nature (IUCN) Grasshopper Specialist Group, to provide conservation evaluations and conservation strategy recommendations for North American grasshopper, cricket and katydid species for the IUCN.

8. AFFILIATED PERSONNEL

A. Faculty & Staff

Kelly Miller, Curator, Professor

Sandra Brantley, Senior Collection Manager, Research Assoc. Professor

David Lightfoot, Senior Collection Manager, Research Assoc. Professor

Mark Ward, UNM/Valles Caldera National Preserve Research Scientist

B. Graduate students

Matthew Leister, Master's student
Catherine Cumberland, Ph.D. candidate
Julieta Bettinelli, PhD candidate
Karen Wright, PhD candidate (finished in 2018)

C. Undergraduate Students

Marlo McCarter
Wesley Noe
Allison Verhaagen
Mae Ling Kao

D. Research Associates

Robert Parmenter, Valles Caldera National Preserve
Eric Metzler, Alamogordo, NM
Ernest Valdez, NM Landscapes Field Station

E. Community volunteers

Sharyn Davidson
Richard Buss

PRESENTATIONS/POSTERS

- **Brantley, S.L.*** 2018. MSB Division of Arthropods, Collection Managers's presentations to Dr. Mark Peceny, Dean of UNM's College of Arts and Sciences, August.
- **McCarter, M*** and **M.A. Ward**. 2018. Responses of grasshoppers and crickets to low-severity wildfire in a ponderosa pine forest of the Jemez Mountains: can low-severity wildfires be beneficial? Poster. UNM Biology Department Research Days, Albuquerque, March.
- **Ward, M.A.*** and **S.L. Brantley***. 2018. The sites they are a-changin': beetles and arachnids in ponderosa pine 2011-2015. Collaborative Forest Landscape Restoration Project (CFLRP) meeting, Santa Fe, March.

MSB Division of Birds

2018 Annual Report

1. DIVISION HIGHLIGHTS

2018 was another busy and productive year for the MSB Division of Birds. Ten of our Division-affiliated personnel attended the American Ornithological Society meeting in Tucson and presented on their research. We conducted fieldwork in many parts of the world this year, starting in February with an expedition to the Andes of north-central Peru. We conducted fieldwork in southern and central New Mexico at various times during spring and summer, including a successful effort to recover geolocators (micro-tracking devices) from Gray Vireos at the Sevilleta National Wildlife Refuge. We also collected the first tissues of Bell's Vireos from New Mexico, a species of regional conservation concern. In early summer, we undertook a major expedition to the Solomon Islands as part of Associate Curator, Michael Andersen's NSF-funded field research program. During July, we undertook a student led expedition to Peru to study the migratory behavior and ecology of the Giant Hummingbird. At the end of the fall, we conducted an expedition to Chile, where we collected the first modern museum specimens of birds in existence from that country. We hosted field researchers from the Moore Laboratory at Occidental College and from Harvard University from two separate collecting efforts: we brought Dr. Ryan Terrill and collaborators from the Moore Lab to Mesa Chivato to study molt-migration of Chipping Sparrows, whereas we brought Dr. Kathrin Naepflin and her collaborators from Harvard University all around Albuquerque to collect House Finches for a study of Mycoplasma pathogens. We collected samples of woodpecker brains for collaborators on North Campus so they could study the birds' resistance to CTE. In July, we participated in survey of nesting Brown-capped Rosy Finches at Vermejo Park coordinated by the New Mexico Ornithological Society. We hosted an evening class for the Master Naturalists in the collection so that they could see birds up close. We also helped the Maxwell Museum identify feathers in their artifacts. We conducted a major import of specimens from Australia, including many specimens that were collected by graduate student, Serina Brady, during her internship at the Australia National Wildlife Collection, along with additional specimens that were donated by the Australia National Wildlife Collection and that represent the diversity of the Australian avifauna. We taught two UNM courses: Avian Scientific Specimen Preparation (taught annually) and the Natural History Museum Curation class. Finally, we published two major papers based on the collection that comprised successful student thesis projects carried out in the Division of Birds. One of those publications was by Libby Beckman, now a postdoc at Berkeley (Beckman et al. 2018, below) that was featured with a special invited commentary in the journal *Molecular Ecology*. The other was by Chauncey Gadek, now a Ph.D. student in our division, in *Journal of Animal Ecology* (see Gadek et al. 2018, below). Finally, Xena Mapel, Division affiliated

undergraduate, was awarded Outstanding Undergraduate by the UNM Biology Department. She started as a M.S. student in the fall after graduating with her B. S.

2. TABLE OF COLLECTION ACTIVITY

Metric	Number
Collection Growth	968
Loans (outgoing(no. of specimens)/incoming (no. of specimens)	Outgoing: 26 (881) Incoming: 8 (100)
Specimen Records served via electronic databases	12,271 queries, finding 4,880,124 records
Publications using the collection	28
Citations of publications using the collection	610

3. EDUCATIONAL IMPACTS OF THE COLLECTION

In addition to its traditional role as a center for the study of birds by students of birds at all levels, this collection is used for approximately one tour per month on average and reaches all demographics of the community from second graders to retirees. It is also used by artists.

3a. COURSES USING THE COLLECTIONS

- BIOL 386L, General Vertebrate Zoology, spring and fall semesters, 53 students
- BIOL 499, Avian Scientific Specimen Prep, Spring, 9 students
- BIOL 191, Biodiversity, Spring, 22 students
- BIOL 303, Ecology and Evolution; core curriculum Sandhill Crane bone lab.



Crowded Bird Range for the MSB's annual open-collections event. Graduate student Jessie Williamson (left, foreground) explains her hummingbird migration research to visitors, while Research Associate Matthew Baumann (center, background) explains Peruvian tanager diversity.

3b. COURSES TAUGHT BY MSB PERSONNEL

Instructor(s)	Semester	Course	Title	Enrollment
Witt	Fall	BIOL 519	T: Ornithological Field Expedition	1
Witt	Fall	BIOL 551	Research Problems	1
Witt	Fall	BIOL 599	Master's Thesis	1
Witt	Fall	BIOL 499	Undergraduate Problems	2
Witt	Fall	BIOL 502	T: Molecular Systematics Discussion	2
Witt	Fall	BIOL 551	Research Problems	2
Witt	Fall	BIOL 502	T: Brown Bag Research Seminar	4
Witt	Fall	BIOL 519	T: High Altitude Biology	7
Witt	Fall	BIOL 402	T: Brown Bag Research Seminar	16
Witt	Fall	BIOL 419	T: High Altitude Biology	22
Andersen	Spring	BIOL 191	Biodiversity	22
Witt	Spring	BIOL 499	Undergraduate Problems	1
Witt	Spring	BIOL 502	T: Molecular Systematic Discussion	1
Witt	Spring	BIOL 599	Master's Thesis	1
Witt	Spring	BIOL 502	T: Brown Bag Research Seminar	2
Witt	Spring	BIOL 551	Research Problems	2
Witt	Spring	BIOL 402	T: Molecular Systematic Discussion	3
Johnson/Witt	Spring	BIOL 502	T: Avian Sci Specimen Prep	3
Witt	Spring	BIOL 519	T: Natl Hist Museum Curation	4
Johnson/Witt	Spring	BIOL 402	T: Avian Sci Specimen Prep	7
Witt	Spring	BIOL 402	T: Brown Bag Research Seminar	26
Witt	Spring	BIOL519	Natural History Museum Curation	19
Witt	Summer	BIOL 499	Undergraduate Problems	1
Witt	Summer	BIOL 599	Masters Thesis	1

4. COLLECTION MANAGEMENT

The collection contained over 46,500 catalogued bird specimens at the end of 2018. These are heavily comprised of recently collected materials, as evidenced from our active expeditionary fieldwork program (see highlights, above). These specimens are catalogued and managed in the Arctos database, from which their data is served to the public.

5. SCIENTIFIC PRODUCTS AUTHORED BY DIVISION PERSONNEL

1. Gadek, Chauncey R; Newsome, Seth D; Beckman, Elizabeth J; Chavez, Andrea N; Galen, Spencer C; Bautista, Emil; Witt, Christopher C; 2018. Why are tropical mountain passes "low" for some species? Genetic and stable-isotope tests for differentiation, migration and expansion in elevational generalist songbirds. *Journal of Animal Ecology* 87: 741-753

2. Johnson, A. B. 2018. Results of an Elf Owl (*Micrathene whitneyi*) survey in Dark Canyon, Guadalupe Mountains, Eddy County, New Mexico. *NMOS Bulletin* 45:
3. Per Alström, Alice Cibois, Martin Irestedt, Dario Zuccon, Magnus Gelang, Jon Fjeldså, Michael J Andersen, Robert G Moyle, Eric Pasquet, Urban Olsson; 2018. Comprehensive molecular phylogeny of the grassbirds and allies (Locustellidae) reveals extensive non-monophyly of traditional genera, and a proposal for a new classification. *Molecular Phylogenetics and Evolution* :
4. Barrow, L. N., Lemmon, A. R., & Lemmon, E. M.; 2018. Targeted Sampling and Target Capture: Assessing Phylogeographic Concordance with Genome-wide Data. *Systematic Biology*.
5. Perez-Eman, Jorge L; Ferreira, JHONIEL PERDIGÓN; Gutierrez-Pinto, Natalia; Cuervo, Andres M; Cespedes, Laura N; Witt, Christopher C; Cadena, CARLOS DANIEL; 2018. An extinct hummingbird species that never was: a cautionary tale about sampling issues in molecular phylogenetics. *Zootaxa* 4442: 491-497
6. Beckman, Elizabeth J; Benham, Phred M; Cheviron, Zachary A; Witt, Christopher C; 2018. Detecting introgression despite phylogenetic uncertainty: The case of the South American siskins. *Molecular ecology* 27: 4350-4367
7. Basile, Anthony J; Jarrett, Catherine L; Witt, Christopher C; Sweazea, Karen L; 2018. Evolution of Naturally High Plasma Glucose Concentrations in Birds. *The FASEB Journal* 32: 860.5-860.5
8. Trujillo-Arias, Natalia; Calderón, Luciano; Santos, Fabricio R; Miyaki, Cristina Y; Aleixo, Alexandre; Witt, Christopher C; Tubaro, Pablo L; Cabanne, Gustavo S; 2018. Forest corridors between the central Andes and the southern Atlantic Forest enabled dispersal and peripatric diversification without niche divergence in a passerine. *Molecular phylogenetics and evolution* 128: 221-232
9. Smith, Brian Tilston; Mauck, William M; Benz, Brett; Andersen, Michael J; 2018. Uneven missing data skews phylogenomic relationships within the lories and lorikeets. *bioRxiv* : 398297
10. O'Connor, Ryan S; Smit, Ben; Talbot, William A; Gerson, Alexander R; Brigham, R Mark; Wolf, Blair O; McKechnie, Andrew E; 2018. Avian thermoregulation in the heat: is evaporative cooling more economical in nocturnal birds?. *Journal of Experimental Biology* 221: jeb181420
11. Hosner, Peter A; Campillo, Luke C; Andersen, Michael J; Sánchez-González, Luis A; Oliveros, Carl H; Urriza, Rolly C; Moyle, Robert G; 2018. An integrative species delimitation approach reveals fine-scale endemism and substantial unrecognized avian diversity in the Philippine Archipelago. *Conservation genetics* 19: 1153-1168

6. SCIENTIFIC PRODUCTS BASED ON THE COLLECTION

1. Ainsworth, C. S. C. P. L. J. E. L. E. F. S. (2018). Ritual Deposition of Avifauna in the Northern Burial Cluster at Pueblo Bonito, Chaco Canyon. *Kiva*, 1–26.

2. Andersen, M. J., McCullough, J. M., Mauck, W. M., III, Smith, B. T., & Moyle, R. G. (2018). A phylogeny of kingfishers reveals an Indomalayan origin and elevated rates of diversification on oceanic islands. *Journal of Biogeography*, *45*(2), 269–281.
3. Antonelli, A., Zizka, A., Carvalho, F. A., Scharn, R., Bacon, C. D., Silvestro, D., & Condamine, F. L. (2018). Amazonia is the primary source of Neotropical biodiversity. *Proceedings of the National Academy of Sciences*, *115*(23), 6034–6039.
4. Beckman, E. J., Benham, P. M., Cheviron, Z. A., & Witt, C. C. (2018). Detecting introgression despite phylogenetic uncertainty: The case of the South American siskins. *Molecular Ecology*, *27*(22), 4350–4367.
5. Burgio, K. R., Carlson, C. J., & Bond, A. L. (2018). Georeferenced sighting and specimen occurrence data of the extinct Carolina Parakeet (*Conuropsis carolinensis*) from 1564–1944. *Biodiversity Data Journal*, (6).
6. CHEEK, R. G., CAMPBELL, K. K., Winker, K., others. (2018). MITOCHONDRIAL DNA SUGGESTS RECENT ORIGINS OF SUBSPECIES OF THE SHARP-SHINNED HAWK AND GREAT BLUE HERON ENDEMIC TO COASTAL BRITISH COLUMBIA AND SOUTHEAST ALASKA. *Western Birds*, *49*, 47–61.
7. Chesser, R. T., Vaseghi, H., Hosner, P. A., Bergner, L. M., Cortes-Rodriguez, M. N., Welch, A. J., & Collins, C. T. (2018). Molecular systematics of swifts of the genus *Chaetura* (Aves: Apodiformes: Apodidae). *Molecular Phylogenetics and Evolution*, *128*, 162–171.
8. Cordero, R. M. (2018). Puebloan Agriculture and its Impact on the Migratory Behavior of Birds. *Kiva*, *84*(1), 85–109.
9. Duursma, D. E., Gallagher, R. V., Price, J. J., & Griffith, S. C. (2018). Variation in avian egg shape and nest structure is explained by climatic conditions. *Scientific Reports*, *8*(1), 4141.
10. Fuchs, J. D. S. D. H. O. G. F. J. B. R. C. (2018). Habitat-driven diversification, hybridization and cryptic diversity in the Fork-tailed Drongo (Passeriformes: Dicruridae: *Dicrurus adsimilis*). *Zoologica Scripta*, *47*, 266–284.
11. Gadek, C. R., Newsome, S. D., Beckman, E. J., Chavez, A. N., Galen, S. C., Bautista, E., & Witt, C. C. (2018). Why are tropical mountain passes “low” for some species? Genetic and stable-isotope tests for differentiation, migration and expansion in elevational generalist songbirds. *Journal of Animal Ecology*, *87*(3), 741–753.
12. Greeney, H. (2018). Antpittas and gnateaters. Bloomsbury Publishing.
13. Hazzi, N. A., Moreno, J. S., Ortiz-Movliav, C., & Palacio, R. D. (2018). Biogeographic regions and events of isolation and diversification of the endemic biota of the tropical Andes. *Proceedings of the National Academy of Sciences*, *115*(31), 7985–7990.
14. Johnson, AB. (2018). Results of an Elf Owl (*Micrathene whitneyi*) survey in Dark Canyon, Guadalupe Mountains, Eddy County, New Mexico. *New Mexico Ornithological Society Bulletin*, *45*(4), 42–44.
15. Jones, E. L. (2018). Coming to Terms with Imperfection: Comparative Studies and the Search for Grazing Impacts in Seventeenth Century New Mexico. In *Zooarchaeology in Practice* (pp. 251–268). Springer.
16. Kearns, A. M., Restani, M., Szabo, I., Schrøder-Nielsen, A., Kim, J. A., Richardson, H. M., et al. (2018). Genomic evidence of speciation reversal in ravens. *Nature Communications*, *9*(1), 906.

17. Lim, M.C.W. 2018. On the evolution and diversification of Andean hummingbirds. Ph.D. Dissertation, Stony Brook University, NY.
18. Machado, A. P. C. L. U. V. G. J. R. A. (2018). The Rocky Mountains as a dispersal barrier between barn owl (*Tyto alba*) populations in North America. *Journal of Biogeography*.
19. Miller, C. R. L. C. E. Z. B. (2018). Bill size variation in northern cardinals associated with anthropogenic drivers across North America. *Ecology and Evolution*, 8, 4841–4851.
20. Natola, L., & Burg, T. M. (2018). Population genetics and speciation of yellow-bellied, red-naped, and red-breasted sapsuckers (*Sphyrapicus varius*, *S. nuchalis*, and *S. ruber*). *Journal of Heredity*, 109(6), 663–674.
21. Peterson, A. T., Kumar, R. S., Nair, M. V., & Talukdar, G. (2018). Digital Accessible Knowledge of the birds of India: characterizing gaps in time and space. *Current Science*, 115(1), 35–42.
22. Pérez Emán, J. L., Ferreira, J. P., Gutiérrez-Pinto, N., Cuervo, A. M., Cespedes, L. N., Witt, C. C., & Cadena, C. D. (2018). An extinct hummingbird species that never was: a cautionary tale about sampling issues in molecular phylogenetics. *Zootaxa*, 4442(3), 491–497.
23. Provost, K. L., Mauck, W. M., III, & Smith, B. T. (2018). Genomic divergence in allopatric Northern Cardinals of the North American warm deserts is linked to behavioral differentiation. *Ecology and Evolution*, 8(24), 12456–12478.
24. Riemer, K, Guralnick, P, R., White, & P, E. (2018). No general relationship between mass and temperature in endothermic species. *eLife*, 7.
25. Roulin, A., Uva, V., & Romano, A. (2018). A melanin-based trait is more strongly related to body size in the tropics than in temperate regions in the globally distributed barn owl family. *Journal of Evolutionary Biology*, 31(12), 1932–1944.
26. Seeholzer, F, G., Brumfield, & T, R. (2018). Isolation by distance, not incipient ecological speciation, explains genetic differentiation in an Andean songbird (Aves: Furnariidae: *Cranioleuca antisiensis*, Line-cheeked Spinetail) despite near threefold body size change across an environmental gr. *Molecular Ecology*, 27(1), 279–296.
27. Trujillo-Arias, N., Calderón, L., Santos, F. R., Miyaki, C. Y., Aleixo, A., Witt, C. C., et al. (2018). Forest corridors between the central Andes and the southern Atlantic Forest enabled dispersal and peripatric diversification without niche divergence in a passerine. *Molecular Phylogenetics and Evolution*, 128, 221–232.
28. Will, P, A., Kitaiskaia, E, V, Kitaysky, & S, A. (2018). Red-legged kittiwake feathers link food availability to environmental changes in the Bering Sea. *Marine Ecology Progress Series*, 593, 261–274.

7. SERVICE AND OUTREACH

We conducted 12 division tours in 2018. We initiated a collaboration with North Campus UNM researchers on Woodpecker Tauopathy. We hosted the president of Western Field Ornithologists to plan the 2019 conference in Albuquerque. We volunteered our services to University of Toledo researchers who were working on Gray Vireos at Sevilleta NWR. We volunteered our services further to researchers from MLZ (Occidental College) and MCZ

(Harvard Univ.) (see highlights, above). We hosted woodcarver Robert Newman to study Burrowing owl specimens. We hosted various UNM anthropologists and zooarchaeologists to identify bird remains. We helped to initiate a bone isotope project with Miranda LaZar, grad student in UNM Dept. of Anthropology. We hosted a Master Naturalist class on bird identification. Finally, we participated in the MSB Open Collections event, 2018, in conjunction with the UNM Biology Research Days events.



An innovative display using specimens arrayed on a map to depict evolutionary diversification across archipelagoes, and the research and collecting program of Asst. Prof. and Curator, Dr. Mike Andersen, in the Solomon Islands. From MSB's annual open-collections event.

8. AFFILIATED PERSONNEL

A. Faculty & Staff

Andrew Johnson, Senior Collection Manager
 Christopher Witt, Curator
 Michael Andersen, Associate Curator
 Blair Wolf, Associate Curator

B. Graduate students

Jessie Williamson
 Chauncey Gadek
 Peter Mattison
 Marialejandra Farias Castro
 Oona Takano
 Jenna McCullough
 Serina Brady
 Xena Mapel
 Ethan Gyllenhaal
 Kristen Oliver

William Talbot

C. Post-bac Students:

Selina Bauernfeind

D. Undergraduate Students

Tina Guo (affiliated researcher and employee)

Xena Mapel (affiliated researcher)

Danielle Wiley (affiliated researcher and employee)

Carolyn McSherry (student volunteer)

Kelsey Erickson (student volunteer)

E. Research Associates

John Hubbard

Donna C. Schmitt

Gregory C. Schmitt

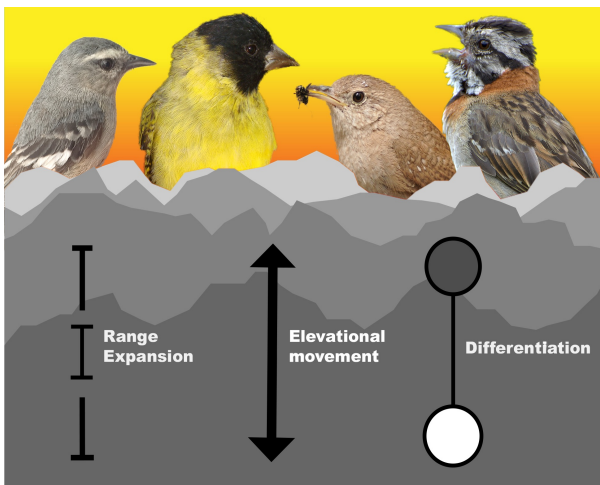
Matthew J. Baumann

Sartor O. Williams

F. Community volunteers

Madison Paulk

Meghan Truckey



Graphical abstract from Gadek et al. 2018, *J. Animal Ecol.*, and study that was entirely based on MSB bird specimens. Janzen's Rule predicts restricted elevational ranges for tropical montane species. On the west slope of the Peruvian Andes, a handful of songbird species defy this prediction, and MSB has outstanding and extensive collections of these species. Gadek et al. made tests for recent population expansion, elevational movement, and genetic divergence that revealed that elevational generalism has been unstable and fleeting. These exceptions prove Janzen's Rule. (Photo credits: Tom Kennedy, *Troglodytes aedon*; Dario Sanches, *Zonotrichia capensis*.)

MSB Division of Fishes: 2018 Annual Report



1. DIVISION HIGHLIGHTS

Currently, the MSB Division of Fishes has 102,028 cataloged lots of fishes (4,074,404 specimens). During the year, 585 lots of fishes (7,217 specimens) were cataloged and integrated into the main collections. There are 91,226 digital files of field notes and 650 jpg files of habitat photographs and specimens (for color). There are 42,743 specimen (georeferenced) locality records. The Curator of Fishes, Thomas Turner, took leave of absence from UNM to August 2018, and served as a rotating Program Officer in the Division of Environmental Biology at the National Science Foundation. Curator-emeritus Steve Ross served as Acting Curator during Dr. Turner's absence. MSB Senior Collections Manager, Alexandra Snyder, retired in September 2018 after 26 years of service to the Division, the Museum, and the University, and the international collections community. She was hired at UNM in 1993 and was Collection Manager at the Burke Museum of Natural History in Seattle, Washington. Before that, she was a curatorial staff member at the University of Michigan Museum of Zoology and supported and archived some of the most important ichthyological work ever conducted in freshwaters of the United States. We are in the process of filling this vacant position. A new Ph.D. graduate student arrived in Fall 2018, Katelyn Driscoll (University of Montana, Missoula) who completed a MS degree in stream ecosystem ecology. Guests hosted in 2018: Jonathan Dombrosky, University of New Mexico Anthropology Department; Stephen Zipper, SWCA Environmental Consultants, Albuquerque, NM; Tracy A. Diver, US Fish and Wildlife Service and Southwestern Native Aquatic Resources and Recovery Center, Dexter NM; Pauletta Dodge, SWCA Environmental Consultants, Albuquerque, NM; Gabriela Wolf-Gonzalez, University of Kentucky, Lexington.

2. TABLE OF COLLECTION ACTIVITY

Metric	Number
Collection Growth (specimens)	7,217
Loans (outgoing(no. of specimens)/incoming (no. of specimens)	5 (1327)/3(935)
Specimen Records served via electronic databases	99,074
Publications using the collection	19
Citations of publications using the collection	269 (Google Scholar)

3. EDUCATIONAL IMPACTS OF THE COLLECTION**3A. COURSES USING THE COLLECTION**

Instructor	Semester	Course	Title	Enrollment
Turner	Fall	BIOL 386L U 001	General Vertebrate Zoology	18
Turner	Fall	BIOL 386L U 002	General Vertebrate Zoology	19
Turner	Fall	BIOL 551 M 033	Research Problems	1
Turner	Spring	BIOL 551 M 032	Research Problems	3

3B. COURSES TAUGHT BY MSB PERSONNEL

Instructor	Semester	Course	Title	Enrollment
Turner	Fall	BIOL 386L U 001	General Vertebrate Zoology	18
Turner	Fall	BIOL 386L U 002	General Vertebrate Zoology	19
Turner	Fall	BIOL 551 M 033	Research Problems	1
Turner	Spring	BIOL 551 M 032	Research Problems	3

4. COLLECTION MANAGEMENT

MSB fish and data records are available from the following data portals: ARCTOS, Global Biodiversity Information Facility (GBIF), FishNet2 network, and iDigBio.

Collections were received from the following sources and projects: Wyoming Dept. Game and Fish, Laramie WY, USGS Grand Canyon Monitoring Center, Flagstaff AZ, Southwest Native Aquatic Resources and Research Center, Dexter NM, USFWS NM/TX Fish and Wildlife

Conservation Office, Albuquerque NM, US Bureau of Reclamation (Salt Lake City and Albuquerque), U.S. Bureau of Land Management (Taos and Las Cruces), BioPark Aquatic Conservation Facility, Albuquerque NM, American Southwest Ichthyological Researchers, and New Mexico Dept. Game and Fish.

Ongoing sponsored research projects generated by Turner Aquatic Conservation Laboratory were supported, in part, by MSB collection management: Rio Grande Silvery Minnow (*Hybognathus amarus*) Genetic Monitoring, Bonytail Chub (*Gila elegans*) Reproductive Ecology and Genetics, Gila Trout (*Oncorhynchus gilae*) Genetics, Fire response of Gila River Native Fishes, and Canadian River Native Fishes genetic and demographic monitoring projects.

Grand Canyon National Park Colorado River larval fish surveys generated about 150 lots (20 dram vial jars) and 44,418 age-0 specimens during 2018. Larval Catostomids (maintained in 95% EtOH) from this project are being genotyped under a two-year U.S. Bureau of Reclamation project (Principal Investigators: Thomas F. Turner, University of New Mexico, Thomas E. Dowling, Wayne State University, and Trevor J. Krabbenhoft, University of Buffalo).

San Juan River larval fish collections in 2018 yielded 41,064 age-0 specimens (maintained in 95% EtOH) including 54 Colorado Pikeminnow and 1,833 Razorback Sucker. Specimens continue to show a high rate of opercular deformities (15.3%) as first reported by Barkstedt et al. in 2018 (see publications). The MSB continues to receive funding to catalogue and maintain fish collected in the Grand Canyon and San Juan River and these long-term collections form the foundation of current long-term assessments of endangered fish populations.

MSB Research Associate, Tracy Diver (UNM, M.S. 2015) and current Fish Biologist at the USFWS's Southwestern Native Aquatic Resource and Recovery Center in Dexter, NM, initiated a project using MSB larval fish to determine effective number of breeding (N_b) Colorado Pikeminnow and Razorback Sucker in the San Juan River. In 2018, she spent almost one-month at MSB taking tissue samples from 2016–2018 larval Colorado Pikeminnow ($n=173$), Razorback Sucker ($n=382$), and Flannelmouth Sucker (2013–2018; $n=786$). Selected specimens were dissected and heads retained so that otoliths could be examined and aged (in days).

Another MSB Division of Fishes based project conducted in 2018 concerned age and growth of larval San Juan River Colorado Pikeminnow and Razorback Sucker. Otoliths were extracted from ca. 500 larval Colorado Pikeminnow and 500 larval Razorback Sucker collected from 2009 to 2017 (and stored in 95% EtOH). Daily growth was determined (in days), and spawning dates were back calculated and modeled using a variety of variables (year, discharge, water temperature). In addition, four different growth functions were generated using multiple models (von Bertalanffy, Gompertz, logistic, and polynomial). The 400+ different MSB catalogued lots used in this project are noted in the manuscript slated for submission in mid-2019.

A five-year cooperative, interdisciplinary research project between the University of New Mexico and Colorado State University was funded (by the U.S. Bureau of Reclamation)

beginning in 2018. The scope of the work is to investigate relationships between changing habitat conditions in the Middle Rio Grande and the population dynamics of Rio Grande Silvery Minnow by integrating data sets and knowledge among the disciplines of hydrology, geomorphology, and biology. The CSU team, from their Department of Civil Engineering, provides expertise in the field of sediment transport and river mechanics. The CSU team developed state-of-the-art computer models in hydrology and hydraulics for the simulation of water, sediment, and contaminant transport at the watershed level. The UNM team provided expertise on the life history, habitat use, ecology, and genetics of Rio Grande Silvery Minnow. This collaborative analysis of almost 20 years of fish data will rely on information generated from over 40 Rio Grande Silvery Minnow projects (with all project material housed at MSB for reference and verification). In 2018, the first biological synthesis of Rio Grande Silvery Minnow was drafted (using the aforementioned projects). The final version of the report was accepted in early 2019 and will appear in the 2019 MSB annual report.

In 2018, a long-term cooperative project (cyprinid fish larvae and early juveniles of the middle and lower Pecos River and Rio Grande) between the MSB Division of Fishes and Colorado State University Larval Fish Laboratory was completed. This 222-page tome provides 16 early life history description of fishes from the study area. Detailed keys establish meristic values, morphometric measures, developmental rates, and pigmentation characters from protolarvae to early juvenile ontogenetic stages. Accompanying those data are original detailed scientific illustrations depicting dorsal, lateral, and ventral views of specimens throughout larval development. All of the larval used in this study (including the developmental series reared at Southwestern Native Aquatic Resource and Recovery Center in Dexter, NM, are catalogued in the Division of Fishes and referenced throughout this work. This work is a companion volume to a similar effort being prepared for the fishes of the Middle Rio Grande, NM by CSU and MSB Fishes personnel.

In 2018, MSB Division of Fishes personnel worked with Gabriela A. Wolf-Gonzalez, a graduate student at the University of Kentucky Department of Forestry and Natural Resources who is studying the diet of a reintroduced river otter population in New Mexico (advisor, Dr. John J. Cox). Ms. Wolf-Gonzalez used specimens in the Division of Fishes to create an identification guide to fish scales so that the river otter prey items (remaining in their scat) could be identified for their study. Division of Fishes specimens (potential fish prey) from the range of reintroduced river otter were examined and scales and pharyngeal teeth removed from selected MSB material (see MSB visitors).

5. SCIENTIFIC PRODUCTS AUTHORED BY DIVISION PERSONNEL

5B. JOURNAL ARTICLES

1. Alò, D., C. Correa, H. Samaniego, C. A. Krabbenhoft, and T. F. Turner. 2018. Otolith microchemistry identifies diadromous populations of Patagonian river fishes. *bioRxiv*:174656.
2. Barkstedt, J. M., S. L. Clark-Barkalow, M. A. Farrington, J. L. Kennedy, and S. P. Platania. 2018. Frequency of Opercular Deformities in Age-0 Native Catostomids in the San Juan River from 1998 to 2012. *Transactions of the American Fisheries Society*, 147(6):1115-1123.
3. Camak, D. T. and K. R. Piller. 2018. Going with the flow: Testing the role of habitat isolation among three ecologically divergent darter species. *Copeia*, 106(2):375-387.
4. Echelle, A. A., M. R. Schwemm, A. F. Echelle, W. D. Wilson, and T. F. Turner. 2018. Native-nonnative status of *Gambusia geiseri* (Poeciliidae) populations, conservation value of nonnatives, and a missing mitochondrial ancestor of *G. speciosa*. *The Southwestern Naturalist* 63(2):xxx-xxx.
5. Gilbert, E. I., S. L. Durst, A. P. James, J. E. Davis, T. B. Sinclair, and N. R. Franssen. 2018. Cranial morphological scaling and relative prey size limitations for a native predator in an invaded system. *Environmental Biology of Fishes*, 101(6):1067-1076.
6. Horwitz, R. J., D. H. Keller, P. F. Overbeck, S. P. Platania, R. K. Dudley, and E. W. Carson. 2018. Age and Growth of the Rio Grande Silvery Minnow, an Endangered, Short-Lived Cyprinid of the North American Southwest. *Transactions of the American Fisheries Society*, 147(2):265-277.
7. Krabbenhoft, T. J., and T. F. Turner. 2018. Comparative transcriptomics of cyprinid minnows and carp in a common wild setting: a resource for ecological genomics in freshwater communities. *DNA Research* 25(1):11-23.
8. Osborne, M. J., A. V. Sanchez, T. E. Dowling, and T. F. Turner. 2018. Variance in reproductive success is driven by environmental factors, not mating system, in Bonytails. *Transactions of the American Fisheries Society*, 147(6):1100-1114.

5C. TECHNICAL REPORTS

1. Brandenburg, W. H., D. E. Snyder, S. P. Platania, and K. R. Bestgen. 2018. Cyprinid fish larvae and early juveniles of the middle and lower Pecos River and Rio Grande— Morphological descriptions, comparisons, and illustrations and computer-interactive key. Report for U.S. Bureau of Reclamation, Albuquerque, NM.
2. Dudley, R. K., A. L. Barkalow, S. P. Platania, and G. C. White. 2018. Rio Grande Silvery Minnow Reproductive Monitoring during 2018. U. S. Bureau of Reclamation Report – Contract R17PC00033; <https://doi.org/10.13140/RG.2.2.30287.53927>
3. Dudley, R. K., S. P. Platania, and G. C. White. 2018. Rio Grande Silvery Minnow population monitoring during 2017. U. S. Bureau of Reclamation Report – Contract R17PC00028; <https://doi.org/10.13140/RG.2.2.14096.71684/1>

4. Farrington, M. A., R. K. Dudley, J. L. Kennedy, S. P. Platania, and G. C. White. 2018. San Juan River 2017 Colorado Pikeminnow and Razorback Sucker larval fish survey. Draft Report. San Juan River Basin Implementation Recovery Program, USFWS, Albuquerque, NM. 71 pp.
5. Kegerries, R., B. Albrecht, R. Rogers, W. H. Brandenburg, A. L. Barkalow, M. C. McKinstry, B. D. Healy, J. R. Stolberg, E. C. Omana Smith, and H. E. Mohn. 2018. Razorback Sucker *Xyrauchen texanus* research and monitoring in the Colorado River inflow area of Lake Mead and the lower Grand Canyon, Arizona and Nevada. Final Report prepared by BIO-WEST, Inc., for U. S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, UT – Contract GS-10F-0331S.
6. Osborne, M. J., and T. F. Turner. 2018. Genetic monitoring of Rio Grande Silvery Minnow: Status of wild and captive stocks in 2018. Final Report to U.S. Bureau of Reclamation, Albuquerque, NM. 51 pp.
7. Osborne, M. J. Genetic and demographic studies to guide conservation management of Bonytail in off-channel habitats. Research Report submitted to the Lower Colorado Multi-Species Conservation Program, U.S. Bureau of Reclamation, Albuquerque, NM. 23 pp.
8. Platania, S. P., D. A. Hendrickson, and A. E. Cohen. 2018. Documentation Related to a 1991 Observation of Sturgeon in the Rio Grande–Río Bravo, USA (Texas) and Mexico (Coahuila). <http://hdl.handle.net/2152/65044>
9. Propst, D. L. and K. Bixby. 2018. Conserving Native Rio Grande Fishes in Southern New Mexico and West Texas: A Conceptual Approach. https://www.wildmesquite.org/files/conserving_native_rio_grande_fishes_in_southern_nm_and_west_tx.pdf
10. Smith, D. M., K. P. Driscoll, and D. M. Finch. 2018. Riparian and wetland ecosystems of the Ashley National Forest: An assessment of current conditions in relation to natural range of variation. General Technical Report for U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO – RMRS-GTR-378. 101 pp.
11. Turner, T. F. and 14 co-authors. 2018. Review of the Comparative Survival Study (CSS) Draft 2018. Annual Report. ISAB 2018-4. <https://www.nwcouncil.org/sites/default/files/ISAB%202018-4%20ReviewCSSdraft2018AnnualReport18Oct.pdf>
12. Turner, T. F. and 14 co-authors. 2018. Review of the 2014 Columbia River Basin Fish and Wildlife Program. ISAB 2018-3. <https://www.nwcouncil.org/sites/default/files/isab-2018-3-review2014fwp23march.pdf>
13. Turner, T. F. and 14 co-authors. 2018. Review of NOAA Fisheries Document: A Power Analysis of Two Alternative Experimental Designs to Evaluate a Test of Increased Spill at Snake and Columbia River Dams, Using Smolt-to-Adult Returns of Anadromous Salmonids. ISAB 2018-2. https://www.nwcouncil.org/sites/default/files/isab-2018-2-noaa_spillstatisticalpoweranalysis19march.pdf
14. Turner, T. F. and 14 co-authors. 2018. Review of Spring Chinook Salmon in the Upper Columbia River. ISAB 2018-1. <https://www.nwcouncil.org/sites/default/files/ISAB%202018-1UpColSpringChinookReview10AprilUPDATE.pdf>

5D. AWARDS, GRANTS, AND CONTRACTS (PI in bold)

- **Hamilton, G.L.** A novel approach to trace effects of invasive species across food webs using stable isotopes. American Society of Ichthyologists and Herpetologists, McCarley Award. \$1,000
- **Hamilton, G.L.** A novel approach to trace effects of invasive species across food webs using stable isotopes. UNM Center for Stable Isotopes Pilot Grant. \$500.
- **Hamilton, G.L.** A novel approach to trace effects of invasive species across food webs using stable isotopes. UNM GPSA New Mexico Research Grant. \$5,000.
- **Osborne, M. J.**, and T. F. Turner. Development of high-throughput markers for Rio Grande Silvery Minnow genetics. U.S. Bureau of Reclamation. 2018: \$170,802.
- **Osborne, M. J.** Genetic status assessment of Chihuahua Chub. New Mexico Department of Game and Fish. 14 Dec 2018 to 31 Dec 2019: \$12,704.
- **Osborne, M. J.** and T. F. Turner. Rio Grande Silvery Minnow Genetics Assessment and Monitoring. U. S. Bureau of Reclamation. 1 December 2017 to 30 November 2018. \$221,414.
- **Turner, T. F.**, D. T. Camak, M. J. Osborne. Model-based projection of the genetic effects of natural recolonization of Gila trout. US Fish & Wildlife Service. 1 July 2017 to 31 May 2018. \$80,000
- **Turner, T. F.** Linking morpho-dynamic and biological-habitat conditions on the Middle Rio Grande. Colorado State University. 22 September 2017 to 21 September 2018. \$90,000.
- **Turner, T. F.** and M. J. Osborne. Range-wide genetic assessment of loach minnow and spikedace Bureau of Reclamation 30 August 2018 to 30 September 2021. \$138,525.00
- **Turner, T. F.** Curation of Lower Colorado River Basin Larval Fish Collections and Digital Files Bureau of Reclamation 16 April 2018 to 30 September 2022. \$293,883.

5E. OTHER

- Brandenburg, W. H., A. S. Burdett. 2018. Native Fishes of Grand Canyon. Education poster and brochure funded by U.S. Bureau of Reclamation and Grand Canyon Association.

6. SCIENTIFIC PRODUCTS BASED ON THE COLLECTION

6B. JOURNAL ARTICLES BASED ON THE COLLECTION

1. Alò, D., C. Correa, H. Samaniego, C. A. Krabbenhoft, and T. F. Turner. 2018. Otolith microchemistry identifies diadromous populations of Patagonian river fishes. *bioRxiv*:174656.
2. Archdeacon, T. P., S. R. Davenport, J. D. Grant, and E. B. Henry. 2018. Mass upstream dispersal of pelagic-broadcast spawning cyprinids in the Rio Grande and Pecos River, New Mexico. *Western North American Naturalist*, 78(1):100-106.
3. Bangs, M. R., M. R. Douglas, S. M. Mussmann, and M. E. Douglas. 2018. Unraveling historical introgression and resolving phylogenetic discord within *Catostomus* (Osteichthys: Catostomidae). *BMC Evolutionary Biology*, 18(1):86.
4. Barkstedt, J. M., S. L. Clark-Barkalow, M. A. Farrington, J. L. Kennedy, and S. P. Platania. 2018. Frequency of Opercular Deformities in Age-0 Native Catostomids in the San Juan River from 1998 to 2012. *Transactions of the American Fisheries Society*, 147(6):1115-1123.
5. Echelle, A. A., M. R. Schwemm, A. F. Echelle, W. D. Wilson, and T. F. Turner. 2018. Native-nonnative status of *Gambusia geiseri* (Poeciliidae) populations, conservation value of nonnatives, and a missing mitochondrial ancestor of *G. speciosa*. *The Southwestern Naturalist* 63(2):xxx-xxx
6. Gilbert, E. I., S. L. Durst, A. P. James, J. E. Davis, T. B. Sinclair, and N. R. Franssen. 2018. Cranial morphological scaling and relative prey size limitations for a native predator in an invaded system. *Environmental Biology of Fishes*, 101(6):1067-1076.
7. Horwitz, R. J., D. H. Keller, P. F. Overbeck, S. P. Platania, R. K. Dudley, and E. W. Carson. 2018. Age and Growth of the Rio Grande Silvery Minnow, an Endangered, Short-Lived Cyprinid of the North American Southwest. *Transactions of the American Fisheries Society*, 147(2):265-277.
8. Osborne, M. J., A. V. Sanchez, T. E. Dowling, and T. F. Turner. 2018. Variance in reproductive success is driven by environmental factors, not mating system, in Bonytails. *Transactions of the American Fisheries Society*, 147(6):1100-1114.
9. Schmidt, B. V., and J. Schaefer. 2018. Ecological and landscape effects on genetic distance in an assemblage of headwater fishes. *Ecology of Freshwater Fish*, 27(2):617-631.
10. Sherwood, J. L., A. J. Stites, M. J. Dreslik, and J. S. Tiemann. 2018. Predicting the range of a regionally threatened, benthic fish using species distribution models and field surveys. *Journal of Fish Biology*, 93(5):972-977.

6C. TECHNICAL REPORTS BASED ON THE COLLECTION

- Brandenburg, W. H., D. E. Snyder, S. P. Platania, and K. R. Bestgen. 2018. Cyprinid fish larvae and early juveniles of the middle and lower Pecos River and Rio Grande—Morphological descriptions, comparisons, and illustrations and computer-interactive key. Report for U.S. Bureau of Reclamation, Albuquerque, NM.

- Dudley, R. K., A. L. Barkalow, S. P. Platania, and G. C. White. 2018. Rio Grande Silvery Minnow Reproductive Monitoring during 2018. U. S. Bureau of Reclamation Report – Contract R17PC00033; <https://doi.org/10.13140/RG.2.2.30287.53927>
- Dudley, R. K., S. P. Platania, and G. C. White. 2018. Rio Grande Silvery Minnow population monitoring during 2017. U. S. Bureau of Reclamation Report – Contract R17PC00028; <https://doi.org/10.13140/RG.2.2.14096.71684/1>
- Farrington, M. A., R. K. Dudley, J. L. Kennedy, S. P. Platania, and G. C. White. 2018. San Juan River 2017 Colorado Pikeminnow and Razorback Sucker larval fish survey. *San Juan River Basin Implementation Recovery Program, USFWS, Albuquerque, NM.*
- Kegerries, R., B. Albrecht, R. Rogers, W. H. Brandenburg, A. L. Barkalow, M. C. McKinstry, B. D. Healy, J. R. Stolberg, E. C. Omana Smith, and H. E. Mohn. 2018. Razorback Sucker *Xyrauchen texanus* research and monitoring in the Colorado River inflow area of Lake Mead and the lower Grand Canyon, Arizona and Nevada. Final Report prepared by BIO-WEST, Inc., for U. S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, UT – Contract GS-10F-0331S.
- Osborne, M. J., and T. F. Turner. 2018. Genetic monitoring of Rio Grande Silvery Minnow: Status of wild and captive stocks in 2018. Final Report to U.S. Bureau of Reclamation, Albuquerque, NM. 51 pp.
- Osborne, M. J. Genetic and demographic studies to guide conservation management of Bonytail in off-channel habitats. Research Report submitted to the Lower Colorado Multi-Species Conservation Program, U.S. Bureau of Reclamation, Albuquerque, NM. 23 pp.
- Platania, S. P., D. A. Hendrickson, and A. E. Cohen. 2018. Documentation Related to a 1991 Observation of Sturgeon in the Rio Grande–Río Bravo, USA (Texas) and Mexico (Coahuila). <http://hdl.handle.net/2152/65044>
- Propst, D. L. and K. Bixby. 2018. Conserving Native Rio Grande Fishes in Southern New Mexico and West Texas: A Conceptual Approach. https://www.wildmesquite.org/files/conserving_native_rio_grande_fishes_in_southern_nm_and_west_tx.pdf

6D. OTHER PRODUCTS BASED ON THE COLLECTION

- Brandenburg, W. H., A. S. Burdett. 2018. Native Fishes of Grand Canyon. Education poster and brochure funded by U.S. Bureau of Reclamation and Grand Canyon Association.

7. SERVICE AND OUTREACH

7A. CONTRIBUTED TALKS/POSTERS AT PROFESSIONAL MEETINGS (presenter's name in bold)

- **Brandenburg, W. H.**, A. L. Barkalow, R. Kegerries, B. Albrecht, R. J. Rogers, H. E. Mohn, M. C. McKinstry, B. D. Healy, E. C. Omana Smith, and J. R. Stolberg. Distribution of larval Razorback Sucker *Xyrauchen texanus* and associated fish community in the Colorado River, Grand Canyon. Colorado River Aquatic Biologists, Laughlin, NV. 10-11 January 2018.

- **Brandenburg, W. H.**, R. Kegerries, R. B. Albrecht, A. L. Barkalow, H. E. Mohn, M. C. McKinstry, B. D. Healy, E. C. Omana Smith, and J. R. Stolberg. Razorback Sucker *Xyrauchen texanus* research and monitoring in the Colorado River inflow area of Lake Mead and the lower Grand Canyon, AZ and NV. Glen Canyon Dam Adaptive Management Program, Annual Reporting Meeting and Technical Workgroup, Flagstaff, AZ. 6-7 March 2018.
- **Camak, D. T.**, M. J. Osborne, and T. F. Turner. An annotated SNP assay for assessment of genetic diversity in Gila Trout. Joint Meeting of Ichthyologists and Herpetologists, Rochester, NY. 11-15 July 2018.
- **Cameron, A. C.**, D. T. Camak, T. J. Pilger, D. L. Propst, M. J. Osborne, and T. F. Turner. Disentangling natural dispersal versus human-mediated introduction of the longfin dace (*Agosia chrysogaster*) across the trans-continental divide. Joint Meeting of Ichthyologists and Herpetologists, Rochester, NY. 11-15 July 2018.
- **Driscoll, K. P.**, and M. M. Friggens. After Fire: Toolkit for the Southwest. Great Plains Grassland Summit, Denver, CO. 10-11 April 2018.
- **Hamilton, G.L.**, S. Benally, S.D. Newsome, and T.F. Turner. Trophic discrimination factors and tissue turnover time in the Red Swamp Crayfish (*Procambarus clarkii*): a controlled feeding experiment. 7th Natural History of the Gila Symposium, Silver City, NM. 22-24 February, 2018.
- **Osborne, M. J.**, A. V. Sanchez, T. E. Dowling, and T. F. Turner. Large variance in reproductive success is driven by environmental factors not mating system in Bonytail. Joint Meeting of Ichthyologists and Herpetologists, Rochester, NY. 11-15 July 2018.
- **Ross, S.T.**, T.C. Modde, and D.G. Ross. Comparison of Aging Structures and Life History Aspects of an Historical Population of the Roundtail Chub, *Gila robusta* (Cyprinidae), in the Yampa River Canyon, Colorado. Desert Fishes Council, Death Valley, CA. 14-18 November 2018.
- **Turner, T. F.**, T. J. Pilger, K. B. Gido, D. L. Propst, and J. Whitney. 2018. Disturbance in a stream network: genetic and demographic data help predict post-disturbance community structure. Society for Freshwater Sciences Annual Meeting, Detroit, MI. May 2018.
- **Turner, T. F.**, M. J. Osborne, and T. E. Dowling. Effective population size and restoration of 'big-river' fishes of the Colorado Basin. Invited presentation at a symposium entitled "Genetic estimates of population size" Canadian Society of Ecology & Evolution, Guelph, Ontario, Canada. 19 July 2018.

7B. ATTENDANCE AT PROFESSIONAL MEETINGS

- **A. C. Cameron**
 - Joint Meeting of Ichthyologists and Herpetologists. Rochester, NY. July 2018.
- **D. T. Camak**
 - Joint Meeting of Ichthyologists and Herpetologists. Rochester, NY. July 2018.
- **G. L. Hamilton**
 - Society for Freshwater Science. Detroit, MI. May 2018.
 - 7th Natural History of the Gila Symposium, Silver City, NM. February 2018.

- **K. P. Driscoll**
 - Great Plains Grass Summit. Denver, CO. April 2018.
- **S. T. Ross**
 - Desert Fishes Council. Death Valley, CA. November 2018.
- **T. F. Turner**
 - Society for Freshwater Science. Detroit, MI, May 2018.
 - Joint Meeting of Ichthyologists and Herpetologists. Rochester, NY. July 2018.
 - Canadian Society of Ecology and Evolution, Guelph, Ontario. CA. July 2018.
- **W. H. Brandenburg**
 - Colorado River Aquatic Biologists. Laughlin, NV. January 2018.
 - Glen Canyon Dam Adaptive Management Program, Annual Reporting Meeting and Technical Workgroup. Flagstaff, AZ. March 2018.

7C. SERVICE AS EDITOR OR ON EDITORIAL BOARD OF A JOURNAL

- **S.T. Ross**
 - Co-editor, Volumes 2 and 3, North American Freshwater Fishes, Johns Hopkins University Press.
- **T. F. Turner**
 - Editorial Board, Ecology of Freshwater Fish

7D. SERVICE AS OFFICER OF PROFESSIONAL SOCIETY/ORGANIZATION

- **G.L. Hamilton**
 - Chair (Elections Committee), UNM Graduate & Professional Student Association
 - Member (Grants Committee), UNM Graduate & Professional Student Association
 - Co-Chair (Social Committee), UNM Biology Graduate Student Association
 - Member, 8th Natural History of the Gila Symposium Planning Committee
- **M. J. Osborne**
 - Member, Rio Grande Silvery Minnow Propagation and Genetics Workgroup
 - Alternate Member, Gila Trout Recovery Team
 - Alternate Member, Executive Committee Middle Rio Grande Collaborative Program
 - Scientific Member, University of New Mexico IACUC Committee
- **S.T. Ross**
 - Chair, Robert K. Johnson Award for Excellence in Service Committee, American Society of Ichthyologists and Herpetologists.
- **T. F. Turner**
 - Program Director, DEB Pop & Community Ecology, National Science Foundation
 - Program Director, Coupled Human & Natural Systems, National Science Foundation
 - Independent Science Advisory Board Member, Northwest Power Council
 - Executive Committee, Middle Rio Grande ESA Collaborative Workgroup
 - Member, Gila Trout and Chihuahua Chub Recovery Team
 - Organizer, American Fisheries Society Genetics Symposium

7E. SERVICE (OTHER)

- **M. J. Osborne**
 - Bosque School, Albuquerque, NM, mentor for research project.
 - Zia Elementary School, science fair judge.

7F. OTHER PROFESSIONAL ACTIVITIES

- **K. P. Driscoll**
 - Presentation to National New Employee Orientation. *How Research & Development and my work align with the FS priority "Apply Knowledge Globally"*. 1 March 2018.
 - Presentation to First Friday All Climate Change Talks (FFACTS) hosted by Forest Service Research & Development and the USDA Climate Hubs. *After Fire: Toolkit for the Southwest*. 2 March 2018.
- **M. J. Osborne**
 - Journal Referee, Molecular Ecology
 - Journal Referee, North American Journal of Aquaculture
 - Journal Referee, Genetica
- **R. K. Dudley**
 - Journal Referee, North American Journal of Fisheries Management
- **T. F. Turner**
 - Journal Referee, Transactions Am Fish Soc (2)
 - Journal Referee, Estuaries and Coasts
 - Journal Referee, Freshwater Biology
 - Proposal Review, National Science Foundation (211)

8. AFFILIATED PERSONNEL**8A. FACULTY AND STAFF**

Thomas F. Turner, Curator of Fishes, Professor of Biology, and Assoc. Dean for Research
Steven P. Platania, Associate Curator of Fishes
Stephen T. Ross, 2017-2018 Acting Curator of Fishes, Museum of Southwestern Biology,
Curator Emeritus, and UNM Adjunct Professor of Biology
Megan J. Osborne, Research Assistant Professor, MSB Research Associate
Alexandra M. Snyder, Former Collections Manager (retired September 2018)
Scott R. Clark, Former Postdoctoral Research Fellow (left UNM November 2018) and
current U.S. Fish and Wildlife employee (Baton Rouge, LA)

8B. GRADUATE STUDENTS

Museum Research Assistants-Graduate Student TA

Alexander C. Cameron Fall 2018

MSB Fishes Graduate Students, UNM Biology

David T. Camak, Ph.D. Candidate
Alexander C. Cameron, Ph.D. Student
Gregor L. Hamilton, Ph.D. Student
Katelyn Driscoll, Ph.D. Student

8C. UNDERGRADUATE STUDENTS

Brian Fitzgerald, A&S Biochemistry
Charisa Bell, A&S Biology

8D. RESEARCH ASSOCIATES

Curatorial Associates

David L. Propst, Curatorial Associate and UNM Adjunct Professor of Biology

Research Associates

Adam L. Barkalow, M.S., American Southwest Ichthyological Researchers, Albuquerque
Stephani L. Clark-Barkalow, M.S., American Southwest Ichthyological Researchers,
Albuquerque
W. Howard Brandenburg, American Southwest Ichthyological Researchers, Albuquerque
James E. Brooks, US Fish and Wildlife Service, Albuquerque (retired)
Brooks M. Burr, Ph.D. Southern Illinois University, Carbondale
Robert K. Dudley, Ph.D., American Southwest Ichthyological Researchers, Albuquerque
Michael A. Farrington, M.S., American Southwest Ichthyological Researchers,
Albuquerque
Eliza I. Gilbert, M.S., USFWS Ecological Services, Albuquerque
Jennifer L. Kennedy, American Southwest Ichthyological Researchers, Albuquerque
Martinique J. Chavez, American Southwest Ichthyological Researchers, Albuquerque
Tracy Diver, M.S., Southwestern Native Aquatic Resources and Recovery Center, Dexter

MSB Division of Genomic Resources

2018 Report

1. DIVISION HIGHLIGHTS

In 2018, the Division of Genomic Resources finalized the transition to a fully functional, vapor-phase, nitrogen storage system during the third year of funding from the National Science Foundation Collections in Support of Biological Research (CSBR-1561342). The focus for this year was to complete an inventory of samples moved to nitrogen storage from ultralow mechanical freezers, and to finalize the tracking of newly-migrated samples from the DGR Locator database to Arctos Object Tracking. Teresa Mayfield was hired with grant funds as project manager to oversee the inventory and object tracking of samples moved into storage in cryotanks. With Teresa's help, >140,000 samples were moved into vapor-phase nitrogen, and another 70,000 samples will be moved in 2019, during the planned one-year grant extension.

The division issued 53 loans of 2,168 specimens in 2018. The DGR collection grew by 74,502 new samples, a 15% growth rate. The total number of cryovials in the collection is over 500,000.

Major projects archived in DGR in 2018 include NEON, BLM Malpais birds, BLM Malpais mammal tissues and parasites, Pecos mammal tissues and parasites, Philmont Scout Ranch mammal tissues, Solomon Islands birds, and Mexican wolf blood and serum samples,

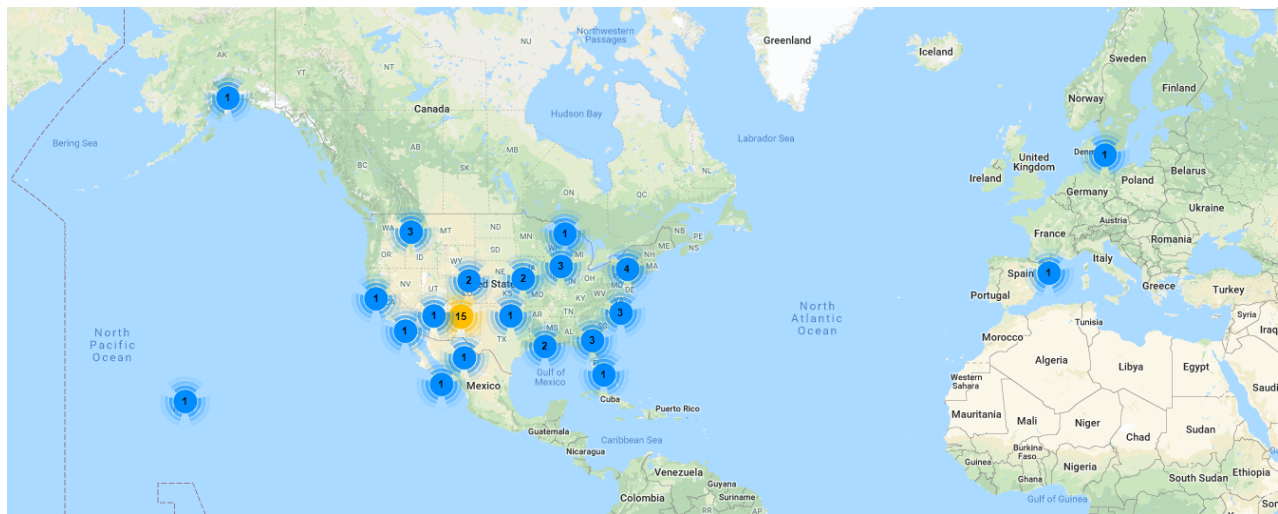
In addition, a new MOU was signed with the Albuquerque Biopark and approximately 3,000 zoo tissues were officially accessioned into MSB collections. Barcoding of this collection is ongoing through the efforts of student and community volunteers.

The Division also obtained \$5,500 in funding from the Alaska Department of Fish and Game in 2018 to cover curatorial costs for archiving ADFG marten tissues and parasites from Central Alaska. These funds have been placed in a new Non-Student Accounts Receivable index for the museum. This fund is also now being used to recover costs for external loans (\$100 in 2018) based on a new policy in the Divisions of Mammals and Birds.

In order to recover costs associated with cryogenerator service and maintenance, the Division now sells liquid nitrogen to other units across UNM. Initial sales to the Hanson lab (Department of Biology) in Castetter Hall have raised over \$1,500. These funds are earmarked for service and maintenance of the cryogenerator. In August, MSB Collection Manager Tom Giermakowski traveled to the Netherlands and received a week-long training and certification as a local maintenance engineer from the manufacturer.

2. TABLE OF COLLECTION ACTIVITY

Metric	Number
Collection Growth	74,502 cryovials Total cataloged specimens/cryovials: 213,147/507,906 (estimated) MSB:Herp: 2,301/2,251 MSB:Para: 2575/2815 MSB:Fish: 8,259/5,380 MSB:Bird: 20,098/36,699 MSB:Mamm: 182,489 /463,012
Loans (all consumable, outgoing loans)	Total: 53 loans, 2,168 samples By Collection: 36 MSB:Mamm loans (1269 samples) 15 MSB:Bird loans (420 samples) 2 MSB:Herp loans (59 samples)
Specimen Records served via electronic databases	See separate division reports
Publications using the collection	See separate division reports
Citations of publications using the collection	See separate division reports



Geographic Distribution of DGR Loans issued in 2018

3. EDUCATIONAL IMPACTS OF THE COLLECTION

DGR employed two graduate student assistants, Jenna McCullough and Serina Brady, in 2018. The division employed and trained five undergraduate students, including three paid hourlies and two volunteers, and two community volunteers (see list in Section 8 below).

Examples of UNM student research supported by the DGR collection:

Postdoctoral Students:

Lisa Barrow, 1 loan, 229 bird tissue samples

Master's Students:

Katrina Derieg, 1 loan, 31 mammal tissue samples

Paris Hamm, 3 loans, 90 mammal tissue samples

Dianne Peterson, 3 loans, 376 mammal ectoparasite samples

Ph.D. Students

Carlos Carrion, 2 loans, 33 mammal tissue samples

Jocelynn Colella, 3 loans, 85 mammal tissue samples

Jessie Williamson, 1 loan, 15 bird tissue samples

3a. COURSES USING THE COLLECTIONS

Natural Resource Management, Geography & Environmental Studies Department

3b. COURSES TAUGHT BY MSB PERSONNEL

Instructor(s)	Sem	Course	Title	Enrollment
Michael Andersen	Spring 2018	Biol 191	Biodiversity	22
Michael Andersen	Fall 2018	Biol 303	Ecology and Evolution	155

4. COLLECTION MANAGEMENT

The National Science Foundation Collections in Support of Biological Research award #1561342 project is nearing completion with a requested one-year extension through 2020. All samples transferred to vapor-phase nitrogen have been inventoried, and effort is ongoing to finalize object tracking and linkage of parts to specimen voucher data records. The total number of samples transferred to vapor-phase nitrogen storage is over 145,000, representing over 70,000 cataloged specimens.

Growth of the Division of Genomic Resources was exceptionally high (15%) this year, with the addition of 74,502 cryovials. This includes 3,488 cryovials from Pecos, El Malpais, and Gila, and other New Mexico mammal and bird field expeditions that were transferred directly from liquid nitrogen into vapor-phase nitrogen storage. Other accessions include Solomon Islands birds, prep room bird and mammal tissues, and the large collection of NEON (National Ecological Observatory Network) samples. The NEON accessions include 41,203 mammal blood, ear clip, and fecal samples representing **20,254 individual mammals that were sampled over a multi-year period by mark / recapture. A majority of NEON tissues do not have voucher specimens**, but some vouchers representing trap mortalities are archived, including organ tissues and parasites.

5. SCIENTIFIC PRODUCTS AUTHORED BY DIVISION PERSONNEL

1. **Andersen, M. J., McCullough, J. M.**, Mauck, W. M. III, Smith, B. T., and Moyle, R. G. 2018. A phylogeny of kingfishers reveals an Indomalayan origin and elevated rates of diversification on oceanic islands. *Journal of Biogeography* 45: 269–281.
2. Alström, P., Cibois, A., Irestedt, M., Zuccon, D., Gelang, M., Fjeldså, J., **Andersen, M. J.**, Moyle, R. G., Pasquet, E. and Olsson, U. 2018. Comprehensive molecular phylogeny of the grassbirds and allies (Locustellidae) reveals extensive non-monophyly of traditional genera, and a proposal for a new classification. *Molecular Phylogenetics and Evolution* 127: 367–375.
3. Hosner, P. A., Campillo, L. C., **Andersen, M. J.**, Sánchez-González, L. A., Oliveros, C. H., Urriza, R. C., and R. G. Moyle. 2018. How do different views on species limits affect recognition of avian diversity and endemism in biodiversity hotspots? An example in the Philippine Archipelago. *Conservation Biology* 19: 1153–1168.

6. SCIENTIFIC PRODUCTS BASED ON THE COLLECTION

See Publication lists for Division of Mammals, Birds, Reptiles and Amphibians and Fishes for publications related to genomic resources.

Number of GenBank accessioned DNA sequences currently associated with specimens in the Division of Genomic Resources.

Collection code	Accessions in Genbank
MSB:Mamm	3,602
MSB:Bird	2,433
MSB:Herp	1,683
MSB:Para	663
MSB:Fish	88
MSB:Host	12
Total	8,481

7. SERVICE AND OUTREACH

Presentations at Scholarly Meetings Related to Museum Collection Management:

- Biological Collections Network (BCoN), Workshop on “**Integration, Attribution, and Value in the Web of Natural History Museum Data**”, Invited participant, Lawrence, Kansas, February 13-14, 2018. Oral Presentation: Presentation: “*Linking Across Collections: Host/Parasite Relationships*”. Mariel Campbell, Dusty McDonald, Eric Hoberg, Carla Cicero, Joseph Cook. <https://bcon.aibs.org/working-groups/data-attribution-and-integration/>
- Biological Collections Network (BCoN) Workshop: “**Addressing Legal Issues Involved in Digitized Collections: The Nagoya Protocol as a Test Case**” – March 27-28, 2018 at the Museum of Comparative Zoology, Harvard University in Cambridge, MA. Invited Participant. <https://bcon.aibs.org/working-groups/addressing-legal-issues-involved-in-digitized-collections-the-nagoya-protocol-as-a-test-case/>
- International Society for Biological and Environmental Biorepositories, EnviroBio Working Group, “**Animals, plants, environments, and humans – Brainstorming models for Cross-sector & Interdisciplinary collaboration and utilization**”, Workshop Task Force and GGBN Representative, Annual Meeting, Dallas, TX, May 20-24, 2018.
- Digital Data in Biodiversity Data Conference, Berkeley, CA,. Biological Collections Network (BCoN) Workshop: **Data Attribution and Integration**. Presentation: “*Tying Samples and Organisms Together Across Multiple Collecting Events: The Challenge of Integration and Attribution Across Platforms*.” Mariel Campbell, David Bloom, Carla Cicero, Joseph Cook, Dusty McDonald, John Wiczorek. 4-6 June 2018.
- Society for the Preservation of Natural History Collections (SPNHC)+TDWG 2018 Joint Meeting, Conference Symposium: Challenges for Implementing Collections Data Quality

Feedback: Synthesizing the Community Experience, Who Has Time for Biological Collections Data Quality Feedback? Maybe a Community Can Help. Oral presentation, Teresa J. Mayfield, Dunedin, New Zealand, 25 Aug- 1 Sept 2018.

Service to Museum-Related Societies and Databases:

- Arctos Collection Management System and Biodiversity Database. Arctos Working Group Co-chair. Mariel Campbell.
- Arctos Collection Management System and Biodiversity Database. Arctos Working Group Treasurer. Teresa Jegelewicz Mayfield.
- Society for the Preservation of Natural History Collections. Managing Editor. Mariel Campbell

8. AFFILIATED PERSONNEL

A. Faculty & Staff

Michael Andersen, Curator
Mariel Campbell, Collection Manager
Teresa Jegelewicz Mayfield, Project Manager

B. Graduate students

Jenna McCullough, Division graduate assistant, Master's degree (Andersen)
Serina Brady, Division graduate assistant, Master's degree (Andersen)

C. Undergraduate Students

Avery Diercks, Student Employee
Emma Fries, Student Employee
Monica Naranjo, Student Employee
Blaque Armijo, Student Volunteer and Independent Study
Debby Mayberry, Student Volunteer

E. Community volunteers

Osa Day, high school intern
Sarah Dozal, community volunteer

MSB Herbarium: 2018 Annual Report



1. HERBARIUM HIGHLIGHTS

The UNM Herbarium contained 136,663 specimens at the end of 2018. UNM has the largest collection of plant specimens in New Mexico, and is archived primarily for use in scientific research. Each specimen represents the field efforts of the collector and is mounted individually by student employees, databased, stored, and available for web-based, in-house, or outgoing-loan access by the public.

In our move to modernize the herbarium and make this resource available for wider use and enjoyment by the public we have imaged over seventy thousand specimens that are available for high-resolution viewing and research. This recent emphasis by the staff, student employees, and volunteers at the herbarium complements the fully databased and web-accessible holdings of this division of the museum. These resources are available through multiple internet portals that receive thousands of views per month.

2. TABLE OF COLLECTION USE

2018

1. Collection: growth & current size (New Specimens Cataloged/total specimens): **1150 / 136,663** Accessioned and **1073** in our Teaching Collection
 2. Loans Out: **17 (717 specimens)**.
 3. Professional Visitors to the Collections: **191 plus tour groups**.
 4. Collection Database Web Site Hits: **22,000**
 6. Outside Publications Citing MSB Specimens: **Unknown**
 7. Peer-Reviewed Publications by Staff : **0**
 8. Graduate Students (using or working in collections) - **4**
 9. Graduate Theses/Dissertations Completed (UNM/Other*) – **0, 0**
 10. Undergraduate Students (using or working in collections) - **11**
-

3. EDUCATIONAL IMPACTS OF THE COLLECTION

3a. COURSES USING THE COLLECTIONS

ARTS 141. Introduction to Art and Ecology, 14 students

4. COLLECTION MANAGEMENT

As we enter the year, 2019, our focus is primarily on creating images of all of our specimens. Under various grants, including our most recent NSF grant, we have completed the imaging of 215 plant families, 1520 genera, 8586 species, and 2127 subspecific taxa. We serve over ninety thousand specimen images through both the SEINet (<http://swbiodiversity.org>) and iDigBio (<https://www.idigbio.org/>) portals. Our entire collection is digitized; all of the label information for over 136,000 specimens is available for use by the public and scientific research community.

We completed the remounting of a few thousand specimens from the early 1900s in 2016, and continue to remount older specimens as we encounter them within the imaging workflow. Many of these specimens are part of the Brother Arsene Collection; they were each imaged in their original condition and then removed from their acidic paper where possible. Once free they were mounted onto acid-free paper using modern techniques to preserve both the specimen and the historic label. Similarly, as we pull each specimen to image it, we have the opportunity to assess the status of the specimen and have found that many are in need of repairs. While this slows the imaging of specimens it gives us a unique opportunity to better curate the collection, repairing specimens that were mounted many years ago.

Our specimens traveled on loan to seventeen different institutions for taxonomic and systematic research this year. We received visits to our division by the botanical community as well as group visits by schools and organizations. We average 2-3 information requests per week by e-mail and/or phone, and the SEINet and iDigBio portals receive thousands of visits to our collection records.

While growth of the collection has slowed during our imaging initiative, access to, and usability of, the collection has grown tremendously. We have had the privilege of working with innovative bioinformatics programmers to maximize the availability of UNM's collections and information to the national and international community. This year's planning will lead to further growth and access to information.

Tim Lowrey, Curator of the Herbarium, has taken on the considerable task of completing a taxonomic key and treatment of the Asteraceae for the state's illustrated flora, *Flora Neomexicana*. This treatment of the Sunflower Family includes 191 genera, 618 species, and 95 infraspecific taxa. Similarly, the Southwest Carex Working Group has, at times, taken up residence at the herbarium as they do the same for the Cyperaceae, or sedge family. Members include Max Licher, Jim McGrath, Bill Norris, and Glenn Rink. Max and Glen have also used our collection for their revision of the Juncaceae. As a result, almost all of our sunflowers, sedges, rushes, and bulrushes have been reviewed, verified, and revised within this process. These efforts greatly benefit our collections and provide a much-needed tool for investigation by scientists, enthusiasts, and the general public.

7. Service and Outreach

- Dr. Tim Lowrey:
 - Graduate Policy Committee
 - Faculty Senate Graduate and Professional Committee
 - M.S. Committee of M. Gattreaux
 - Ph.D. Committee of Karen Wright
 - Presidential Search Committee
 - Provost's Committee on Academic Success
 - Assoc. Deans of Research Advisory Committee
 - NM Rare Plant Technical Council
 - Graduate Teaching Academy
 - Research Associate, Missouri Botanical Garden, St. Louis, MO. 1985-present.
- Phil Tonne:
 - The UNM Museum Council
 - NM Rare Plant Technical Council

Interpretive activities or collections-related outreach includes tours for the public, including K-12 and UNM students. The Herbarium works closely with the Native Plant Society of New Mexico (NPSNM) and the New Mexico Rare Plant Technical Council, as well as local schools and the Bosque Ecosystem Monitoring Program.

8. Affiliated Personnel

A. Faculty/Staff

Tim Lowrey, Professor, Curator and Associate Dean
Phil Tonne, Senior Collection Manager

B. Graduate students

Lauren Bansbach, Herbarium Graduate Assistant.
Andrea Lopez, Herbarium Graduate Assistant.
Kyle Robinson, Graduate Student Employee.

C. Undergraduate Student Workers and Volunteers

LeeRoy Allen
Mari Aoki
Kenzie De Leon
JoLynn Fenger
Gwen Houston-Hatton
Trent Llewellyn
Courtney Love
Hedda Oeritsland
Madison Paulk
Pricilla Camila De la Pena Schott
Samantha Stutz

D. Research Associates

Daniela Roth, State Forestry Division Botanist, EMNRD.
Robert Sivinski, retired State Forestry Division Botanist; botanical consultant at present.

AWARDS, GRANTS, AND CONTRACTS

Our NSF grant for imaging of the collection was awarded in 2017 and remains in force. This grant comprised \$190,944 to image and georeference the plants of the Southern Rocky Mountains. This collaborative, multi-institutional (37 partners) grant is funded by NSF's Advancing Digitization of Biodiversity Collections (ADBC) and aims to mobilize data from approximately two million herbarium specimens to help understand global environmental change. As we go through this 4-year process, imaged and georeferenced specimen data are added and available through the SEINet (<http://swbiodiversity.org>) and iDigBio portals. Students are participating in this opportunity to expand accessibility and utility of our amazing collection of plants (now over 135,000 specimens and over 10,300 species represented).

MSB Division of Mammals

2018 Annual Report

1. DIVISION HIGHLIGHTS

In 2018, the Division of Mammals (DOM) gained significant new holdings of specimens (now 2nd largest mammal collection worldwide), supported a large number of peer-reviewed publications (>90), played a role in graduating several undergraduate and graduate students, established a new endowed research fellowship for mammalogy students (Findley Fund), and completed a large project with the National Ecological Observatory Network. We also experienced a significant loss, however. On May 20, Founding Director and long-time (1955-1978) Curator of Mammals of The Museum of Southwestern Biology, James S. Findley died at the age of 92. During his highly productive career at UNM, Jim mentored 50 graduate students, was President of the American Society of Mammalogists, and served as Chair of the Biology Department. His wit, humor, insights, and fairness will be sorely missed (see obituary in *J. Mammalogy* 100: 599-607).

A. MSB DOM Recognition.

DOM saw substantial national and international exposure for collection related activity.

- a. The DOM surpassed the British Museum in size and is now the 2nd largest collection in the world with over 320,000 specimens.
- b. DOM staff published 17 papers, many of which are establishing new directions for field sampling, data integration, host-pathogen relationships, and archival best practices.
 - i. Dunnum, Jonathan L., Bryan S. McLean, and Robert C. Dowler. "Mammal collections of the Western Hemisphere: a survey and directory of collections." *Journal of Mammalogy*.
 - ii. Greiman, Stephen E., Joseph A. Cook, Vasyl V. Tkach, Eric P. Hoberg, Damian M. Menning, Andrew G. Hope, Sarah A. Sonsthagen, and Sandra L. Talbot. "Museum metabarcoding: a novel method revealing gut helminth communities of small mammals across space and time." *International journal for parasitology*.
 - iii. Hope, Andrew G., Brett K. Sandercock, and Jason L. Malaney. "Collection of Scientific Specimens: Benefits for Biodiversity Sciences and Limited Impacts on Communities of Small Mammals." *BioScience*
 - iv. Malaney, Jason L., and Joseph A. Cook. "A perfect storm for mammalogy: declining sample availability in a period of rapid environmental degradation." *Journal of Mammalogy*.

- v. Schindel, David E., and Joseph A. Cook. "The next generation of natural history collections." *PLoS biology*
 - vi. Schmitt, C.J., Cook, J.A., Zamudio, K.R. and Edwards, S.V., 2018. Museum specimens of terrestrial vertebrates are sensitive indicators of environmental change in the Anthropocene. *Philosophical Transactions of the Royal Society B*.
- c. Joe Cook promoted to Regents' Professor, University of New Mexico
 - d. Joe Cook appointed to National Academy of Sciences Committee "Biological Collections: Past, Present, and Future Contributions and Options for Sustaining Them" 2018-19
 - e. Jocie Colella awarded the Shadle Fellowship, American Society of Mammalogists "The impact of introgression on mammalian evolution." \$4800
- B. Infrastructure development.** The DOM grew to 322,371 specimens in 2018, adding nearly 20,000 new specimens and now representing >1,700 species from 78 countries.
- C. Training in specimen-based research and curation.** Training remains an integral goal of the DOM, principally through Biology, Anthropology, Museum Studies and Fine Arts. Students associated with the collection as workers or volunteers gain experience in bioinformatics, natural history specimen preparation, curation, and field and laboratory-based research. Students were involved in all activities of the division during 2018. This year we saw a significant increase in volunteer help and logged 1900 hours of unpaid volunteer work.
- a. 18 UNM students worked in the division in 2018
 - i. 2 graduate students
 - ii. 5 paid undergraduates
 - iii. 11 volunteer undergraduates
 - iv. Of these 18:
 - 1. 14 females
 - 2. 4 males
 - b. 68 Albuquerque Public Schools high school interns/volunteers
 - c. 11 other volunteers from various institutions
- D. Publications utilizing MSB DOM specimens or data.** The DOM collection continues to be utilized heavily by a wide range of disciplines and is the basis for a large number of peer-reviewed publications, agency reports, and policy directives. Tracking every publication that utilizes our specimens is difficult, as not all authors are careful to acknowledge use of DOM specimens. Thus, the number of publications utilizing our material should be viewed as an underestimate.
- During 2018 DOM specimens were cited or specimen data were utilized in at least 94 studies published in 71 journals:

E. Theses/Dissertations.

- a. In 2018, at least 8 theses or dissertations were completed that utilized MSB mammal specimens.

- F. **New Initiatives:** we have undertaken a collaboration with John Korbin from Sandia National Labs to CT scan both skeletal and fluid preserved specimens. This collaboration has already resulted in hundreds of high quality scans and 3D printed models which are excellent tools for outreach and education. These large data files will be posted to MorphoSource administered through Duke University.

2. TABLE OF COLLECTION ACTIVITY

Metric	Number
Collection Growth	19,611
Loans (outgoing (# specimens)/ incoming (# specimens)	109 (3,158) / 6 (93)
Specimen Records served via electronic databases	49,771 / 66,318,909
Publications using the collection	94 (+ 8 theses/dissertations)
Citations of publications using the collection	5,057 (2018) – 75,850 (total)

Google scholar profile: <https://scholar.google.com/citations?user=kBYStsAAAAJ&hl=en>

3. EDUCATIONAL IMPACTS OF THE COLLECTION

- Three theses or dissertations were completed by DOM students in 2018.
 - **Kaylen Jones**, M.S. (2018). *From our collection: Discover mammals*. Now Freelance scientific illustrator.
 - **Lindsey Frederick**, M. S. (2018). *Howling the lobo out of existence*. Now Collection Manager, New Mexico Museum of Natural History and Science.
 - **Jessica Weber**, Ph. D. (2018, w/ distinction). *Genomic signatures of adaptive evolution*. Now postdoctoral associate, Harvard University.
- 18 undergrad or grad students received experience and training while working in the DOM collections.
- 34 graduate students examined specimens or received loans of material for theses or dissertation projects.
- 3 COMEXUS students (undergrad) from Mexico for 6 weeks and 1 LSAMP student (4 weeks) in summer 2018.
- 11 K-12 schools visited and/or received presentations on the use and value of natural history collections and evolution/adaptations.
 - Cibola HS
 - Albuquerque HS
 - Sandia HS
 - Estancia HS

- Eldorado HS
- Silverton School, Colorado
- Eagle Ridge Middle School
- Jefferson Middle School
- Alice King Community School
- Elevation Children's Center
- Montessori on the Rio Grande

3a. COURSES USING THE COLLECTIONS

24 UNM Classes receiving specimens, visits, or presentations from the Division of Mammals .

Course	Semester	Students
BIOL 204L - Plant and Animal Form and Function.	Spring	180
BIOL 204L - Plant and Animal Form and Function.	Fall	180
BIOL 203L – Ecology and Evolution.	Spring	240
BIOL 203L – Ecology and Evolution.	Fall	240
BIOL 386L – General Vertebrate Zoology.	Fall	30
BIOL 386L – General Vertebrate Zoology.	Spring	40
BIOL 389L – Mammalogy	Fall	17
BIOL 699 – Dissertation	Spring	3
BIOL 699 – Dissertation	Fall	2
ART 429/BIOL 419 – Art and Biodiversity	Fall	12
BIOL – Ecology of the Past	Fall	20
ART /ART HIST – Drawing I (2 sections)	Fall	41
Arts 191	Fall	14
BIOL 461/561 (Tropical Biology)	Spring	15
MSST 476/576 Mus Studies	Spring	8
MSST 476/576 Mus Studies	Fall	14
BIOL - Museum Curation	Spring	18
BIOL 402 – Museum Scientific prep	Spring	1
BIOL 499 – undergrad problems	Spring	1
BIOL 551 Research problems	Spring	2
BIOL 551 Research problems	Fall	2
BIOL 400 – Senior honors thesis	Fall	1
BIOL 402 – Phylogenomics	Spring	1
BIOL 402 – Museomics	Spring	1

3b. COURSES TAUGHT BY MSB PERSONNEL

Instructor	Semester	Course	Title	Enrollment
*Cook, Joseph	Spring	BIOL 402 U 006	T: Phylogenomics	2
*Cook, Joseph	Spring	BIOL 402 U 053	T: Museomics	1
*Cook, Joseph; Dunnum, Jonathan	Spring	BIOL 402 U 037	T: Mammal Sci Prep	1
*Cook, Joseph	Spring	BIOL 461L U 002	Intro to Tropical Biol.	10
*Cook, Joseph	Spring	BIOL 499 U 007	Undergrad Problems	1
*Cook, Joseph	Spring	BIOL 551 M 007	Research Problems	2
*Cook, Joseph	Spring	BIOL 561 M 001	Tropical Biology	5
*Cook, Joseph	Spring	BIOL 699 P 007	Dissertation	3
*Cook, Joseph	Fall	BIOL 699 P 007	Dissertation	2
*Cook, Joseph	Fall	BIOL 551 M 007	Research Problems	2
*Cook, Joseph	Fall	BIOL 400 U 007	Senior Honors Thesis	1
*Cook, Joseph	Fall	BIOL 489L U 001	Mammalogy	17
*Cook, Joseph	Fall	BIOL 402 U 054	T: Evol. Genomics	1

4. COLLECTION MANAGEMENT

Collection Growth. The DOM cataloged 19,611 new specimens during 2018 and now curates 322,371 specimens. The collection is now the 2rd largest collection in the world. New accessions (111) of mammalian material amounted to >5,000 specimens.

The continued exceptional growth is the result of several facets of our operation:

a. Specimen growth through fieldwork

- i. Directed specimen-based field studies related to Joseph Cook's research program.
- ii. Highly successful fieldwork in a wide variety of projects spanning the Western Hemisphere, eastern Asia, and collaborations with state and federal resource agencies in the western US and Canada. Work primarily sponsored by the National Science Foundation, US Fish and Wildlife Service, US Geological Service, National Park Service, and Bureau of Land Management.

b. Specimen growth through donation

- i. A well-developed network of researchers and agencies worldwide continue to deposit their material in DOM.
 - a. National Ecological Observatory Network (NEON)
 - b. USFWS – Mexican wolf recovery program
 - c. USDA – Animal Damage Control
 - d. Panamanian Health Department – Gorgas
 - e. Alaska Department of Fish and Game

f. Canadian Resource Departments – Yukon, B.C. Alberta, NWT

5. SCIENTIFIC PRODUCTS AUTHORED BY DIVISION PERSONNEL

1. Bell, Kayce C., John R. Demboski, and Joseph A. Cook. "Sympatric Parasites Have Similar Host-Associated, but Asynchronous, Patterns of Diversification." *The American Naturalist* 192, no. 3 (2018): E106-E119.
2. Colella, Jocelyn P., Ellie J. Johnson, and Joseph A. Cook. "Reconciling molecules and morphology in North American Martes." *Journal of Mammalogy* 99, no. 6 (2018): 1323-1335.
3. Colella, Jocelyn P., Tianying Lan, Stephan C. Schuster, Sandra L. Talbot, Joseph A. Cook, and Charlotte Lindqvist. 2018. Whole-genome analysis of *Mustela erminea* finds that pulsed hybridization impacts evolution at high latitudes. *Communications Biology* 1, no. 1: 51 (on-line)
4. Colella, J.P., Wilson, R.E., Talbot, S.L. and Cook, J.A., 2018. Implications of introgression for wildlife translocations: the case of North American martens. *Conservation Genetics*, on-line.
5. Cook, J.A. 2018. Primary infrastructure for mammalogy in the Anthropocene. *Mastozoologia Neotropical* 25:267-268.
6. Cook, Joseph A., and Jessica E. Light. 2018. The emerging role of mammal collections in 21st century mammalogy, *Journal of Mammalogy*, gyy148. on-line
7. Dunnun, Jonathan L., Bryan S. McLean, and Robert C. Dowler. 2018. Mammal collections of the Western Hemisphere: a survey and directory of collections." *Journal of Mammalogy* 99: 1307-1322.
8. Geluso, Keith, and Michael A. Bogan. 2018. Bats in the Bear Lodge Mountains and Surrounding Areas in Northeastern Wyoming. Museum of Texas Tech University, Occasional papers 355:1-17.
9. Greiman, S. E., J.A. Cook, V. V. Tkach, E. P. Hoberg, D. M. Menning, A. G. Hope, S. A. Sonsthagen, and S. L. Talbot. 2018. Museum metabarcoding: a novel method revealing gut helminth communities of small mammals across space and time." *International Journal of Parasitology* on-line.
10. Hope, Andrew G., Brett K. Sandercock, and Jason L. Malaney. 2018. Collection of Scientific Specimens: Benefits for Biodiversity Sciences and Limited Impacts on Communities of Small Mammals. *BioScience* 68: 35-42.
11. Malaney, Jason L., and Joseph A. Cook. 2018. A perfect storm for mammalogy: declining sample availability in a period of rapid environmental degradation." *Journal of Mammalogy* 99:773-788.
12. McLean, B. S., N. Batsaikhan, A. Tchabovsky, and J. A. Cook Impacts of late Quaternary environmental change on the long-tailed ground squirrel (*Urocitellus undulatus*) in Mongolia. *Zoological Research*: 60.

13. McLean, Bryan S., Kayce C. Bell, Julie M. Allen, Kristofer M. Helgen, and Joseph A. Cook. 2018. "Impacts Of Inference Method And Dataset Filtering On Phylogenomic Resolution In A Rapid Radiation of Ground Squirrels (Xerinae: Marmotini)." *Systematic Biology* online.
14. McLean, Bryan S., Kristofer M. Helgen, H. Thomas Goodwin, and Joseph A. Cook. 2018. Trait-specific processes of convergence and conservatism shape ecomorphological evolution in ground-dwelling squirrels." *Evolution* 72: 473-489.
15. Sánchez-Vendizú, P., Cook, J.A., Wood, J. and Salazar-Bravo, J., 2018. First record of *Proechimys pattoni* da Silva, 1998 (Rodentia, Echimyidae) in northwestern Bolivia. *Check List*, 14, p.1115.
16. Schindel, David E., and Joseph A. Cook. "The next generation of natural history collections." *PLoS biology* 16, no. 7 (2018): e2006125.
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Theses/Dissertations

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2. Ćirković, Valentina S. "Phylogenetic analysis of hantaviral molecular evolution in different rodent species." PhD diss., University of Belgrade 2018.
3. Jones, Kaylen, (2018). *From our collection: Discover mammals*. M.S. thesis in Museum Science. Now Freelance scientific illustrator.
4. Frederick, Lindsey, (2018). *Howling the lobo out of existence*. M. S. thesis Museum Science. Now Collection Manager, New Mexico Museum of Natural History and Science.
5. Jones Scherbinski, Jennie K. "The influence of microclimate and local adaptation for a climate-sensitive species (*Aplodontia rufa*)." (2018).M.S. thesis, Humboldt State University.
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7. Passarelli, Tessa. "Evolutionary History of the mysTR Retrotransposons and Connection to mysERV Elements." (2018). Senior Honors thesis Eastern Michigan University.
8. Jessica Weber, Ph. D. (2018). *Genomic signatures of adaptive evolution*. Now postdoctoral associate, Harvard University.

7. SERVICE AND OUTREACH

- Hosted 57 researchers in the collections from 32 institutions or UNM departments.
- Gave presentations on MSB and value and use of natural history research collections to:
 - 6 UNM classes
 - 11 area K-12 schools

- Bernalillo County Master Naturalists
- Pueblo of Isleta Environmental Fair
- Sandia Labs environmental science fair
- Many other visiting community members
- J.A. Cook committee service
 - Latin American Institute Scholarships Committee, UNM
 - Mammal Conservation Committee, American Society of Mammalogists
 - Student Science Policy Committee, American Society of Mammalogists
 - Moderator, The Last Oil; UNM Symposium on Arctic National Wildlife Refuge
 - Commission Member, IUCN Species Survival Commission, Small Mammal Specialist Group
 - Faculty Sponsor, Student Chapter, UNM Wild
- J.L. Dunnun committee service
 - Systematic Collections Committee, American Society of Mammalogists
 - Latin American Awards Committee, American Society of Mammalogists
 - IACUC, UNM
 - Arctos Database Working Group
 - NEON Scientific Research Collections Technical Working Group

8. AFFILIATED PERSONNEL

A. Faculty & Staff

- J.A. Cook, Curator
- J.L. Dunnun, Collection Manager
- M.A. Bogan, Emeritus Curator
- J.S. Findley, Emeritus Curator
- Stephen O. MacDonald, Curator II (retired)
- Adrienne Ranzewski, Curatorial Associate

B. Graduate students

- Jessica Weber. 8th year Ph.D student. Hypoxia tolerance and adaptive responses in Caviomorph rodents.
- Colella, Jocie. 6th year Ph.D student. *Mixing it up: the impact of episodic introgression on the evolution of high-latitude meso-carnivores.*
- Liphardt, Schuyler. 4th year Ph.D. student. Hantavirus evolution.
- Carrion, Carlos. 4th year Ph.D. student. Systematics of Neotropical Myotis.
- Peterson, Dianne. 2nd year M.S. student. *Onychomys* and plague dynamics.
- Campbell, Mariel. 2nd year PH.D. student.
- Jones, Kaylen. 3rd year M.S. Museum studies student.
- Frederick, Lindsey. 3rd year M.S. Museum studies student.

- Derieg, Katrina. 1st year M.S. student. *Neotoma* spp. systematics and phylogeography.

C. Undergraduate Students

Employees

- Alex Olivas
- Keila Gutierrez
- Rabia Khan
- Somiya Dunnum
- Teah Armikabirian

Class or program requirement volunteer

- Alec Wyatt – Bernalillo co. Master Naturalist
- Debby Maberry – UNM, Museum Studies
- Gabriella Salazar - COMEXUS
- Lizette González - COMEXUS
- Marissa Breslin - UNM
- Monica Villegas – AMP SCORE Summer program
- Noemi Santana – COMEXUS

Volunteer

- Aurelia Dixon - UNM
- Danielle Parsons - UNM
- Hailey Patterson - UNM
- Jessie Smith - Eastern New Mexico University
- Katrina Derieg - UNM
- Maddie Jeshurin - UNM
- Maria Gigliotti - UNM
- Nanda Ramos - Eckerd College
- Pooja Bhakta - UNM
- Sophie Farr - UNM
- Tommy Galfano - UNM

D. Research Associates

Curatorial Associates

- Jerry W. Drago, State Veterinary Lab
- William Gannon, UNM Graduate Studies
- David J. Schmidly, UNM Department of Biology (emeritus)

Research Associates

- J. Scott Altenbach, UNM Department of Biology (retired), NM

- Sydney Anderson, American Museum of Natural History (retired), NY
- Robert J. Baker, The Museum, Texas Tech University, Lubbock, TX
- Troy L. Best, Department of Biology, Auburn University (retired), AL
- Fernando Cervantes, UNAM, Mexico City, Mexico
- Paul J. Cryan, Ft. Collins, CO
- Natalie Dawson, University of Montana, Missoula, MT
- John Demboski, Denver Museum of Science and Nature, Denver, CO
- Guillermo D'Elia, Universidad de Valdivia, Chile
- Jennifer K. Frey, NMSU, Las Cruces, NM
- Kurt Galbeath, Northern Michigan University, Marquette, MI
- Scott L. Gardner, Dept. Nematology, Curator, University Nebraska, NE
- Keith Geluso, University of Nebraska, Lincoln, NE
- Ken Geluso, Albuquerque, NM
- David J. Hafner, New Mexico Museum Nat. History (retired)
- Art Harris, University of Texas (retired), El Paso, Texas
- Heikki Henttonen, Finnish Forest Research Institute, Finland
- Edward J. Heske, Illinois Biological Survey, IL
- Eric Hoberg, Beltsville, MD
- Andrew Hope, Kansas State University, Manhattan, KS
- Tom Jung, Whitehorse, Yukon
- Sue Kutz, University of Calgary, Alberta
- Enrique Lessa, Universidad de la Republica, Montevideo, Uruguay
- Stephen MacDonald, Gila, NM
- Jason Malaney, Austin Peay state University, TN
- Michael Mares, Oklahoma University, Norman, OK
- Pablo Marquet, Universidad Catolica, Santiago, Chile
- Rodrigo Medillín, UNAM, Mexico City, Mexico
- Gary Morgan, New Mexico Museum Natural History, NM
- Eduardo Palma, Universidad Catolica, Santiago, Chile
- Robert Parmenter, Valles Caldera, Jemez, NM
- James L. Patton, Museum of Vertebrate Zoology (retired), Berkeley, California
- Reggie Rausch, Burke Museum, University of Washington, Seattle, WA
- Brett R. Riddle, University of Nevada, Las Vegas, NV
- Jorge Salazar Bravo, Texas Tech University, Lubbock, TX
- C. Greg Schmitt, Farmington, NM
- Sandy Talbot, Molecular Ecology Lab- USGS Anchorage, AK
- Fernando Torres Perez, Vina del Mar, Chile
- Ernie Valdez, USGS-UNM, Tijeras, NM
- Jack Whitman, Ketchum, ID
- Don E. Wilson, Smithsonian (retired), Washington, DC
- Nyamsuren Batsaikhan, National University of Mongolia, Ulaan Baatar

E. Community volunteers

- Destiny Frey - Amy Biehl High School (fulfilling program/class requirement)
- Quentin Drake - Amy Biehl High School (fulfilling program/class requirement)
- Samantha Candelaria-Ley - Amy Biehl High School (fulfilling program/class requirement)
- Hazen Augé - Cleveland High School (volunteer)
- Lizzy Enos - Bosque School (volunteer)
- Quinn Ennis - Albuquerque Academy (volunteer)
- Sierra Romero - Albuquerque High School (volunteer)
- Zora Lehmer-Mearns - Albuquerque High School (volunteer)
- Various - Amy Biehl High School (fulfilling program/class requirement, 10 students on average, 6 visits, 2 hours each)
- Amy Ewing - Master Naturalist (fulfilling program/class requirement)
- Ann Racehorse - Master Naturalist (fulfilling program/class requirement)
- Brandt Magic - (fulfilling program/class requirement)
- Kody Baumgardner - UNM, Continuing Education post-bac (fulfilling program/class requirement)



In the Mammal Range, Somiya Dunnum and Rabia Khan, student associates of the Division of Mammals, explain the differences among rodent species of New Mexico at MSB's annual open collections event.

MSB Division of Parasites: 2018 Annual Report

1. DIVISION HIGHLIGHTS

The 2018 highlights include a major donation from Dr. Eric P. Hoberg, Research Associate of the Division of Parasites, and former curator of the National Parasite Collection. Dr. Hoberg's donation included Arctic and Antarctic parasite specimens, mostly helminths from birds and marine mammals. This collection is extraordinarily unique and valuable from a scientific research and taxonomic perspective.

During 2018, two students graduated with their Ph.D.'s — Drs. Erika Ebbs and Martina Laidemitt. These two students worked for several years on projects relating to the Division of Parasites, and both spent multiple semesters as graduate assistants in the collection. Their dissertation projects contributed substantially to the growth of the collection, and their publications contributed to its prominence.

2. TABLE OF COLLECTION ACTIVITY

Metric	Number
Collection Growth	2,276 Parasite specimens (lots); 826 Host specimens (lots)
Loans (outgoing(no. of specimens)/incoming (no. of specimens))	3 (63)/2 (63)
Specimen Records served via electronic databases	Arctos: 14,959 queries-5,874,844 records served.
Publications using the collection	8

3. EDUCATIONAL IMPACTS OF THE COLLECTION

3a. COURSES USING THE COLLECTIONS

BIOL 239, Microbiology for Health Science Majors, spring & fall semesters, 200 students

5. SCIENTIFIC PRODUCTS AUTHORED BY DIVISION PERSONNEL

1. Ashrafi K, Nouroosta A, Sharifdini M, Mahmoudi MR, Rahmati B, Brant SV. 2018. Genetic diversity of an avian nasal schistosome causing cercarial dermatitis in the Black Sea-

- Mediterranean migratory route. *Parasitology Research* 117(12):3821-383. doi: 10.1007/s00436-018-6087-0
2. Ebbs ET, Loker ES, Brant SV. 2018. Phylogeography and genetics of the globally invasive snail *Physa acuta* Draparnaud 1805, and its potential to serve as an intermediate host to larval digenetic trematodes. *BMC Evolutionary Biology* 18: 103. doi.org/10.1186/s12862-018-1208-z
 3. Bondarenko S, Kontrimavichus V. 2018. Revision of *Aploparaksis* Clerc, 1903 (Cestoda: Cyclophyllidea, Aploparaksidae), with keys to the species of the genus. *Biologija* 64 (1): 1-64. doi.org/10.6001/biologija.v64i1.3659
 4. Loker ES, Bayne CJ. 2018. Molluscan Immunobiology: challenges in the Anthropocene Epoch. *Advances in Comparative Immunology* pp. 343-407. In: Cooper E. (eds) *Advances in Comparative Immunology*. Springer, Cham. doi.org/10.1007/978-3-319-76768-0_12
 5. Verocai GG, Kutz SJ, Hoberg EP. 2018. *Varestrongylus* (Nematoda: Protostrongylidae), lungworms of ungulates: a phylogenetic framework based on comparative morphology. *Parasitology Research* 117(7): 2075-2083.
 6. Verocai GG, Kutz SJ, Hoberg EP. 2018. Historical biogeography among species of *Varestrongylus* lungworms (Nematoda: Protostrongylidae) in ungulates: episodic expansion and host colonization linking Eurasia and North America. *Parasitology Research* 117(7): 2125-2137. doi.org/10.1007/s00436-018-5900-0
 7. Zhang SM, Bu L, Laidemitt MR, Lu L, Mutuku MW, Mkoji GM, Loker ES. 2018. Complete mitochondrial and rDNA complex sequences of important vector species of *Biomphalaria*, obligatory hosts of the human-infecting blood fluke, *Schistosoma mansoni*. *Nature Scientific Reports* 7341. DOI:10.1038/s41598-018-25463-z

6. SCIENTIFIC PRODUCTS BASED ON THE COLLECTION

1. Barrow LN, Allen JM, Huang X, Bensch S, Witt C. 2018. Genomic sequence capture of haemosporidian parasites: methods and prospects for enhanced study of host parasite evolution. *Molecular Ecology Resources* 19(2): 400-410. doi.org/10.1111/1755-0998.12977
2. Bell KC, Demboski JR, Cook JA. 2018. Sympatric parasites have similar host-associated, but asynchronous, patterns of diversification. *The American Naturalist* 192 (3): DOI: 10.1086/698300
3. Haukisalmi V, Ribas A, Junker K, Spickett A, Matthee S, Henttonen H, Jrijer J, Halajian A, Anders JL, Nakao M. 2018. Molecular Systematics and evolutionary history of catenotaeniid cestodes (Cyclophyllidea). *Zoologica Scripta* 47 (2): 221-230. doi.org/10.1111/zsc.12272

4. Schaeffner BC, Ditrich O, Kuchta R. 2018. A century of taxonomic uncertainty: re-description of two species of tapeworms (Diphylobothriidae) from Arctic seals. *Polar Biology* 41: 2543-2559. [10.1007/s00300-018-2396-0](https://doi.org/10.1007/s00300-018-2396-0)
5. Swantesson-Franz RJ, Marquez DA, Goldstein CI, Schmidt-Rhaesa A, Bolek MG, Hanelt B. 2018. New hairworm (Nematomorpha, Gordiida) species described from the Arizona Madrean Sky Islands. *Zookeys* 733: 131-145. doi: [10.3897/zookeys.733.22798](https://doi.org/10.3897/zookeys.733.22798)

8. AFFILIATED PERSONNEL

A. Faculty & Staff

Dr. Eric S. Loker, Curator

Dr. Sara V. Brant, Senior Collections Manager

B. Graduate students

Caitlin Babbitt

Coltin Gerhart

Emily Sarvis

D. Research Associates

Dr. Eric Hoberg

E. Community volunteers

Alex Price

Extramural funding: Awards that were active during 2018, sorted by project start date, totaling ~\$1.8 million.

Project Title	Lead PI	Unit	Sponsor	Award Amount	Award Begin Date	Award End Date
MSB Division of Genomic Resources Facilities Upgrade	Joseph Cook	Mammals, Genomic Resources, Birds	National Science Foundation	\$433,598.00	3/1/16	4/30/19
Diversity and distribution of avian malaria in New Mexico under climate change	Christopher Witt	Birds	U.S. Department of the Interior Bureau of Land Management	\$10,000.00	7/7/16	7/31/21
" "	Christopher Witt	Birds	U.S. Department of the Interior Bureau of Land Management	\$35,000.00	7/7/16	7/31/21
Improved archiving of Mexican wolf (<i>Canis lupus baileyi</i>) specimens in the MSB Division of Mammals	Jonathan Dunnum	Mammals	US Fish & Wildlife Service	\$15,000.00	9/1/16	8/31/21
" "	Jonathan Dunnum	Mammals	US Fish & Wildlife Service	\$15,000.00	9/1/16	8/31/21
" "	Jonathan Dunnum	Mammals	US Fish & Wildlife Service	\$15,000.00	9/1/16	8/31/21
Rio Puerco Mammal Studies - BLM	Joseph Cook	Mammals	U.S. Department of the Interior Bureau of Land Management	\$32,000.00	9/1/16	8/31/18
" "	Joseph Cook	Mammals	U.S. Department of the Interior Bureau of Land Management	\$45,000.00	9/1/16	9/30/21
Collaborative Research: Discovery and analysis in the cradle of speciation theory: biotic surveys of Melanesia's terrestrial vertebrates	Michael Andersen	Genomic Resources	National Science Foundation	\$348,769.00	9/15/16	8/31/21
Promoting Undergraduate Research in Systematics: Insects as a Template for Training	Kelly Miller	Arthropods	Department of Agriculture	\$20,000.00	9/28/16	9/27/21
" "	Kelly Miller	Arthropods	Department of Agriculture	\$20,000.00	9/28/16	9/27/21
" "	Kelly Miller	Arthropods	Department of Agriculture	\$40,000.00	9/28/16	9/27/21
Where do Chilean coastal Giant Hummingbirds (<i>Patagona gigas</i>) go during the austral winter?	Christopher Witt	Birds	Nuttall Ornithological Club	\$4,000.00	12/17/16	1/31/18
Distribution of Gila Monsters in southwestern New Mexico	Jacek Giermakowski	Herps	New Mexico Game and Fish Department	\$21,358.00	2/13/17	1/31/18
MSB Division of Genomic Resources Facilities Upgrade	Joseph Cook	Mammals	National Science Foundation	\$66,378.00	4/13/17	4/30/19
Survey and Monitoring of the Narrow-headed Gartersnake, <i>Thamnophis rufipunctatus</i> , to Forward Its Recovery	Jacek Giermakowski	Herps	Western New Mexico University	\$3,000.00	4/27/17	6/30/18

Extramural funding table (continued)

Distribution and population connectivity of Merriam's ground squirrel (<i>Urocyonotus canus vigilis</i>)	Joseph Cook	Mammals	US Fish & Wildlife Service	\$10,000.00	5/24/17	6/30/19
Diversity and distribution of avian malaria in New Mexico under climate change	Christopher Witt	Birds	U.S. Department of the Interior Bureau of Land Management	\$45,000.00	6/7/17	7/31/21
PRFB Workshop - Research Using Biological Collections	Joseph Cook	Mammals	National Science Foundation	\$98,172.00	8/1/17	7/31/18
Hybridization/introgression within and among mesocarnivore species	Joseph Cook	Mammals	US Geological Survey	\$10,405.00	8/15/17	7/14/18
Digitization TCN: Collaborative Research: Using Herbarium Data To Document Plant Niches In The High Peaks And High Plains Of The Southern Rockies - Past, Present, And Future	Timothy Lowrey	Herbarium	National Science Foundation	\$190,944.00	9/1/17	8/31/21
Invert Collection Identifications	David Lightfoot	Arthropods	Sandia National Laboratories	\$7,995.00	3/12/18	9/30/18
Curation of Lower Colorado River Basin Larval Fish Collections and Digital Files	Thomas Turner	Fishes	Bureau of Reclamation	\$293,883.00	4/16/18	9/30/22
Survey and Monitoring of the Narrow-headed Gartersnake, <i>Thamnophis rufipunctatus</i> , to Forward Its Recovery	Jacek Giermakowski	Herps	Western New Mexico University	\$3,000.00	7/1/18	6/30/19
" "	Jacek Giermakowski	Herps	Western New Mexico University	\$3,000.00	7/1/18	9/30/19
Hybridization/introgression within and among mesocarnivore species	Joseph Cook	Mammals	US Geological Survey	\$10,000.00	9/24/18	9/30/19
Total awards active in 2018				\$1,796,502.00		

Google Scholar profiles for individual collections provide an innovative way for MSB to track the research impacts of its holdings. Scientific products (peer-reviewed papers, dissertations, etc.) can be compiled, summarized, and measured by citation impacts. Here are summary views for MSB's collection profiles to date.



MSB Amphibians and Reptiles: publications based on specimens

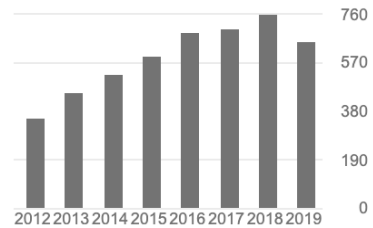
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[Herpetology](#)

TITLE	CITED BY	YEAR
A global test of ecoregions JR Smith, AD Letten, PJ Ke, CB Anderson, JN Hendershot, MK Dhani, ... Nature ecology & evolution 2 (12), 1889	5	2018
Climatic Niche Dynamics and Its Role in the Insular Endemism of <i>Anolis</i> Lizards JA Velasco, E Martinez-Meyer, O Flores-Villela Evolutionary Biology 45 (3), 345-357		2018
Comparison of climate vulnerability among desert herpetofauna	4	2018

Cited by [VIEW ALL](#)

	All	Since 2014
Citations	6401	3938
h-index	38	33
i10-index	131	89



Division of Birds: Publications based on the collection

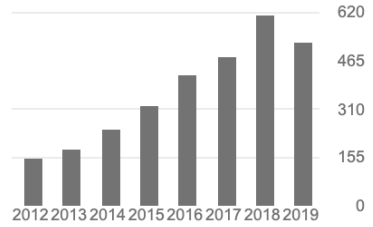
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[Specimen-based research](#) [Birds](#) [Ornithology](#) [Evolutionary Biology](#)

TITLE	CITED BY	YEAR
Comprehensive DNA barcode coverage of North American birds KCR Kerr, MY Stoeckle, CJ Dove, LA Weigt, CM Francis, PDN Hebert Molecular ecology notes 7 (4), 535-543	537	2007
Molecular phylogenetics and the diversification of hummingbirds JA McGuire, CC Witt, JV Remsen Jr, A Corl, DL Rabosky, DL Altshuler, ... Current Biology 24 (8), 910-916	226	2014
Reproductive interdependence of pinon jays and pinon pines	182	1978

Cited by [VIEW ALL](#)

	All	Since 2014
Citations	4023	2600
h-index	34	28
i10-index	80	62





Division of Mammals: publications by affiliated personnel or based on the collection

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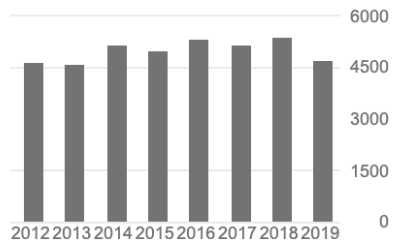
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[mammals](#) [conservation](#) [systematics](#) [evolution](#) [ecology](#)

TITLE	CITED BY	YEAR
Ecoepidemiology of Alphaviruses and Flaviviruses C Guzmán, A Calderón, S Mattar, L Tadeu-Figuereido, J Salazar-Bravo, ... Emerging and Reemerging Viral Pathogens, 101-125		2020
Taxonomy of the Sylvilagus brasiliensis complex in Central and South America (Lagomorpha: Leporidae) LA Ruedas, SM Silva, JH French, RN Platt, J Salazar-Bravo, JM Mora, ... Journal of Mammalogy		2019

Cited by [VIEW ALL](#)

	All	Since 2014
Citations	84410	30650
h-index	119	64
i10-index	1068	647



MSB Division of Fishes

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[Desert fishes](#) [ecology](#) [aquatic research](#) [stable isotope study](#) [genetics](#)

TITLE	CITED BY	YEAR
Reproductive strategies and egg types of seven Rio Grande basin cyprinids SP Platania, CS Altenbach Copeia, 559-569	203	1998
Status and conservation of the Rio Grande silvery minnow, Hybognathus amarus KR Bestgen, SP Platania The Southwestern Naturalist, 225-232	152	1991
FLOW REGULATION AND FRAGMENTATION IMPERIL PELAGIC-SPAWNING RIVERINE FISHES	148	2007

Cited by [VIEW ALL](#)

	All	Since 2014
Citations	4526	1668
h-index	38	21
i10-index	106	52

