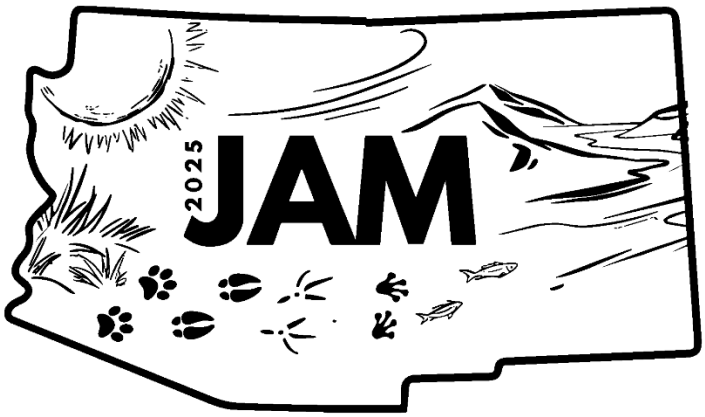

ABSTRACTS FOR THE

58TH JOINT ANNUAL MEETING

NEW MEXICO AND ARIZONA CHAPTERS OF THE WILDLIFE SOCIETY AND ARIZONA/NEW MEXICO CHAPTER OF THE AMERICAN FISHERIES SOCIETY

FEBRUARY 6-8, 2025

THE CLYDE HOTEL

ALBUQUERQUE, NEW MEXICO

PRESENTED BY:

New Mexico Chapter
THE WILDLIFE SOCIETY
EST. 1968

Wildlife Best Student Paper Competition

Adam Cupito, Department of Natural Resources Management, Texas Tech University, 1312 Boston Avenue, Lubbock, TX 79409; acupito@ttu.edu
Clint Boal, USGS Cooperative Fish & Wildlife Research Unit, Department of Natural Resources Management, Texas Tech University, 1312 Boston Avenue, Lubbock, TX 79409

Avian community response to pinyon-juniper woodland management in south-central New Mexico

Introduction: Pinyon-juniper woodlands in the southwestern United States have expanded in range and density since the mid-1800s, encroaching on former grassland savannas due to fire suppression, overgrazing, and climate change (Crow & Van Riper, 2010). This creates a management paradox, requiring conservation strategies for both woodland specialists and grassland-dependent birds.

Methods: Bird communities were monitored via point-count surveys (2018-2024) at Fort Stanton Snowy River Cave National Conservation Area, New Mexico, to evaluate responses to pinyon-juniper woodland thinning. Surveys compared bird occurrences between Control (n=97) and Treatment (n=123) plots, with data analyzed using species-specific occupancy models and community-level ordination techniques.

Results

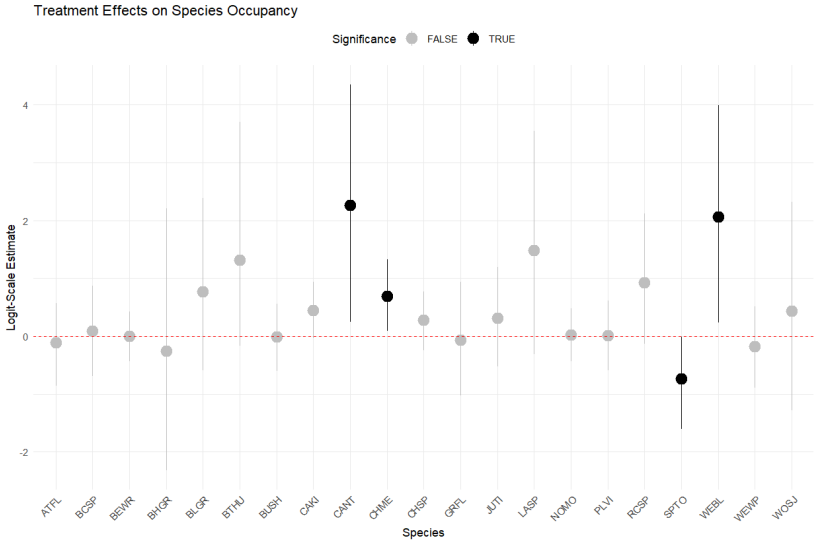

Figure 1. Logit-scale treatment effects on bird occupancy probabilities with 95% credible intervals. Black points indicate significant effects (CIs not overlapping zero), showing positive responses to treatment by Canyon Towhee, Chihuahuan Meadowlark, and Western Bluebird, as well as negative responses by Spotted Towhee. Grey points indicate that there is no significant treatment effect on occupancy.

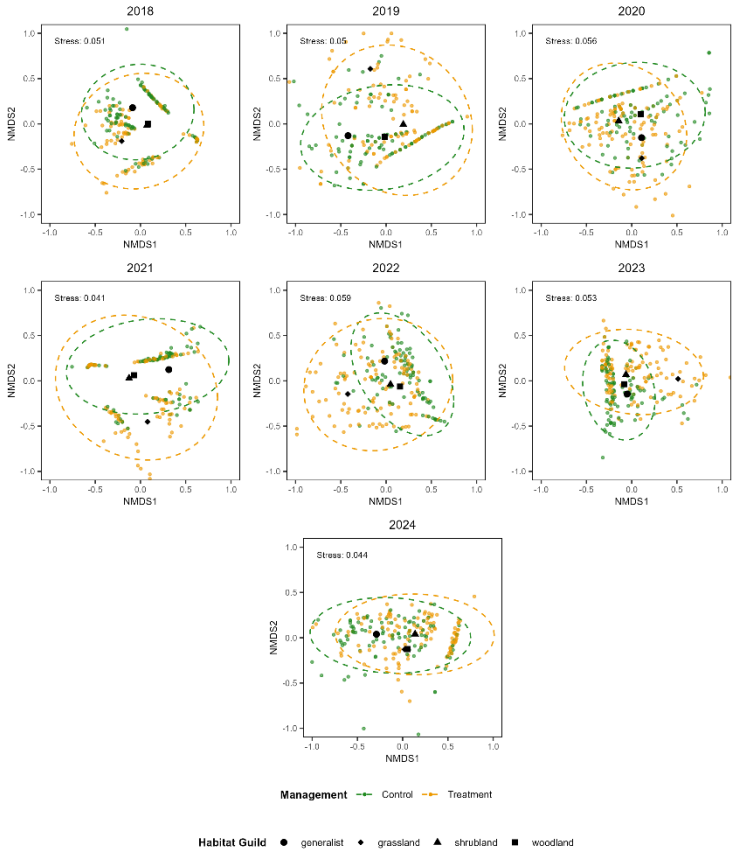

Figure 2. Non-metric multidimensional scaling (NMDS) ordination of bird community composition from 2018-2024. Individual sites are shown as colored points (green = Control, orange = Treatment), with 95% confidence ellipses indicating community separation. Prominent symbols represent habitat guilds (generalist, grassland, shrubland, and woodlands). Low stress values (<0.06) suggests reliable results.

Conclusions and Management Implications: While pinyon-juniper thinning created distinct habitat responses among several species, community-level differences between Control and Treatment sites were minimal. Notably, woodland specialists showed neutral responses to treatment, while some grassland species favored treated areas. Current thinning practices create habitat mosaics that appear to maintain landscape-scale biodiversity. We recommend maintaining diverse vegetation structures in a mosaic, from grasslands and shrubland to mature woodlands, to maximize avian diversity across the landscape.

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Kiera C. Majzner, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona 86011; kcm392@nau.edu
Crystal M. Hepp, TGEN North, 3051 W Shamrell Blvd, Ste 106, Flagstaff, AZ 86001; chepp@tgen.org
Faith M. Walker, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona 86011; Faith.Walker@nau.edu

Rabies virus prevalence and dispersal in the AZ-Mexico borderlands region prior to the arrival of the common vampire bat (*Desmodus rotundus*)

Rabies virus (RABV) causes the highest fatality rate of any infectious disease, with nearly 60,000 human deaths globally each year. In Arizona, one of the leading U.S. states for rabid wildlife, there are regular exposures to humans due to suburban outbreaks of the disease in wildlife. Infection rates, however, are greatly exceeded by those in Latin America due to the common vampire bat (*Desmodus rotundus*). This hematophagous species is moving northward and is projected to cross the U.S.-Mexico border in coming years. Establishing RABV presence and dispersal requires a RABV detection approach based on non-traditional sample types that can be applied broadly. Recently, we used a highly sensitive RT-PCR assay to demonstrate that RABV can be detected from fecal samples of rabid bats. We hypothesize that pairing this assay with fecal samples will enable us to determine distribution and dispersal of the virus in the borderlands area prior to the arrival of vampire bats. Specifically, we will **Aim 1**: Determine presence of RABV in southern Arizona urban and rural (including agricultural) areas by sampling guano from bridges, mines, and caves, and applying the LN34 assay, and **Aim 2**: Define local dispersal patterns of RABV in the border region by performing whole genome sequencing on rabid animal samples provided by the state as well as positive guano samples from Aim 1. Toward this end, we have collected 160 guano samples from southern Arizona rural areas and have extracted RNA from 26 RABV positive bat samples.

Raymond O. Owino, University of Arizona, School of Natural Resources, and the Environment, 1064 E. Lowell St, Tucson, Arizona, USA 85721; rowino@arizona.edu
Isobel Hawkins, University of Oxford, Department of Biology, 11a Mansfield Rd, Oxford OX1 3SZ, UK
Iris Noordermeer, Leiden University, Institute of Biology, Sylviusweg 72, 2333BE Leiden, The Netherlands
Margaret Mercer, University of Arizona, School of Natural Resources, and the Environment, 1064 E. Lowell St, Tucson, Arizona, USA 85721
Lauren A. Stanton, University of California Berkeley, Department of Environmental Science, Policy, and Management, 130 Mulford Hall, Berkeley, CA, USA 94720
Jacob R. Goheen, University of Wyoming, Department of Zoology and Physiology, 1000 E. University Ave., Laramie, Wyoming, USA 82071
Jesse M. Alston, University of Arizona, School of Natural Resources, and the Environment, 1064 E. Lowell St, Tucson, Arizona, USA 85721

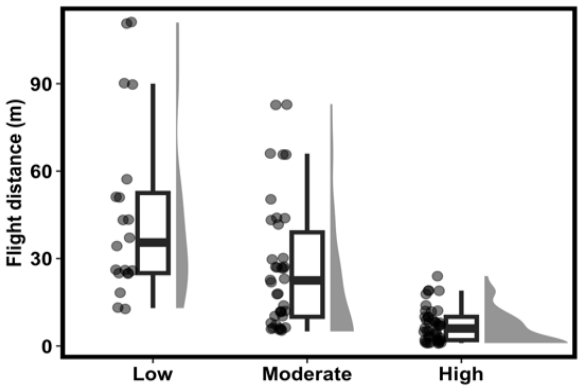
Animals acclimated to humans show relaxed antipredator behavior: The case of Guenther's dik-diks.

Introduction: Fear of humans as apex predators can have a cascading effect on landscape use by other non-human species, controlling where wildlife occurs within landscapes.[1–3] Even in situations where humans are not actively hunting or poaching animals, human activities within landscapes disproportionally affect large carnivores,[4] with many carnivores actively avoiding areas near humans. [3,5] Where humans are not present, however, landscape use by prey species is in part influenced by fear of predation.[1,6] Therefore, in human-dominated landscapes where humans do not hunt or poach prey species, the tendency for large carnivores to avoid human-dominated areas can create areas in which prey experience reduced predation risk.[7,8] When animals experience prolonged exposure to benign interactions with humans, it can lead to habituation (i.e., loss of response to stimuli that have little or no effect on survival[9,10]). When interactions with humans are benign, time and energy spent running from humans as opposed to feeding and breeding could be detrimental.[11,12] In such situations, behaviors that are costly and no longer necessary, such as vigilance, may be selected against,[13] thus allowing animals to allocate more time to feeding and breeding [6]. Since the survival of animals is dependent on timely responses to threats of predation, however, decreased time spent on antipredator behavior such as vigilance could be detrimental should predation risk increase again.[14,15] This could occur, for example, when a novel predator arrives in an area, predator defenses created through human activities are breached, or prey individuals disperse or are translocated into other areas with higher predation risk.[16] Using Guenther's dik-dik (*Madoqua guentheri)* as our study species, we tested whether human activity affects habituation, and by extension, antipredator responses to both direct and indirect threats of predation. Because prolonged exposure to humans can lead to habituation, we hypothesized that dik-diks living in areas of higher human activity respond less strongly to human presence than those living in areas of lower human activity (Hypothesis 1). Because large carnivores tend to avoid areas with high human activity, [3] and prey species can develop predator naivety after prolonged isolation from predators,[13,17] we hypothesized that dik-diks in areas of higher human activity respond less strongly to both direct (Hypothesis 2) and indirect threats of predation (Hypothesis 3) than dik-diks living in areas of lower human activity.

Methods: We stratified our study area into three sites according to levels of human activity (low, moderate and high). We then used flight initiation distance (i.e., the distance between an approaching human and an animal when the animal begins to flee) to compare how variation in human activity influenced habituation to humans by dik-diks. We carried out a simple linear regression with the three sites as categorical explanatory variable, equivalent to a one-way Analysis of Variance (ANOVA).

To compare how variation in human activity affects the amount of time dik-diks spend on antipredator behavior, we simulated varying levels of predation threats using playback recordings from (1) spotted hyena (*Crocuta crocuta*) vocalizations, (2) white-browed sparrow-weaver (*Plocepasser mahali*) alarm calls, and (3) sooty boubou (*Laniarius leucorhynchus*) songs, that represented a direct predation threat, an indirect predation threat, and a non-threatening control, respectively. We analyzed the proportion of time dik-diks spent in response to broadcasted calls, combining vigilance and flight as a "response" and no response otherwise. We used three generalized linear models (binomial family, logit link) to assess the relationship between response time and threat level (control, direct, and indirect).

Results: All three hypotheses were supported. In our study area, flight initiation distances and responses to recorded calls of spotted hyena, white-browed sparrow-weaver, and sooty boubou (simulating a direct cue of risk, an indirect cue of risk, and a control, respectively) decreased sequentially as human activity increased, indicating that dik-diks have habituated to humans where there is more human activity (Hypothesis 1; Fig. 1). Similarly, dik-diks responded more strongly to both direct (Hypothesis 2; Fig. 2), and indirect (Hypothesis 3; Fig. 2) threats of predation than controls, and the strength of responses decreased with increasing human activity.



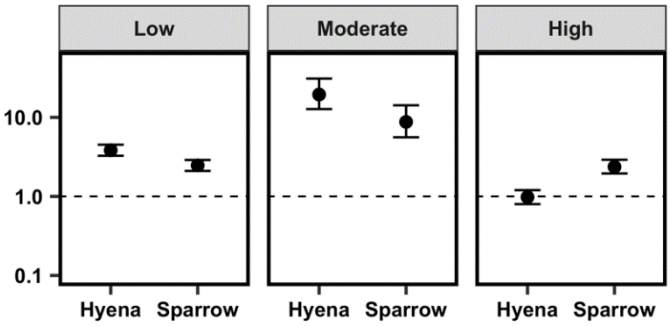


Figure 2: Across each area, dik-diks respond more strongly to both direct (spotted hyena calls) and indirect threats of predation (white-browed sparrow-weaver alarm calls) compared to the nonthreatening control (sooty boubou song, depicted by the dashed line with odds on the y-axis).

Conclusions: Overall, our results indicate that dik-diks exposed to higher levels of human activity are progressively more habituated and naïve to threats of predation from non-human predators. As human populations expand and increasingly coexist with large carnivores, increased human activity may increase susceptibility of dik-diks and other wildlife to their non-human predators. These results are particularly relevant for ecotourism in working landscapes and translocation or reintroduction of animals habituated to humans.

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Wildlife Presentations

Victor Andreev, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St. Tucson, AZ 85721; victorandreev@arizona.edu
Adrian Munguia Vega, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St. Tucson, AZ 85721; airdrian@arizona.edu
Greer Dolby, University of Alabama at Birmingham, Department of Biology, 3117 East Science Hall, Birmingham, AL 35205; gdolby@uab.edu
Melanie Culver, US Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, School of Natural Resources and the Environment, University of Arizona, 1064 E. Lowell St. Tucson, AZ 85721; mculver@arizona.edu

Recent evolutionary history and current population structure of *Peromyscus eremicus* species complex from Baja California

We studied genetic composition of American cactus mouse from the *Peromyscus eremicus* species complex, *P. fraterculus* and *P. eva,* to better understand the evolution of biodiversity in the Baja California region. Principal component analysis of allele frequencies and clustering in FastStructure identified two weakly differentiated genetic groups (Northern and Southern) within *Peromyscus fraterculus*. Additionally, two southmost samples, corresponding to *P. eva*, formed a distinct third group. The recovered mid-peninsular subdivision in *P. fraterculus* well agrees with the population structure brake previously described in Riddle et al (2000). Another, more prominent genetic break was recovered between *P. fraterculus* and *P. eva* south of the Loretto, BCS, Mexico. The dynamics of the effective population size (Ne) of *P. fraterculus* in the past 20,000 years aligns well with the LGM population contraction and the post-glaciation recovery. Interestingly, discrepancies in the Ne trajectories across individual chromosomes and between southern and northern populations suggest region-specific effect of directional and balancing selection. Modeling of demographic history of *P. fraterculus* revealed initial split between southern and northern population around 214,000 years ago, followed by a relatively recent period of symmetrical gene flow approximately 3,500 years ago. This timing is concordant with known fluctuations in rainfall patterns in late Pleistocene and Holocene, and accompanying changes in sea level and habitat availability. Our findings suggest that historical fluctuations in the regional climate (rather than a seaway) have significantly impacted the evolutionary dynamics of Baja California species.

Clare Aslan, Northern Arizona University, Center for Adaptable Western Landscapes, 1395 South Knoles Drive, Flagstaff, Arizona 86011; Clare.Aslan@nau.edu
Gregory Cruz, Northern Arizona University, Center for Adaptable Western Landscapes, 1395 South Knoles Drive, Flagstaff, Arizona 86011; gc728@nau.edu
Ashley Bennett, Electric Power Research Institute, 942 Corridor Park, Knoxville, TN 37932; abennett@epri.com

The contribution of electric utility transmission line rights-of-way to pollinator biodiversity in Arizona

Power line rights-of-way (ROWs) act as linear strips of grassland habitat, maintained to minimize densities of tree canopy cover and woody fuels. Since native pollinators rely on flowering plants which often depend on open-canopy habitat, ROWs have the potential to support pollinator populations across landscapes. This presentation will present findings across a four-year study for data collected on plants and pollinators on ROWs across three vegetation types in Arizona. In 2023, flowering plants were more abundant within the ROW than in adjacent off-ROW habitat across all ecotypes combined and within the ponderosa pine and pinyon-juniper ecotype, but not within Sonoran Desert ecotypes. Bees were significantly more abundant within the ROW than in adjacent off-ROW habitat, but the reverse was true for non-bee insects. By contrast, in 2024 both flowering plants and bees were significantly more abundant on the ROW than in off-ROW habitat but only for the ponderosa pine ecotype; no significant differences were observed in the other ecotypes. Integrated Vegetation Management (IVM) treatments using a combination of herbicide and mechanical clearing to remove woody vegetation were implemented in the ponderosa pine habitat in 2022. IVM treatments were monitored through the end of the growing season in

2024 to track recovery post-treatment. ROWs may provide essential habitat for flowering plants that are critical resources to pollinators, particularly where forests are otherwise densely overgrown and allow little sun-exposure for understory flowering plants. We anticipate findings from this work will help inform management recommendations aimed at maximizing pollinator resources while meeting other ROW management objectives.

Heather L. Bateman, Arizona State University, School of Applied Sciences and Arts, Mesa, Arizona, 85212; heather.l.bateman@asu.edu
Jeffrey A. G. Clark, Global Institute of Sustainability, Arizona State University, Tempe, Arizona, 85281; jeff.a.g.clark@gmail.com
Fabio Suzart de Albuquerque, Arizona State University, School of Applied Sciences and Arts, Mesa, Arizona, 85212; fabio.albuquerque@asu.edu

Climate, vegetation, and urban lizard declines: A decade-long study of perennial and intermittent reaches along the Salt River

Animals living in urban desert ecosystems are affected by temperature extremes and habitat losses. Cities can alter both the physical and biotic environment by increasing temperature and modifying vegetation of species habitat. Perennial and intermittent rivers provide resources to many animal communities. Most long-term urban studies have focused on highly mobile species, such as arthropods, birds, and mammals. However, for desert animals, such as reptiles, a unique suite of challenges can influence species composition and abundance. To evaluate whether abiotic climatic variables or biotic variables related to vegetation cover affect species abundance, we studied the lizard community in Phoenix, Maricopa County, AZ, along perennial (wet) and intermittent (dry) stream types. We calculated abundance from visual encounter surveys for 10 years along the Salt River. Common species included *Aspidoscelis tigris* (tiger whiptail), *Uta stansburiana* (common side-blotched lizard), and *Urosaurus ornatus* (ornate tree lizard). Bioclimatic and vegetation cover data were obtained from geospatial datasets and organized into annual values and as lagged effects (year prior to lizard abundance data). Abundance for total lizards decreased during the study and was positively associated with precipitation. Lagged effects of vegetation variables were a better fit for abundance. Abundance for two of three species was positively related to precipitation and associated with perennial reaches. Our study provides one of the few assessments of multi-year changes in urban lizard communities in a desert city and suggests drought conditions with low precipitation could have negative impacts on urban lizard abundance.

Javan M. Bauder, U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona,1064 E Lowell St., Tucson, AZ 85721; jbauder@arizona.edu
Christopher L. Prewitt, Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 1064 E Lowell St., Tucson, AZ 85721; clprewitt@arizona.edu
Christina R. Perez, Bureau of Land Management, 3201 E Universal Way, Tucson, AZ 85756; crperez@blm.gov
David H. Hall, School of Environment and Natural Resources, 1064 E Lowell St., Tucson, AZ 85721; davidhall31@gmail.com

Recovery of a Chiricahua leopard frog metapopulation in southeast Arizona following the removal of invasive American bullfrogs

The Chiricahua leopard frog (*Lithobates chiricahuensis*, hereafter CLF) has declined throughout its range due to a combination of habitat loss, invasive species, and disease and is currently federally threatened. The Bureau of Land Management's Las Cienegas National Conservation Area (LCNCA) historically supported CLF but by the early-mid 2000s CLF reproduction was documented at only a single site. In 2010, a coalition of public agencies, non-governmental organizations, and the University of Arizona initiated the Frog Project with the goal of restoring aquatic habitats on LCNCA. A central component of this effort was the complete eradication of invasive American bullfrogs (*Lithobates catesbeiana*) from LCNCA, specifically an approximately 3.2 km stretch of Cienega Creek. These eradication efforts have been successful: the last bullfrog detected on LCNCA was in 2017. The creation and annual monitoring of the Elgin Buffer Zone south of LCNCA has succeeded in preventing bullfrog recolonization on the

LCNCA. A combination of CLF translocations, natural CLF dispersal, and the creation/restoration of wildlife ponds on LCNCA allowed the number of sites with CLF reproduction to increase to a high of 14 sites during 2017. During the past four years CLF reproduction has been detected in 6–10 sites. The fungal pathogen *Batrachochytrium dendrobatidis* (Bd) is ubiquitous on LCNCA and continues to cause annual winter die-offs. Yet CLF still persist due to overwinter survival of tadpoles which metamorphose and reproduce the following year. This collaborative recovery effort illustrates the potential success of landscape-level bullfrog eradication for native species recovery in arid southwestern landscapes.

Brent D. Bibles, Unity Environmental University, New Gloucester, ME; bbibles@unity.edu
Clint W. Boal, US Geological Survey Texas Cooperative Wildlife Research Unit, Texas Tech University, Lubbock, TX; Clint.Boal@ttu.edu
Romey Swanson, Singing Dog Wildlife, LLC, Austin, TX; romeyswanson@gmail.com

Use of passive audio monitors to investigate owl communities: Lessons learned
In March 2024, we initiated fieldwork to assess the presence, distribution, and habitat associations of the owl community in the Trans-Pecos region of Texas, with an emphasis on the Mexican Spotted Owl. Distribution, habitat use, and community composition of owls in this region is poorly understood, in part due to the difficulty of conducting nocturnal surveys in the region. Passive audio monitors (PAMs) provide an opportunity to mitigate some of these challenges. We deployed 85 PAMs in four mountain ranges, with locations guided by a habitat model based on forest cover, percent cover, narrow canyons, and solar radiation. We present the results of our work with a focus on species detected, number of detections, and the land cover and topographic characteristics associated with the presence of owls and discuss some of the challenges we encountered in use of automated recordings. Benefits included the ability to survey substantially more areas than would have been possible using nocturnal surveys and PAMs were effective at detecting owls in rugged environments. In addition, we were able to detect two owl species in mountain ranges for which they were previously unknown. Challenges involve the computational requirements of processing and the reliability of automated classification. With caveats, we believe that PAMs are a useful tool for guiding directed survey efforts, as well as useful in providing data to improve habitat models for nocturnal species.

Alto Bridges, Wildlife Student, Bosque School, 4000 Bosque School Road NW, Albuquerque, NM 87120; alto.bridges@bosquestudents.org

Using stable isotope analysis to track migratory patterns of warbler species from 2019-2023
There are various species of warblers in the *Parulidae* family that travel through New Mexico as migrants. Recently, a number of warbler species are showing range changes. I specifically looked at Lucy's Warbler (*Vermivora luciae*), Yellow-rumped Warbler (*Dendroica coronata)* and MacGillvray's Warbler (*Oporonis tolmiei*). Through federally and state permitted bird banding activities, Bosque School and its partner bird banders, have kept a library of bird feathers from mist net captured birds including from these warbler species. Gathering more information on the migration of these species' crossing through New Mexico, and where these migratory birds are coming from is becoming increasingly important for understanding future conservation efforts. Because of this, my project focuses on using this collected data and processing it at the University of New Mexico's Center for Stable Isotopes using hydrogen stable isotopes signatures within bird feathers to track their migration and gather more information on the changes these warblers have made over the past few years regarding where they molt. Comparing the differences in their migration may give us a better understanding of how these species may affect each other.
**Student (high school)

Catherine A Castagnet, Texas Tech University, Department of Natural Resources Management, 2500 Broadway W, Lubbock, Texas 79409; catcasta@ttu.edu
Nathan S Gill, Texas Tech University, Department of Natural Resources Management, 2500 Broadway W, Lubbock, Texas 79409; nathan.gill@ttu.edu
John Oakleaf, U.S. Fish and Wildlife Service, 2105 Osuna NE, Albuquerque, NM 87113; john_oakleaf@fws.gov
Philip Gipson, Texas Tech University, Department of Natural Resources Management, 2500 Broadway W, Lubbock, Texas 79409; philip.gipson@ttu.edu

Comparing the efficacy and accuracy of acoustic recorders and game cameras in detecting Mexican gray wolves

Autonomous recording units (ARUs) have been studied as a non-invasive method for surveying wild wolves via detection of and analyzing wolf howls. Their efficacy has been compared to other non-invasive survey methods such as game cameras and scat collection. We compared the use of two non-invasive methods (game cameras and ARUs) to detect Mexican wolves and measure pack composition at concentric distances from known homesites (den and rendezvous) (e.g., collared site) and areas identified as suitable wolf homesites but not currently occupied by collared wolves (e.g., uncollared site). We deployed 45 cameras and 27 ARUs over nine collared sites as well as three cameras and four ARUs over four uncollared sites in the Apache-Sitgreaves National Forest and the Gila National Forest. Uncollared sites were located using a resource selection function (RSF) model that ranked the suitability of den and rendezvous locations. Audio data is currently being sorted using Kaleidoscope Pro to locate wolf howling events and will be transcribed into Excel to denote specific information about the event. We found that the detection rates from cameras at 1.6 km to 3.2 km decreased significantly when detection rates for cameras at the same homesite distance were not combined. When we combined detection rates, we found that the detection rates from cameras at 1.6 km to 4.8 km decreased significantly. Once ARU data is sorted, detection data will be analyzed over distance and detection rates for both non-invasive methods will be compared using ANOVA.
**Student

Melissa Villatoro Castañeda, Department of Biology, MSC03-2020, 1 University of New Mexico, Albuquerque, New Mexico 87131; melvc20@unm.edu
J. Tomasz Giermakowski, Museum of Southwestern Biology, MSC03-2020, 1 University of New Mexico, Albuquerque, New Mexico 87131; tomas@unm.edu

Phenotypic variation of Arizona Toad (*Anaxyrus microscaphus*) tadpoles in New Mexico

The size and morphology of tadpoles of the same species are often related to environmental factors such as water depth, temperature, or external stressors. Thus, tadpoles from populations in different areas might exhibit different characteristics because they respond differently to changing habitats. This, in turn, has consequences for their survival and persistence and is therefore important for managing the species and its habitat. We focused on the body condition and tail width of Arizona Toad tadpoles, a species of conservation interest whose altitudinal distribution in New Mexico ranges over 1200 m. To investigate that, we measured the dorsal and tail areas of 567 individuals collected at different breeding sites at the eastern edge of the species' range in west-central New Mexico. Our results show that at different altitudes, ranging from 1368 to 2408 mast, the tadpoles' dorsal body area and tail width differed significantly. Most noteworthy is that tadpoles of larval stages had wider tails recorded at lower altitudes, suggesting higher stress. We also assessed differences in body condition and tail width across drainages and found significant differences between specific drainages. These results suggest that differences exist between different habitats and thus can be used to prioritize monitoring of specific populations of Arizona Toads. Furthermore, the relationship between body condition and environmental factors could also be used to examine the consequences of changes in water availability due to climate change in Arizona Toads throughout its range.

Luisa J. Zamora Chavez, Arizona State University, School of Life Sciences, 777 E. University Dr., Tempe, AZ 85287; lzamorac@asu.edu

Dakota M. Rowsey, Vertebrate Collections, Arizona State University Natural History Collections, 734 W. Alameda Dr., Tempe, Arizona 85282; drowsey@asu.edu
Nathan S. Upham, Arizona State University, School of Life Sciences, 777 E. University Dr., Tempe, AZ 85287; nathan.upham@asu.edu

Uncovering Wild Rodent Lung Fungal Community Dynamics in a Madrean Sky Island

Microbial communities play critical roles in the fitness, evolution, and community structure of wildlife hosts. Moreover, wildlife pathogens can pose threats to biodiversity, humans and domestic animals, and create significant economic losses. While bacteria and viruses in microbiomes are comparatively well studied, few systematic studies have focused on the impact of host genetics on mycobiome (fungal microbiome) composition. Furthermore, less is known about the lung mycobiome. Using ribosomal RNA ITS2 sequences from the lungs of 30 individuals across 4 rodent species (Family: Heteromyidae, Cricetidae) collected in the Santa Catalina Mountains (north of Tucson, AZ), we investigate how the rodent host's (1) phylogenetic ancestry and (2) habitat affects its lung mycobiome. The three target habitats (desertscrub, desert grassland, and interior chaparral) were chosen in part to determine the presence and elevational range of *Coccidioides*, the causative agent of coccidioidomycosis (Valley Fever). Heteromyid rodents specifically have been shown to have a particularly high incidence of *Coccidioides*. Preliminary results have shown diverse fungi in the lungs, including the orders Pleosporales, Eurotiales, and Caplodiales. Given that mammalian microbiomes have been shown to closely parallel the phylogeny of their host species – a hypothesis termed "phylosymbiosis" – and fungal species' high responsiveness to environmental influences, we expect a joint interaction of host genetics and habitat to ultimately determine mycobiome composition. Our findings will provide insights relevant to future regional wildlife management and understanding the role of small mammals as reservoirs for emerging fungal pathogens.
**Student

Matthew J. Clement, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; mclement@azgfd.gov

Adjusting for non-response bias in surveys of natural resource users

Nonresponse bias is a well-known and widespread problem in surveys of people. Such bias arises when the propensity to respond to a survey varies with the outcome variable, resulting in data that is missing not at random (MNAR). For example, successful hunters may be more likely to respond to surveys than unsuccessful hunters. Numerous methods have been proposed to address nonresponse bias in MNAR data, but it remains a challenging problem. Here, we modify an occupancy model and apply it to MNAR data. Our occupancy approach allows us to model both the outcome variable and response propensities, and is informed by the full history of contact attempts for each survey subject. We analyzed both simulated data and surveys of deer hunters in Arizona, USA. Using simulated data with adequate sample sizes, the proposed occupancy model was unbiased, with good coverage and low root-mean-square-error. Our analysis of deer hunter data using the state-observation model produced plausible estimates of deer harvest compared to previous intensive surveys. The model could be extended to address detection heterogeneity, inaccurate responses, and changes in outcome variables through time. We suggest our model could be broadly useful for many surveys of natural resource users.

Rosemary Cochran, Wildlife Student, Bosque School, 4000 Bosque School Road NW, Albuquerque, NM 87120; rosemary.cochran@bosquestudents.org

Documenting Ord's kangaroo rat habitat use within a wildland urban interface

Within Albuquerque (NM) the Ord's Kangaroo Rat (*Dipodomys ordii*) habitat is growing smaller and smaller due to the urban development around it. My research aims to find out how this species' population in this area is impacted because of this fragmentation. Alongside my work with the kangaroo rats, I want to know what other species are prevailing within that studied area, establish a baseline population estimate, and diet analysis. I have been live trapping small mammals using Sherman box traps and collecting hair and fecal samples, along with ear tagging them for mark capture recapture studies.

Samples have been processed at the University of New Mexico, Center for Stable Isotopes. I have compared my data with that from the University of New Mexico team researching kangaroo rats at the Sevilleta National Wildlife Refuge (Socorro County, NM).
**Student (high school)

Rebecca A. Cozad, Amphibian and Reptile Conservancy, 6844 Bardstown Road STE 677 Louisville, Kentucky 40291; bcozad@arcprotects.org

Bullfrog monitoring and removal efforts in and around the Gila National Forest
American bullfrogs (*Lithobates catesbeianus*) are among one of the most prolific invasive species in the western United States, where they predate on and outcompete native species, and can spread disease to native amphibian populations. The Gila National Forest is home to several herpetofaunal species of interest, such as the Arizona Toad and the threatened Chiricahua Leopard Frog, Narrowheaded Gartersnake, and Northern Mexican Gartersnake, all of which are impacted by the presence of bullfrogs and other invasives. Amphibian and Reptile Conservancy (ARC) is conducting work in and around the Gila National Forest to monitor the presence and spread of bullfrogs and has begun removal efforts at targeted sites. Through these removal efforts, and in collaboration with our partners, we are working to protect existing metapopulations of focal species and to restore populations at sites where these species have been heavily impacted or replaced by bullfrogs. During this first year of removals, we conducted surveys at over 200 sites for bullfrogs and removed 112 juvenile and adult bullfrogs, 2,077 tadpoles, and more than 1,000 bullfrog eggs by hand. ARC plans to expand removal efforts during the spring and summer of 2025, and to continue strengthening community engagement and collaboration with other local stakeholders.

Dakota D. Crane, GeoSystems Analysis, Inc., Albuquerque, NM, 87113; dakota@gsanalaysis.com
Chase Taylor, Pattern Energy, Albuquerque, NM, 87102; chase.taylor@patternenergy.com
Brad Newman, Pattern Energy, Albuquerque, NM, 87102; brad.newman@patternenergy.com
Quentin R. Hays, GeoSystems Analysis, Inc., Corvallis, OR, 97330; qhays@gsanalysis.com

Avoiding disturbance to nesting birds during construction of renewable energy facilities in the Southwest United States: a case study at the SunZia Wind Project
Most North American birds and their nests are protected under the Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703-712). Monitoring avian reproductive activity helps inform management actions to avoid and/or minimize disturbance to birds protected under the MBTA during construction projects. We conducted nesting bird surveys in all areas proposed for ground-disturbing construction activities at the SunZia Wind Project in central New Mexico to identify and protect active bird nests of during the 2024 avian reproductive season. Surveys were conducted between February 15 – August 31, 2024, covered approximately 2,119 linear miles and 340,931 acres, and resulted in the identification and protection of 510 active bird nests of 43 species. Active nests were protected by temporarily eliminating construction activities within species-specific distances, which were established in coordination with the U.S. Fish and Wildlife Service. In addition to erecting physical barriers to protect active bird nests, we built and maintained an ESRI geospatial information system dashboard which included all nests and associated avoidance buffers, and which was updated in real time and provided to construction managers to incorporate into daily construction plans. Active nests were monitored regularly to determine nest status and final disposition; once final disposition was determined construction activities were allowed to resume. Integrating real-time nesting bird data into construction planning for renewable energy projects is critical to minimizing overall impacts to local and regional avian populations. Our efforts present a scalable model which can be implemented to minimize impacts to MBTA-protected birds during renewable energy development in North America.

Pete David, Sundance Consultants, LLC 10400 Academy Rd NE, Suite 200, Albuquerque, NM 87111; pdavid@sundance-inc.net

Matt Bandy, Resi Solutions, 11420 Ranchitos Road, Albuquerque, New Mexico 87122;
matt@resi.solutions

Use of drones for post-construction carcass mortality monitoring at wind projects

Sundance Consultants and Resi Solutions completed a paired drone searcher efficiency study in the fall of 2021 and winter of 2022 at two wind project sites where post-construction monitoring was planned or had been completed. The studies consisted of placing bat carcasses, and small or medium-sized birds, and large bird carcass surrogates (turkey decoys modified to resemble a golden eagle). A drone operator coordinated with a biologist so that the drone study was conducted concurrently with the ground surveys to ensure that both methods had the same chance of finding each of the carcasses. The methodology used standard practices similar to that being recommended by the US Fish and Wildlife Service (USFWS) for each of the wind project study sites. Two sites were selected, the proposed (at the time) Western Spirit Wind project in Torrance County and the operating Sterling Wind project in Lea County. Prior to initiating the surveys, a third-party biologist placed carcasses in 6-8 search plots measuring one-hectare (100m x 100m) on the former site (grazed juniper savanna) and in the latter site (grazed shortgrass prairie). Approximately 10 to 15 carcasses representing each of the targeted groups (bats, small/medium birds, and large bird decoys) were placed in the plots, and the drone flew the same 6-meter interval transects being walked by the surveyor. Carcass detection results were comparable for 10-meter drone and on-the-ground surveys, but the former covered 26 ac/hr compared to 4 ac/hr for the pedestrian surveys. The 20-meter drone surveys were significantly ($p<0.01$) less effective at locating small-medium sized birds and bats, and the 7-meter drone method was significantly less effective ($p<0.01$) at locating large birds.

Kathryn Davison, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix AZ 85086;
kdavison@azgfd.gov
Ian Latella, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix AZ 85086;
ilatella@azgfd.gov
Audrey Owens, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix AZ 85086;
aowens@azgfd.gov

Spatiotemporal visualization of frog communities in Arizona

We used spatiotemporal geoprocessing to represent Chiricahua leopard frog data for almost two decades of monitoring and management across its range in Arizona. The Chiricahua leopard frog (CLF; *Rana chiricahuensis*) is historically found throughout the state occupying pond and stream habitat at elevations of 1000-2710m (3281-8890 ft). It was listed as threatened under the Endangered Species Act in 2002, and long-term recovery actions have been implemented since then to augment populations and ensure sustainability in an everchanging climate. Major threats include habitat loss and degradation, predation by nonnatives and the introduction of disease. Weaving together multiyear site data can help build an understanding of CLF movement and habitat changes which can inform future management and highlight range and site-specific challenges and successes.

Aaron N. Facka, Wildlands Network, Western Program, 2501 E 20th St Suite 19, Farmington NM, 87401;
aaron@wildlandsnetwork.org.
Kevin P. Smith, Wildlands Network, 2501 E 20th St Suite 19, Farmington NM, 87401;
kevin@wildlandsnetwork.org.
Benjamin Robinson, Ute Mountain Ute Tribe, Towaoc, CO, 81334; brobinson@utemountain.org.
Farley Ketchum, Ute Mountain Ute Tribe, Towaoc, CO, 81334; fketchumsr@utemountain.org.
Jessica Fort, Navajo Nation Department of Fish and Wildlife, Window Rock, AZ, 86515; jfort@nndfw.org.
Quentin Hays, GeoSystems Analysis Inc, Tucson, AZ, 85716; qhays@gsanalysis.com.
Ryan McBee, Bureau of Land Management, Farmington NM, 87402; rmcbee@blm.gov.
Anthony Optaz, New Mexico Department of Game and Fish, Santa Fe, NM 87507;
anthony.opatz@dgf.nm.gov.
Katrina Adamcyzk, New Mexico State Land Office, Santa Fe, NM, 87507; kadamczyk@slo.state.nm.us.
Michael Dax, Wildlands Network, 417 Deer Creek Road, South Fork, CO, 81154.
michael@wildlandsnetwork.org.

Pronghorn space-use and movements near utility scale solar energy development in New Mexico

As development of Utility-Scale Solar Energy (USSE) increases across North America and the American West, large swaths of land that are valuable to pronghorn, and similar wildlife, are likely to be altered through conversion to photovoltaic panels or made inaccessible because of fencing and road building. An important consequence of such alterations is the loss of habitat, changes in movements, or loss of connectivity for wildlife. Studies on the response of pronghorns to solar construction are nearly absent. In 2023, with funding from the U.S. Department of Energy, Wildlands Network began a collaborative study on the effects of solar development on pronghorn in northwestern New Mexico. In summer of 2023, construction began on a 445-hectare solar facility on land with known pronghorn use. In March 2024, we deployed GPS collars on 30 female pronghorns within 13 km of the ongoing construction. From 135,000 locations, we show 57% of collared females have used space within 100 m of the solar fencing whereas 63% of females have used space within 1km. On average, 1.5% of female's locations occur within 100 m which is higher than indicated compared to random movements or locations. We show movements through narrow passages between fenced arrays with no association between preference of passages and length, width, or area of the passages. Pronghorns appear to use land near the facility and through passages to access necessary resources. We confirmed this pattern of usage at an already existing solar facility in northeastern NM using remote cameras in late 2024.

Sanjiv Fernando, RESOLVE, Conservation Solutions Program, 2445 M Street NW, Suite 550, Washington, District of Columbia 20037; sfernando@resolve.ngo
Casey McKeon, Resolution Copper, Permitting and Approvals, 102 W Magma Heights Dr, Superior, AZ 85173; Casey.McKeon@riotinto.com
Carly Vynne, RESOLVE, Conservation Solutions Program, 2445 M Street NW, Suite 550, Washington, District of Columbia 2003; cvynne@resolve.ngo

Biodiversity assessment of the Resolution Copper Project: Pathways to nature positive in critical mineral development

Copper is a critical mineral for the energy transition, essential for renewable energy infrastructure and electric vehicle production. The proposed Resolution Copper project in Arizona represents one of the largest untapped copper deposits in the United States, containing an estimated 1.7 billion metric tons of ore at an average grade of 1.5%. With the potential to supply nearly 25% of the nation's copper demand, this project could play a pivotal role in advancing clean energy technologies. RESOLVE and Regeneration Enterprises conducted a third-party review to assess the Resolution Copper project's net impact on key ecological criteria within the project footprint, focusing on wildlife, vegetation communities, and water resources. The analysis also provided recommendations to support the project towards a Nature Positive outcome, including actions to protect critical habitat, manage invasive species, and limit ecological disturbances. Resolution Copper is now working towards implementing these recommendations and is collaborating with NGO partners to advance conservation and restoration efforts in Arizona. The findings from this assessment provide valuable insights into how the mining industry can responsibly produce and supply critical minerals while protecting nature, aligned with commitments from industry leaders to contribute towards a nature positive future.

Gracie Ann Fischer, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St., Environment and Natural Resources 2, Tucson, Arizona, 85719; gfischer@arizona.edu
Desiree Andersen, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St., Environment and Natural Resources 2, Tucson, Arizona, 85719; desireeandersen@arizona.edu
Leigh Combrink, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St., Environment and Natural Resources 2, Tucson, Arizona, 85719; leighcombrink@arizona.edu

Modeling avian hotspots of potential West Nile Virus outbreaks: A case study in Coconino County, Arizona

West Nile Virus (WNV) is an arbovirus that infects birds and is spread by *Culex* mosquitoes. West Nile Virus has been detected in over 150 bird species, with morbidity and mortality of avian hosts varying significantly between clades. Changing climate, land use and biodiversity loss will influence the distribution of both avian hosts and mosquitoes, impacting the spread of vector-borne diseases. To identify potential hotspots of WNV outbreaks, we used MaxEnt species niche distribution modeling and ArcGIS Pro to model the habitat distribution of three high-competency amplifying hosts (American Robin [*T. migratorius*], House Sparrow [*P. domesticus*], House Finch [*H. mexicanus*]), two low-competency hosts (Common Raven [*C. corax*], American Crow [*C. brachyrhynchos*]), and one supersuppressor host (Northern Cardinal [*C. cardinalis*]) of WNV in Coconino County, Arizona. We included other variables influencing habitat use and distribution, such as temperature, rainfall, normalized difference vegetation index, and elevation. We found that the ranges of all high-competency bird species shifted seasonally, with contracted distributions in the spring. Understanding how the distributions of hosts shift under different climatic scenarios will allow both wildlife conservation and public health professionals to identify potential transmission 'hotspots' and perform proactive measures to mitigate future outbreaks.
**Student

Brandon Foley, Arizona Game and Fish Department, 3500 S Lake Mary Rd, Flagstaff, AZ 86005; bfoley@azgfd.gov
Dan Groebner, Arizona Game and Fish Department, 2878 East White Mountain Boulevard, Pinetop, AZ 85935; dgroebner@azgfd.gov
Audrey Owens, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086; aowens@azgfd.gov

Status and distribution update of northern leopard frogs in Arizona

Northern leopard frogs (*Rana pipens*) were once abundantly distributed across North America, but with the introduction of disease, non-native species, drought, habitat loss and fragmentation their distribution has diminished. In Arizona, they were common across the northern half of state above the Mogollon Rim. By 2006, when the species was petitioned for listing as Threatened under the Endangered Species Act, the Arizona population decreased to one wild population after two of the three known populations in the northeast portion of the state were suspected to have been extirpated. Since 2006, Arizona has developed four refuge populations within its historical range: three were developed on the Arizona Strip in House Rock Valley Wildlife Area, and one refuge was created in Williams at the Bearizona Wildlife Park. In 2011 the species was not warranted to be listed as Threatened and refugia in Arizona continued to have self-sustaining populations and are important for genetic management and wild introductions. In 2015, wildlife biologists in Arizona began reintroduction efforts, with the goal of performing several years of releases at each site alongside intensive monitoring to detect survival, breeding success, or cause for unsuccessful establishment. Arizona has attempted introductions at 14 wild sites, with known success at a site on the Paria Plateau and a renovated site known as Meath Wash in the southwest portion of its range in Arizona. Game and Fish and partners are currently assessing ten sites in varying elevations and habitat types to continue reintroductions while addressing potential issues that could prevent establishment.

Caleb Garzanelli, USDA APHIS Wildlife Services, 8836 N 23 Avenue, Suite 2, Phoenix, Arizona 85021; caleb.garzanelli@usda.gov
Stewart Breck, USDA APHIS WS National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO 80521
Christopher Carrillo, USDA APHIS Wildlife Services, 8836 N 23 Avenue, Suite 2, Phoenix, Arizona 85021
Colby Gardner, U.S. Fish and Wildlife Service, 2105 Osuna Rd NE, Albuquerque, NM 87113
John Oakleaf, U.S. Fish and Wildlife Service, 2105 Osuna Rd NE, Albuquerque, NM 87113
David Bergman, USDA APHIS Wildlife Services, 8836 N 23 Avenue, Suite 2, Phoenix, Arizona 85021

Effectiveness of neck fladry collars in deterring Mexican gray wolves

Fladry and turbo fladry has been proven to be an effective tool in non-lethal protection of livestock against predators. Wildlife Services employees in Arizona have used non-lethal turbo-fladry specifically to deter Mexican Gray Wolves (*Canis lupus baileyi*) out of livestock pastures. However, many livestock pastures are too large to effectively install fladry around the whole pasture. In response to this, Wildlife Services Arizona Program employees, members of the National Wildlife Research Center (NWRC), the U.S Fish and Wildlife Service, and one livestock owner in Arizona tried the use of fladry on collars for cattle. These collars contained red fladry triangular flags and were fitted with a bell around the neck of cattle. Cattle with and without neck fladry were then moved into pastures on U.S Forest Service allotments and state leases. Results indicated that the neck fladry collars did not reduce depredations on cattle. In general, more fladry collared cattle were depredated upon while wearing the collar than uncollared cattle. Observations through the trial indicated that the collars became degraded and compromised, which may have contributed to their ineffectiveness. While this experiment was only conducted with one resource owner, it suggested that an alternative nonlethal tool maybe more effective than the one tested.

J. Tomasz Giermakowski, Museum of Southwestern Biology, MSC03-2020, 1 University of New Mexico, Albuquerque, New Mexico 87131; tomas@unm.edu
James Erdmann, Museum of Southwestern Biology, MSC03-2020, 1 University of New Mexico, Albuquerque, New Mexico 87131; erdmann@unm.edu
Sophia R. Rivera, Museum of Southwestern Biology, MSC03-2020, 1 University of New Mexico, Albuquerque, New Mexico 87131; srivera14@unm.edu

Monitoring of frog breeding phenology near Gila Cliff Dwellings of southwestern New Mexico

Amphibians that breed in arid environments face many challenges, including unpredictable weather, ephemeral breeding sites, and invasive species. Successfully monitoring these species for conservation efforts presents an additional challenge for many of the same reasons and is often constrained by personnel and logistical costs. To overcome this challenge, we deployed and evaluated the use of autonomous recording units (ARUs) to describe the breeding phenology of the native Arizona Toad (*Anaxyrus microscaphus*) and the invasive American Bullfrog (*Rana catesbeiana*) in the vicinity of the Gila Cliff Dwellings National Monument in southwestern New Mexico. We analyzed the recordings using different approaches and compared methodologies to develop activity estimates. ARUs had limited detection capabilities, yet the two species showed marked differences in the timing and seasonality of their breeding, which were related to environmental conditions. Based on calling activity, Arizona Toads started breeding simultaneously across sites in the spring, whereas bullfrogs started calling much later and sporadically when temperatures were much higher. Calling activity subsided much later for bullfrogs. Based on our results and experience with bioacoustics technology both in the field and in analyses, the use of ARUs is efficient in providing accurate data to track changes in breeding. This provides a lower-cost approach to monitoring species for management efforts in valuable, crucial, but difficult-to-access habitats.

Makayla P. Grandpre, Northern Arizona University, School of Forestry, 200 East Pine Knoll Drive, Flagstaff, Arizona 86011; mpg239@nau.edu.
Matthew Voorhees, Northern Arizona University, School of Forestry, 200 East Pine Knoll Drive, Flagstaff, Arizona 86011; mv777@nau.edu.
Daniel E. Sanchez, Northern Arizona University, School of Forestry, 200 East Pine Knoll Drive, Flagstaff, Arizona 86011; daniel.sanchez@nau.edu.
José G. Martínez-Fonseca, Northern Arizona University, School of Forestry, 200 East Pine Knoll Drive, Flagstaff, Arizona 86011; Jose.G.Martinez@nau.edu.
Savannah Marriott, Northern Arizona University, 1395 Knoles Dr, Flagstaff, AZ 86011, USA; Savannah.Marriott@nau.edu.
Anna Riley, Northern Arizona University, 1395 Knoles Dr, Flagstaff, AZ 86011, USA; ar3955@nau.edu.
Faith M. Walker, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86011; Faith.Walker@nau.edu

Carol L. Chambers, Northern Arizona University, School of Forestry, 200 East Pine Knoll Drive, Flagstaff, Arizona 86011; Carol.Chambers@nau.edu.

Detecting New Mexico meadow jumping mice through environmental DNA

The New Mexico jumping mouse (*Zapus luteus*) is an endangered species reliant on riparian areas in the Southwest, particularly in areas with dense herbaceous vegetation near perennial water sources. To minimize stress or harm to animals, non-invasive survey methods such as track plating and camera trapping are useful. Previously, we developed a method of identifying New Mexico jumping mice using environmental DNA (eDNA) collected from plants, but the effectiveness of this approach was unknown. Our objective was to develop an efficient method for detecting New Mexico jumping mice using eDNA collected using (1) vegetation swabbing or (2) modified track plates. During 2023, we tested 4 sampling intensities at 2 locations in the Apache-Sitgreaves National Forests. Despite sampling areas with high capture rates of New Mexico jumping mice, only the highest eDNA sampling intensity (1 sample/m) identified presence through eDNA. An eDNA track plating method using cheesecloth to collect feces and urine also failed to detect the species. These approaches were time-consuming and costly, making reliable eDNA detection impractical. In 2024, we piloted a new method combining eDNA track plates with game cameras, which could visually confirm our target species. Visual detection using game cameras had a higher (32%) detection rate than eDNA methods (2%) and were more efficient. Both eDNA and camera trapping methods adhered to non-invasive standards. Ultimately, our findings indicate inefficiencies in the use of eDNA but highlight the potential of camera trapping in conservation strategies for this endangered species and its sensitive habitat.

Sophia Griego; Bosque Wildlife Student. 4000 Bosque School Rd NW, Albuquerque, NM 87120; sophie.griego@bosquestudents.org

Stable isotope diet analysis of northern river otter in Rio Grande del Norte National Monument (NM) and Albuquerque Biopark (NM)

The Northern River Otter (*Lontra canadensis*) was reintroduced to New Mexico between 2008-2010. They were extirpated from New Mexico by the 1930s due to over harvesting, habitat degradation including water pollution, and urbanization. These factors led to not only extirpation in New Mexico, but close extinction of the Northern River Otter across North America in the 20th century. One major concern about the reintroduction of these otters is that they will compete with anglers for sport fish. Therefore, I am looking at the diet of the Northern River Otter in a primary reintroduction area within the Rio Grande del Norte National Monument, Taos County (NM) to see if they are eating more sport or non-sport fish. I am doing this through stable isotope analysis on collected river otter hair. In order to collect their hair, I set up multiple non-invasive, non-barb wire, hair snares near areas with high otter activity. Initial hair snare success has been low, and therefore I am modifying our hair capture technique. In the meantime, I am determining reference stable isotope values from captive northern river otter from the Albuquerque (NM) Biopark.

**Student (high school)

Kat Harper, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell St, Tucson, AZ 85719; kharper6@arizona.edu
Natalie Payne, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell St, Tucson, AZ 85719; nataliermercer@arizona.edu
Leigh Combrink, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell St, Tucson, AZ 85719; leighcombrink@arizona.edu
Melanie Culver, U.S. Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell St, Tucson, AZ 85719; mculver@arizona.edu
Jennifer Verdolin, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell St, Tucson, AZ 85719; verdolin@arizona.edu

Diet and microbiome analysis of critically endangered mountain gorillas

Among non-human great apes, only the mountain gorilla (*Gorilla berengei berengei*) is growing in population size. Despite this, mountain gorillas remain critically endangered. Understanding the dynamics of mountain gorilla populations with varying degrees of human contact will provide crucial insight into not only their future and recovery potential, but the future and recovery potential of other endangered great apes. Analyzing dietary patterns through DNA metabarcoding and gut microbiome composition across gorilla troops experiencing different levels of human interaction in Bwindi Impenetrable National Forest, we will examine how anthropogenic influences affect gorilla health and adaptation. I will present our metabarcoding approach for identifying consumed plant species, alongside our methods and forthcoming preliminary results characterizing microbial communities through 16S rRNA sequencing.
**Student

Lias Hastings, US Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, 8836 N. 23rd Ave. Suite 2 Phoenix, AZ 85021; Lias.Hastings@usda.gov
Christopher Carrillo, US Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, 8836 N. 23rd Ave. Suite 2 Phoenix, AZ 85021; chris.d.carrillo@usda.gov
Solena Daniels, US Department of Agriculture, United States Forest Service, 742 S Clover Rd Williams, AZ 86046; Solena.Daniels@usda.gov
Brandon Foley, Arizona Game and Fish Department 3500 S Lake Mary Road, Flagstaff, AZ 86005; bfoley@azgfd.gov
Audrey Owens, Arizona Game and Fish Department 5000 W. Carefree Highway Phoenix, AZ 85086; aowens@azgfd.gov
Shaula Hedwall, U.S Department of the Interior, U.S. Fish and Wildlife Service,2500 South Pine Knoll Drive Flagstaff, AZ 86001 United States; shaula_hedwall@fws.gov
David L. Bergman, US Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, 8836 N. 23rd. Ave. Suite 2 Phoenix, AZ 85021; david.l.bergman@usda.gov

Bullfrog removal to support northern leopard frogs on the Kaibab National Forest
The American bullfrog (*Lithobates catesbeianus)* endemic to eastern North America has become invasive in several parts of the world. Efforts to remove bullfrog populations focus on mitigating their ecological impact on native species and habitats. Once established, they quickly outcompete and prey upon local aquatic species with devastating results. Bullfrog removal strategies include habitat modification, physical trapping, and lethal removal. Despite the challenges, removal efforts aim to restore ecological balance and protect biodiversity in affected areas. In April of 2024, US Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services in collaboration with the US Forest Service, US Fish and Wildlife Service and the Arizona Game and Fish Department, began a multi-year bullfrog removal project south of Williams, Arizona, on the Kaibab National Forest. The goal was the targeted removal of bullfrog populations when and where possible and the establishment of bullfrog free buffer zones around potential release sites for Northern leopard frogs (*Lithobates pipiens*). In the first year of field work, the program surveyed cattle tanks, springs, and lakes in the region to determine the extent of bullfrog presence on the landscape and delineate a removal area and buffer zones. Using various techniques of lethal removal, the program removed over 12,000 bullfrogs from 17 different water sources. Additionally, we detected and removed 19 egg masses from 2 sites. Larger reproductive adults were targeted heavily in the first year. The program plans for subsequent years of removal efforts and would incorporate the use of seining of bullfrog's larvae.

Quentin R. Hays, GeoSystems Analysis, Wildlife and Renewables Program Director, Corvallis, OR 97330; qhays@gsanalysis.com
Adam Cernea Clark, Pattern Energy, Permitting and Policy Strategy Director, Houston, TX 77006; adam.cerneaclark@patternenergy.com

Converting a large alfalfa farm to wintering waterbird habitat in the Middle Rio Grande Valley of New Mexico: Mitigation for the SunZia Project
The SunZia Wind and Transmission Project is the largest clean energy infrastructure project in United States history, comprising a 3.5-gigawatt wind energy development in central New Mexico and

accompanying high-voltage transmission line that delivers electricity to the grid in Arizona. A multi-year environmental review, permitting, and financing process led to the development of robust mitigation for the Project, including a novel, project-specific Migratory Bird Conservation Plan that identifies impacts to birds and their habitats that could result from construction and operation of the Project. The SunZia Project also conducted a Critical Habitat Assessment under International Finance Corporation Performance Standard 6 and produced a follow-on Biodiversity Action Plan. To satisfy mitigation requirements under the plans, the SunZia Project purchased an approximately 1,100-acre alfalfa farm along the Middle Rio Grande in New Mexico which will be converted to functional wildlife habitat focused on wintering waterbirds over a period of years and donated to the U.S. Fish and Wildlife Service or New Mexico Game and Fish Department. This presentation will describe mitigation planning for the SunZia Project, discuss how the restoration of Indian Hill Farms will satisfy conditions under both the Migratory Bird Conservation Plan and Biodiversity Action Plan, and detail how the SunZia Project can serve as a replicable and scalable model for other renewable energy and transmission projects in the United States.

Cheyenne Herzog-Lowrance, Heritage Data Management System, Arizona Game and Fish Department, 5000 W Carefree Hwy, Phoenix, AZ 85086; cherzog@azgfd.gov
Tiffany Sprague, Heritage Data Management System, Arizona Game and Fish Department, 5000 W Carefree Hwy, Phoenix, AZ 85086; tsprague@azgfd.gov

Informing the future: Wildlife management through heritage data

The Heritage Data Management System (HDMS), housed within the Arizona Game and Fish Department (AZGFD), serves as Arizona's central repository for data on sensitive and rare species. As part of a global network of more than 60 Natural Heritage Programs and Conservation Data Centers, HDMS adheres to rigorous standards to ensure high-quality, comparable data on plants and animals. The program elevates the work of AZGFD, researchers, and citizen scientists by integrating their findings into a statewide database. This allows for the fulfillment of project-specific goals while providing a comprehensive perspective on species and habitats throughout the state. These data then contribute to national and global biodiversity efforts, supporting informed conservation decisions on a larger scale. Effective planning requires robust data, and HDMS helps enable informed planning by offering information on species occurrences and area-specific data. Through coordination with various parties, the program informs actions such as habitat restoration, species reintroduction, land acquisition, transportation projects, energy development, and commercial construction. Tools like the Online Environmental Review Tool (OERT) have become essential in project planning, with more than 12,000 projects entered over the past five years (average of 2,500 per year). These numbers highlight how HDMS data helps identify species of concern, guide conservation and management efforts, and support responsible development.

Holly E. Hicks, Arizona Game and Fish Department, 5000 West Carefree Highway, Phoenix, Arizona 85029; hhicks@azgfd.gov
Jennifer Cordova, Arizona Game and Fish Department, 25695 Granada, Seligman, Arizona 86337; jcordova@azgfd.gov
Heather Heimann, Arizona Game and Fish Department, 25695 Granada, Seligman, Arizona 86337; hheimann@azgfd.gov

Conservation of black-footed ferrets in Arizona: Lessons learned

Black-footed ferret (*Mustela nigripes*) management in Arizona has had its ups and downs. Starting in 1996, survival was low with initial releases but in the early 2000s, populations took off until peaking in 2012. Thereafter, populations began to decline and its cause was unknown. We began investigations into survivorship of ferrets and determined the ferrets were traveling long-distances from their release areas when sufficient prey was not available. Our focus then switched towards their main prey, the Gunnison's prairie dog (*Cynomys gunnisoni*) populations. We tested three types of flea control methods and two concentrations and determined fipronil and fipbits to be more effective at reducing fleas than deltamethrin. Through this research we also found that prairie dogs were experiencing sylvatic plague but many animals were surviving after several years of exposure. Prairie dogs and ferrets are typically very susceptible to plague and will have 90-100% mortality rates and plague was likely causing the ferret

decline. After several years of disease treatments and reduced plague prevalence, we are releasing ferrets once again. There have been many lessons learned throughout this management journey. Conservation of ferrets in Arizona will take a new approach to releases and management based our gained knowledge and experiences.

Reilly T. Jackson, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; rjackson@azgfd.gov
Andrew S. Jones, Field Operations Division, Arizona Game and Fish Department, 3500 S. Lake Mary Road, Flagstaff, Arizona, USA 86001; ajones@azgfd.gov
Matthew J. Clement, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; mclement@azgfd.gov
J. Paul Greer, Field Operations Division, Arizona Game and Fish Department, 2878 E. White Mountain Blvd. Pinetop, Arizona, USA 85935; jgreer@azgfd.gov
James C. Devos Jr., Directors' Office, Arizona Game and Fish Department, 5000 W. Carefree Hwy, Phoenix, Arizona 85086; jdevos@azgfd.gov
Esther S. Rubin, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; erubin@azgfd.gov

Mexican wolf habitat selection in Arizona

Reintroductions of endangered species can be challenging in part due to limited information about a species' habitat preferences prior to its listing. The Mexican wolf (*Canis lupus baileyi*) was reintroduced to Arizona in 1998 and only broad, generalized habitat use patterns of Mexican wolves had been observed prior to reintroduction. Over two decades post-reintroduction, Mexican wolf habitat selection, and the implications of this selection on potential distribution, remain poorly understood. Therefore, we used step-selection functions to model habitat selection of reintroduced Mexican wolves in the Arizona portion of the Mexican Wolf Experimental Population Area and then mapped the distribution of suitable areas. We found that collared Mexican wolves in packs selected areas with lower maximum summer temperatures, lower canopy cover within 250 meters, steeper slopes, and lower levels of urban imperviousness compared to available locations. Dispersing wolves selected areas with lower canopy cover within 250 meters and lower mean annual temperatures. Areas highly suitable for Mexican wolves in packs were located in eastern Arizona, including the White Mountains and Sky Islands. Comparatively, areas suitable for dispersing Mexican wolves were limited to parts of central and eastern Arizona, specifically the White Mountains, Mogollon Rim, and the northern Sky Islands. Our study demonstrates the importance of assessing the habitat selection of reintroduced wildlife to refine pre-reintroduction understanding of the species' habitat selection and potential for expansion. Further, our results provide important information for recovery actions in areas suitable for Mexican wolves in Arizona.

Karlee Jewell, U.S. Fish and Wildlife Service, 6700 Edith Blvd NE, Albuquerque, NM 87113; karlee_jewell@fws.gov

Addressing American bullfrogs to support conservation and recovery on native species in the southwest and beyond

American bullfrogs (*Lithobates catesbeianus*) are not native to western North America and threaten dozens of Species of Greatest Conservation Need and many federally Threatened or Endangered species. Control or eradication of American bullfrogs may seem impossible. Federal and state agencies, Tribal nations, local governments, and universities have been working for decades in a handful of landscapes to control bullfrogs where they threaten native amphibians, reptiles, and more. Collaboration over the past four years through the Conservation and Adaptation Resource Toolbox's (CART) Non-Native Aquatic Species Community of Practice and the American bullfrog Working Group has broadened stakeholder engagement, increased communication about the scale of the threat posed by American bullfrogs, and provided inspiration through the development of case studies that document successful control projects in the Southwest, and beyond. Building upon the foundation of case studies, working group members have identified knowledge gaps, are co-developing publications and tools, and have supported the development of collaborative funding proposals that empower the removal of existing

populations and promote the prevention of bullfrog establishment where they are incompatible with native species conservation or recovery. This presentation will showcase the collaborative efforts, successful outcomes, and in-progress products of the American bullfrog Working Group.

Deandra Jones, Ph.D. student, The University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St, Tucson, AZ 85721; deandraj@arizona.edu
Javan Bauder, Assistant Unit Leader, U.S. Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, The University of Arizona, 1064 E. Lowell St, Tucson, AZ 85721; jbauder@arizona.edu
Michael Bogan, Associate professor, The University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St, Tucson, AZ 85721; mbogan@arizona.edu

Black bear research on the Navajo Nation

The Navajo Nation Department of Fish and Wildlife (NNDFW) identified the American black bear (*Ursus americanus*) on the Navajo Nation as a top wildlife priority species due to uncertainties surrounding its population status and human-bear interactions. The last ecological study of black bears on the Navajo Nation occurred in the 1980s and current population estimates are needed to inform future management efforts. Moreover, black bears are deeply integrated into Navajo culture, symbolizing strength, protection, and balance within the ecosystem. This cultural connection makes it essential to integrate Traditional Ecological Knowledge (TEK) into management strategies to align with both ecological and cultural values. Our ongoing research seeks to address these gaps with three main objectives. First, we will estimate black bear abundance in the Chuska Mountains using hair-snare sampling, non-invasive genetic sampling, and spatial capture-recapture methods. Second, we will conduct interviews with Navajo community members to explore the cultural and spiritual significance of black bears. Third, we will use questionnaire surveys to investigate the dynamics of human-bear interactions to shed light on conflicts and coexistence shaping daily life within the Navajo community. In the summer of 2024, we established 36 hair snare stations in the northern Chuska Mountains and collected 885 hair samples, 711 of which are currently being analyzed. We have distributed surveys and received 45 responses thus far. Our research will inform black bear management and conflict resolutions, ensure traditional knowledges are passed down, and lay a foundation for conserving other wildlife species in the area.
**Student

Matt Keeling, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; mkeeling@nmsu.edu
James W. Cain III, U.S. Geological Survey New Mexico Cooperative Fish and Wildlife Research Unit, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88033; jwcain@nmsu.edu

Black bear resource selection in relation to wildfires and forest restoration treatments in the Jemez Mountains - An update

An era of fire suppression, compounded by selective harvesting of large diameter trees and overgrazing has altered historical fire regimes in the western United States. These fire and land management practices have left western forests with increased fuel loads and high densities of small diameter trees. In addition to increased wildfire frequency and severity, increased tree densities are associated with decreased biodiversity, altered ecosystem functions, and reduced habitat quality for some species. In response to the increasing frequency and size of high severity fires, managers are attempting to mitigate altered fire regimes using restoration thinning and prescribed burns to reduce fuel loads and restore historical forest structure. As mitigation treatments become more common, there is a need to understand the effects of large-scale forest manipulation on wildlife and habitat. Using GPS locations spanning 2012-2021, our objective is to assess multi-scale seasonal resource selection to determine how black bears respond to wildfires and forest restoration treatments, the effect of fire severity, time since the disturbance, and other environmental and topographic variables relevant to black bears. We present an update of preliminary results which indicate bears utilize and select fire-based disturbances (wildfires, prescribed burns) during different seasons and at varying times since disturbance.

**Student

Ada L. Kieweg, Bosque School Wildlife Student. 4000 Bosque School Rd NW, Albuquerque NM 87120; ada.kieweg@bosquestudents.org
Lelia M. Yane, Bosque School Wildlife Student. 4000 Bosque School Rd NW, Albuquerque NM 87120; lelia.yane@bosquestudents.org
Daniel Shaw, Bosque School. 4000 Bosque School Rd NW, Albuquerque NM 87120; dan.shaw@bosqueschool.org
Emma A. Elliott Smith, Department of Biology and Center for Stable Isotopes University of New Mexico. MSC03-2020, Albuquerque, NM 87131; eaelliot@unm.edu
Seth D. Newsome, Department of Biology and Center for Stable Isotopes University of New Mexico. MSC03-2020, Albuquerque, NM 87131; newsome@unm.edu

Hispid cotton rat stable isotope diet analysis in a cottonwood-dominated riparian forest before and after wildfire, flooding, and restoration using goats

The Hispid Cotton Rat (*Sigmodon hispidus)* is a newly discovered species in Bernalillo County (NM). Across four years (2021, 2022, 2023, 2024), we conducted small mammal trapping in a cottonwood-dominated riparian forest along the Rio Grande focusing on *S. hispidus*. In 2022, an eight-hectare wildfire burned parts of our study area, which has since experienced a period of regrowth. Hautau (2022) used stable isotope analysis of *S. hispidus* hair samples and noted a shift in the diet of *S. hispidus* pre- and post-fire. During April-July, 2023, the site was flooded by high runoff. In 2024, vegetation restoration involving goats took place in the area. Here, we used carbon (δ^{13}C) and nitrogen (δ^{15}N) stable isotope analysis to characterize the diet and ecology of *S. hispidus* within this changing environment. We analyzed the isotopic composition of *S. hispidus* hair samples and potential food sources including local C_3 and C_4 plants and invertebrates. Our pre-fire, post-fire, post-fire post-flooding, and post-goat samples were collected from both the burn site and a control site. After capturing *S. hispidus* using Sherman box traps, we took standard field measurements, a hair sample, and then released each animal. We compared the isotopic values of *S. hispidus* with their potential food sources. We further evaluated how their diet reflects the fluctuating environment and how it has changed over the four-year time scale of our sampling, including the two years evaluated by Hautau.
**Student (High School)

Macy King; Bosque School Wildlife Student. 4000 Bosque School Rd NW, Albuquerque, NM 87120; macy.king@bosquestudents.org

Environmental education through lagomorph population monitoring at Petroglyph National Monument

Petroglyph National Monument is currently experiencing rapid urban encroachment from the city of Albuquerque (NM) which encircles it. To monitor wildlife in this context we conduct lagomorph population surveys within the monument on at least a quarterly basis and while doing so involve K-12 students from a variety of schools in data collection. We have now completed two years of this ongoing monitoring at Petroglyph National Monument. This builds from over 20 years of lagomorph monitoring we did at the Sevilleta National Wildlife Refuge and Long-Term Ecological Research Station (NM). Our general model is to monitor at least four times a year around the full moon. We drive a standard route using high candlepower spotlights and though we record all observed vertebrates we are focused on lagomorphs, in this habitat specifically the Black-Tailed Jackrabbit (*Lepus californicus*) and the Desert Cottontail (*Sylvilagus audubonii*). Our initial monitoring suggest that lagomorph populations are low with some seasonal variation. This is consistent with expectations related to the impacts of hemorrhagic fever. Student education gains include learning how to follow established scientific protocols, wildlife identafacation skills, and conservation topics, especially rabbits as indicator species and loss of habitat through urbanization. Within this project, we establish baseline lagomorph population data as well as pioneer an easily replicated environmental monitoring program for youth.
**Student (high school)

Jacob B. Lee, Northern Arizona University, Department of Biological Sciences, 617 S Beaver St, Flagstaff, AZ 86011; jbl266@nau.edu
Cory M. Poulos, Northern Arizona University, School of Forestry, 200 E Pine Knoll Drive, Flagstaff, AZ 86011; cmp655@nau.edu
Amy V. Whipple, Northern Arizona University, Department of Biological Sciences, 617 S Beaver St, Flagstaff, AZ 86011; Amy.Whipple@nau.edu
Jeff Jenness, Northern Arizona University, School of Forestry, 200 Pine Knoll Drive, Flagstaff, AZ 86011; Jeff.Jenness@nau.edu
Erika Nowak, School of Earth and Sustainability, 501 E Pine Knoll Dr, Flagstaff, Arizona 86011; Erika.Nowak@nau.edu

What is a picture worth: involving citizen science to investigate venomous reptile ecology

Arizona is home to the highest diversity of venomous reptile species in the United States. These reptiles play essential roles in their ecosystems but face rapid habitat loss due to urban development. While much of this development degrades or destroys habitat, some modifications such as irrigation and landscaping, can possibly supplement habitats. Boyce Thompson Arboretum in Pinal Co., Arizona, is home to five venomous reptile species. Although its primary mission is cultivating diverse flora, landscaping practices may also inadvertently enhance venomous reptile habitat. With multiple venomous snake bites to visitors in recent years, the arboretum seeks to better understand these species to manage risks effectively. This study integrates staff sightings, citizen science, and golf-cart surveys to examine the diversity and relative abundance of venomous reptiles. Staff and visitors contributed by submitting photographs of encounters with venomous reptiles, from which we could extrapolate date and time stamps, exact locations, and species ID. Temperature and humidity dataloggers were deployed using stratified random sampling to record microclimate conditions throughout the arboretum, in zones comprised of different levels of landscaping. To address sampling bias in detections, coding in ArcMap was used to pair encounter locations with random plots. We used time series analyses to investigate how microclimatic conditions affected detection rates. The results of this research can inform risk assessment and management strategies to mitigate human-wildlife conflicts. By involving the public in data collection, this study not only enhances scientific understanding but also promotes community engagement and awareness of the importance of venomous reptiles.
**Student

Brock C. Lorenzen, New Mexico Department of Game and Fish, 1 Wildlife Way, Santa Fe, New Mexico 87507; Brock.Lorenzen@dgf.nm.gov

Restoration in action: enhancing New Mexico's landscapes for wildlife

Habitat loss and degradation is a leading cause of species population declines worldwide. Expanding human populations, urban development, and historical land uses have contributed to the loss and fragmentation of wildlife habitat while remaining habitat is left vulnerable to further degradation. For over a century, the United States has protected swaths of land from development, preserving countless acres of wildlife habitat. However, preservation alone may not be enough to ensure the long-term sustainability and ecological functionality of wildlife habitats. Land and wildlife conservation efforts must emphasize a science-based restoration approach in order to increase the quality, resilience, and functionality of wildlife habitat, thereby reducing the risks of further decline of our region's cherished species. The New Mexico Department of Game and Fish (NMDGF) recognizes the importance of restoring and conserving high quality wildlife habitat as an essential component of its mission. NMDGF funds generated from a variety of sources, including hunters and anglers, are put back on the ground through habitat restoration actions on state and federal public lands, as the NMDGF works to restore natural processes and enhance the quality, sustainability, and resilience of wildlife habitat and associated ecological functions. Here we highlight a sampling of various NMDGF-funded projects that aim to advance landscape restoration and benefit wildlife populations for generations to come.

Ali Lotfi, Arizona State University, School of Mathematical and Natural Sciences, Arizona State University, West Valley campus, P.O. Box 37100, Phoenix, AZ 85069-7100; alotfi3@asu.edu
Faranak Parkami, Arizona State University, School of Community Resources and Development, Tourism Department, 411 N. Central Ave, Suite 550, Phoenix, AZ 85004; fparkami@asu.edu
Kinley Ragan, Phoenix Zoo, Arizona Center for Nature Conservation/Phoenix Zoo, 455 N Galvin Parkway, Phoenix, AZ, 85008 USA; kragan@phoenixzoo.org
Matthew Nelson, Arizona Trail Association, 738 N. 5th Avenue, Suite 201, Tucson, AZ 85705; matthew@aztrail.org
Jan Schipper, Arizona State University, School of Mathematical and Natural Sciences, Arizona State University, West Valley campus, P.O. Box 37100, Phoenix, AZ 85069-7100; jan.schipper@asu.edu

Wildlife on the move: Understanding species dynamics and influencing factors on the Arizona Trail

As trail recreation grows in popularity, it poses increasing risks to natural landscapes, including biodiversity loss and impacts on long-term community stability. Tourists in wildlife habitats can stress species, leading to immediate or long-term impacts that vary from negative to neutral or even positive responses. Understanding the effects of human presence on wildlife highlights the need for careful management strategies. This study investigated the Arizona Trail (AZT), a 1287 km non-motorized path traversing Arizona's diverse landscapes from the Mexican border to the border of Utah. Data was collected from 64 cameras across 19 of 43 AZT passages between October 2017 and August 2023. Wildlife images were sorted, identified, and initially analyzed using Wildlife Insights (cloud-based AI) and CameraSweet. At the locations of our trap cameras, we examined the influence of human activity, cattle and dog presence, and habitat characteristics, including the Terrain Ruggedness Index (TRI), elevation, and distance from the road, on wildlife presence and activity patterns. From 5,530 independent wildlife images, we identified 25 small- and medium-sized mammal species. Humans and wildlife exhibited distinct activity patterns, suggesting that human activity may influence wildlife activity patterns on the trail. Additionally, the highest species richness recorded by a single camera was 17 species. Coyotes were the most widely detected species (84.4% of locations), followed by Mule Deer (78.1%), Gray Fox (73.4%), and Bobcat (71.9%). These findings provide valuable insights for trail managers, wildlife agencies, and researchers, supporting the development of conservation strategies that mitigate the impacts of recreation on wildlife.
**Student

Caleb L. Loughran, Western New Mexico University, Department of Natural Sciences, Silver City, NM 88061; cloughran@wnmu.edu
Joshua R. Ennen, Renewable Energy Wildlife Institute, Washington DC, 20005; jennen@rewi.org

A review of photovoltaic solar energy, microclimates, and thermal ecology of wildlife

The world faces two entwined crises – climate change and biodiversity loss. A key strategy to curtail climate change is transitioning toward renewable energy sources. Photovoltaic solar energy (PSE) is crucial in reducing carbon emissions and mitigating biodiversity impacts from climate change. However, PSE may adversely affect certain wildlife species and natural resources due to shifts in habitat composition, as well as the physical qualities of the habitat that wildlife species rely on. Land conversion to large-scale solar facilities is often assumed to be a net loss of habitat for native plants and animals; however, solar panels create a mosaic of microclimates on a landscape, which can aid thermoregulation, and thus allow animals to pursue and maintain physiological and ecological optima. Thus, the ecological and physiological performance of organisms is heavily influenced by the availability of diverse microclimates. While primary research has shown that microclimate mosaics can optimize ecological and physiological performance of organisms, it is unknown if large-scale solar installations can provide these same benefits, and thus potentially offset the negative impacts caused by construction and operation of these facilities. Here, we discuss the overlapping issues of PSE, habitat conversion, and thermal ecology of wildlife. We focus on understanding the topics and species of interest to various PSE stakeholder groups, tools to understand impacts, mitigation of degradation, and amelioration of potential suitable

habitats. We propose study ideas, current efforts, and future directions in understanding the interface between PSE and wildlife.

Olivia L. Nguyen, Arizona State University, School of Life Sciences, 427 E Tyler Mall, Tempe, AZ 85281, USA; olnguyen@asu.edu
Daniel. L. Childers, Arizona State University, School of Sustainability, 777 E University Dr, Tempe, AZ 85281, USA; dan.childers@asu.edu
Jeffery D. Haight, Arizona State University, School of Life Sciences, 427 E Tyler Mall, Tempe, AZ 85281, USA; jdhaight@asu.edu
Jesse S. Lewis, Arizona State University, College of Integrative Sciences and Arts, 7271 E Sonoran Arroyo Mall, Mesa, AZ 85212, USA; jslewi10@asu.edu

Human behavior and wildlife population dynamics in relation to the COVID-19 pandemic across the gradient of urbanization

Humans can influence wildlife populations and behavior through structural and behavioral disturbances, which vary across the gradient of urbanization. Although anthropogenic structural disturbances are relatively static for a given period, human activity can be dynamic on daily and seasonal scales, which can affect wildlife behaviors and activities. The sudden onset of the COVID-19 pandemic created a unique opportunity to evaluate how a rapid change in human behavior affected wildlife populations along the gradient of urbanization. Using a before-after-control-impact (BACI) study design, we evaluated how changing human behavior influenced wildlife species by comparing time periods before and during the COVID-19 pandemic. The objectives of this project were to utilize data gathered from 50 wildlife cameras distributed throughout the Phoenix Valley, AZ to evaluate (1) how human behavior changed in response to the COVID-19 pandemic and (2) detection probability, occupancy and daily activity patterns of 11 wildlife species, including mammals and birds, in response to changing human behaviors. We found that human activity did not significantly vary during the COVID-19 pandemic. Further, we found that wildlife populations did not appear to alter detection probability, occupancy, or daily activity patterns in relation to the COVID-19 pandemic. In our study area, wildlife may not have responded to COVID-19 restrictions because human activity occurred at consistently high levels and did not change while COVID-19-related restrictions were enacted. This project can help us to better understand how structural and behavioral characteristics of humans can shape wildlife populations along the gradient of urbanization.
**Student

Ryan P. O'Donnell, Arizona Game and Fish Department, 5000 W Carefree Hwy, Phoenix, AZ 85086; rodonnell@azgfd.gov

Distribution of the Arizona night lizard

Arizona is home to more than 50 lizard species, but of these only three species are endemic to the state. The Arizona Night Lizard, *Xantusia arizonae*, is perhaps the most charismatic and mysterious of these: this poorly-known species is found only in granite boulder habitat of the Weaver, Date Creek, and McCloud Mountains of Yavapai County. We conducted 14 days of surveys for Arizona Night Lizards within suitable habitat (i.e., boulder fields with flaking granite), in previously unsurveyed parts of the Weaver, Date Creek, and McCloud Mountains, and in surrounding ranges with apparently suitable habitat. We found six Arizona Night Lizards, extending the known distribution by small degrees in various parts of these ranges, and adding valuable non-detection data. We also added interesting natural history information for the species, including the first record of death-feigning for the family *Xantusiidae*.

Audrey K. Owens, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix AZ 85086; aowens@azgfd.gov
Shoshanna L. Kroeger, Phoenix Coding Academy-Phoenix Union High School District, 4445 N Central Ave, Phoenix, AZ 85012; skroeger@phoenixunion.org

Win-win: Inquiry-based learning in a high school biology classroom using bullfrogs removed for conservation

Each year, thousands of American bullfrogs (*Rana catesbeiana*) are removed from Arizona waters in support of conservation of Chiricahua leopard frogs and other aquatic species. While measuring and dissecting removed bullfrogs can provide important natural history information, biologists involved in removal efforts often do not have the time to complete these undertakings, so such data are not collected and bullfrog carcasses are left on site. AKO has helped coordinate several bullfrog removal projects for the Arizona Game and Fish Department (AGFD), and since 2020 has collaborated annually with SLK (an Integrated Biology and Chemistry teacher) to provide 10th grade students with bullfrog carcasses for dissection during a laboratory exercise investigating the impacts of invasive species. Students develop their own research question about bullfrogs and collect data on sex, morphometrics, and diet. The lab provides the students with an authentic, inquiry-based, learning experience on bullfrog impacts. AGFD manages the long-term stomach content data that can be used for multiple investigations. In 2024, students dissected 50 bullfrogs and found an adult black-necked gartersnake (*Thamnophis cyrtopsis*) in one of the stomachs. This species had never been documented in American bullfrog diet, and the students who made the finding will work with AGFD on a natural history note for publication in a herpetological journal, thus expanding the overall benefit of their laboratory experience. Other benefits of this collaboration include increased public awareness of invasive species, and career exploration in wildlife biology by underrepresented student populations.

Anthony J. Pawlicki, University of Arizona, School of Natural Resources and the Environment, 1311 E 4th Street, Tucson, AZ 85719; anthonypawlicki12@gmail.com
Matt Goode, University of Arizona, School of Natural Resources and the Environment, 1311 E 4th Street, Tucson, AZ 85719; mgoode@ag.arizona.edu

Searching for an elusive and cryptic reptile, the Gila monster, in southwestern New Mexico

The Gila monster (*Heloderma suspectum*) is a venomous lizard which has a restricted range in New Mexico. Due to their cryptic nature and their limited range in New Mexico, the status and viability of their populations are not well understood. Since 2020, we have conducted multiple studies to better understand the distribution and genetic structure of Gila monsters in New Mexico. In 2020 and 2021, we conducted focused surveys in the Little Hatchet Mountains, approximately 40 km east of the closest known population. We conducted road cruising and walking surveys for a total of 13,813 km and 1,052.3 hours. Additionally, we utilized trail cameras using a variety of baiting methods over 846 trap days. Although we did not detect a Gila monster, we received two photo vouchers from researchers working in the area. In 2022, we placed 18 camera traps in two mountain ranges, approximately 20 km east of the closest populations. Camera traps were deployed for a total of 1,942 trap days and they detected one Gila monster. Currently, I am conducting surveys to better understand the population structure and connectivity of Gila Monsters in New Mexico. During the monsoon season of 2024, I captured and acquired tissue samples from three individuals. My study will continue during the upcoming spring with the hope of acquiring enough individuals to run genomic analyses.

Mark A. Peyton, New Mexico State University, Department of Biology, 1200 S. Horseshoe Dr., Foster Hall, Las Cruces, New Mexico 88003; nmcatmap@nmsu.edu.
Sarah Milligan, National Park Service, Bandelier National Monument, 15 Entrance Road, Los Alamos, New Mexico 87544; sarah_milligan@nps.gov
Brittney Van Der Werff, Wildlife Conservation and Creative Design, LLC, 11 W. Heights Ln., Ponderosa, New Mexico 87044; wccdnewmexico@gmail.com
James W. Cain III, U.S. Geological Survey, New Mexico Cooperative Fish and Wildlife Research Unit, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88033; jwcain@nmsu.edu.

Den site to dispersal: insights into puma reproduction, survival, and movement

Pumas (*Puma concolor*) exhibit complex reproductive and survival strategies, with denning and dispersal behaviors critical to population dynamics and conservation. This study examines puma reproduction, early maternal movements, kitten survival, and subadult dispersal using data from GPS collars and remote camera monitoring. To date, we have captured and collared 44 adult and subadult pumas (23 females, 21 males) and identified 43 kittens from 18 litters, with 6 additional litters lost to predation before counting. Our findings reveal that females may forage at distances exceeding 5 km from her kittens during the 8-week denning period, while also utilizing multiple den sites to protect and raise young. Den site habitat is dominated by steep, rugged terrain with physical den structures located adjacent to or under large boulders, or cliffs with thick concealing vegetation. Unrelated adult male pumas are the leading cause of kitten mortality, emphasizing the risks of infanticide. Additionally, we have documented rapid rebreeding after litter loss which demonstrates the resilience and adaptability of pumas, though it also reflects the pressures they face in their habitats. Subadult natal dispersal, critical for gene flow and territory establishment, presents unique challenges as pumas navigate landscapes with the primary cause of subadult mortality being related to human-wildlife conflict. Insights into maternal movements, survival threats, and dispersal patterns provide valuable information for managing puma populations and mitigating human-wildlife conflicts. Currently, we are tracking 7 adults, 4 subadults, and 5 kittens which will further contribute to our understanding patterns in den site use, survival, and dispersal.
**Student

Morgan L. Pierce, Arizona State University, School of Life Sciences, 777 E University Dr, Tempe, AZ 85281 USA; mlpierc2@asu.edu

Sharon J. Hall, Arizona State University, School of Life Sciences, 777 E University Dr, Tempe, AZ 85281 USA; sharonjhall@asu.edu
Nathan S. Upham, Arizona State University, School of Life Sciences, 777 E University Dr, Tempe, AZ 85281 USA; nathan.upham@asu.edu

Rodent diversity and gene flow across urban desert remnants in Metro Phoenix

Arid ecosystems are rapidly urbanizing across the globe, changing the structural and functional connectivity of the landscape. For most taxonomic groups this results in a loss of biodiversity. Rodent studies in particular have found that urbanization affects population structure and genetic diversity. However, few studies have analyzed this trend in arid regions. Desert rodents provide valuable ecosystem services such as seed dispersal, and there is a need to develop baseline knowledge of how these species respond to urbanization. I will investigate the relationships between urbanization and diversity at the genetic and community level. How does urbanization affect rodent community composition across an arid city? To answer this I am sampling rodent populations along a gradient of percent impervious surface in Phoenix, Arizona. I am using genetic identification to estimate rodent species diversity and turnover among and between communities. Furthermore, I am investigating how urbanization affects genetic connectivity of ecologically different rodent species across different metro Phoenix sites, including as obtained from a local pest control company. My initial genetic results from a set of desert pocket mice (*Chaetodipus penicillatus*) provide insights on population genetic structure, genetic health, and gene flow directionality among species. No previous studies within this region have investigated community composition using genetic techniques. Results from this project may be utilized by city planners and health agents interested in using finer-scale patterns of rodent presence to determine health risks or ecological services associated with rodents.
**Student

Christopher L. Prewitt, Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 1064 E Lowell St, Tucson, AZ; clprewitt@arizona.edu
David H. Hall, School of Environment and Natural Resources (ret.), University of Arizona, Tucson, AZ 85721; davidhall31@gmail.com
Javan M. Bauder, U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, 1064 E Lowell St, Tucson, AZ 85721; jbauder@arizona.edu

Eradicating invasive American bullfrogs on the Babocomari River in southeast Arizona

Invasive American bullfrogs (*Lithobates catesbeiana*) have contributed to declines of native herpetofauna in southeast Arizona, particularly the federally threatened Chiricahua leopard (*Lithobates chiricahuensis*). The University of Arizona's Frog Project has been engaged in successful landscape-scale bullfrog eradication efforts since 2007 to promote Chiricahua leopard frog recovery. During the spring of 2024, we initiated a new bullfrog eradication project on one of the largest non-urban bullfrog source populations in southeast Arizona along the Babocomari River. Our study area includes a 13 km stretch of river on a working cattle ranch, of which 6 km contains reproductive bullfrog habitat. Our first-year objective was to halt reproduction by targeting adults. Between 13 March and 29 October 2024, we removed 740 adults, 8364 juveniles, and 464 larvae. In the most populated reaches, the number of adults removed declined markedly since initiating removal efforts. For example, during the first three nights of eradication, we removed 113 adults from an 850m survey reach. During the last six months of eradication, we removed 8 adults from the same reach, with none being removed during the final three of those six months. The likelihood of reproduction during 2024 was very low as no egg masses were detected in any survey reach. Our work provided additional information on the timing of bullfrog metamorphosis, the potential effects of sportfish on bullfrog population, and bullfrog reproductive ecology and diet. We plan to continue eradication efforts through 2027 while transitioning into the establishment of buffer zones to prevent bullfrog recolonization.

Sabine Pritchard, Wildlife Student, 4000 Bosque School Road NW, Albuquerque, NM 87120; sabine.pritchard@bosquestudents.org

Noise levels of American crows within a river corridor

The American crow (*Corvus brachyrhynchos*) often spends its time in large noisy groups. During the colder months, crows tend to congregate in and around the Rio Grande's riverside forest, known locally as the *bosque*. I measured the actual sound levels of these crows in certain areas along the Rio Grande in northern Bernalillo County (NM) and seeing where and when these murders of crows are the loudest. In large groups, this verbal, social species, can be quite loud. Although many people enjoy seeing the crows, others object to the amount of noise they can create. For comparison, I also documented noise levels of nearby traffic and other urban sounds and compared it to the noise levels of these crows. To gather data, my process involved studying a nine-kilometer length of the riverside bosque, divided into 11 sections between both river banks. Within each section I recorded sound levels in decibels using a decibel meter on my phone. At each listening location I recorded, for a standard time period, the ambient sound levels as well as documenting estimates of crow numbers, other sounds, both human and natural, as well as location features. This technique can be easily replicated since it is non-intrusive and uses a free downloadable sound app from the National Institute of Occupational Safety and Health. The times I recorded the loudest sound levels along with the largest crow congregations were in the late afternoon to evening.

** Student (high school)

Luke Ramsey-Wiegmann**, Arizona State University Tempe Campus, College of Global Futures, School of Sustainability, Arizona State University, PO Box 877904, Tempe, AZ 85287-7904; ldramse2@asu.edu

Heather L. Bateman, Arizona State University Polytechnic Campus, College of Integrative Sciences and Arts, 6073 South Backus Mall Wanner Hall 301B, Mesa, Arizona, 85212; Heather.L.Bateman@asu.edu

Daniel L. Childers, Arizona State University Tempe Campus, College of Global Futures, School of Sustainability, Arizona State University, PO Box 877904, Tempe, AZ 85287-7904; Dan.Childers@asu.edu

A portrait of changing community composition in urban wetlands of the Salt River

The Salt River has sustained urban life in central Arizona for 1500 years, but following its complete diversion, the riverbed has been mostly dry. Yet in some places, human activity returns water to the river—intentionally and accidentally. Central Arizona Phoenix Long Term Ecological Research (CAP LTER) has monitored plants and animals in these urban wetlands since 2012 (Bateman and Childers 2024) to understand how urbanization shapes ecological communities. We found that urban wetlands may support more vegetation than nearby non-urban wetlands. While introduced plants are increasingly abundant, urban wetlands also serve as refugia for rare species. To visualize community changes, we collaborated with land managers to remove invasive vegetation, made paper from the harvested biomass, and then hand printed community composition diagrams on the paper. These artistic data visualizations are exhibited at a local nature center to connect our findings to the community. Habitat restoration efforts like this have supported stable bird populations, but urban reptile communities have become less abundant. To understand this decline, we compared our surveys with historical aerial photographs since 1940 (Maricopa County 2024). We used logistic regressions to assess which species are associated with different land uses. Snakes are more strongly impacted by urban land uses than lizards, though desert spiny lizards and zebra-tailed lizards are also particularly sensitive. Commercial land use, as well as sealed landfills had the strongest negative associations with herpetofauna, while riparian forests had the strongest positive associations. These findings can help prioritize species for conservation and sites for habitat rehabilitation.

**Student

Katie Rielage, Bosque School Wildlife Student, 4000 Bosque School Rd NW, Albuquerque, NM 87120; Katie.Rielage@bosquestudents.org

Findings from 21 years of North American porcupine captures, Bernalillo County (NM)

The North American porcupine (*Erethizon dorsatum*), found across the continent, is at its southwestern edge of its range in Bernalillo County (NM) and our work helps to describe its natural history in this part of its range. Since 2003, Bosque School, an independent high school, has captured North American porcupines in Bernalillo County, New Mexico as part of our field and community science program. Across twenty-one years we have collected data from seventy-one porcupine capture and handling events. This data collection includes anatomical measurements, demographic information, and sedative use. Our longitudinal study allows us to gather both basic natural history data about this often unstudied species in this region as well as the effectiveness of the sedative dexmedetomidine and its antagonist atipamezole hydrochloride. Furthermore, we've engaged thousands of K -12 students in our field and community science program who have aided us in gathering data related to this species. For them, the North American porcupine has acted and continues to be an ambassador for field science learning in our native riparian forest along the banks of the Rio Grande.
**Student (high school)

Damien C. Rivera, Arizona State University, School of life Sciences, 777 E. University Drive, Tempe, AZ 85287; dcriver2@asu.edu
Nathan S. Upham, Arizona State University, School of Life Sciences, 777 E. University Dr., Tempe, AZ 85287; nathan.upham@asu.edu

Genetic diversity and connectivity of Brush Mice in the Madrean Sky Islands
The Madrean Sky Islands are a system of 56 mountains with isolated woodland habitat above 1600m, located primarily in the Sonoran Desert. These habitats have been repeatedly isolated and re-connected during glacial cycles, harboring considerable mammal biodiversity, particularly among rodents. However, we lack detailed knowledge regarding the genetic diversity and connectivity of rodent populations across mountains. Our initial work summarizing museum specimen records from the Madrean Sky Islands showed that the brush mouse (*Peromyscus boylii*) is an ideal target for surveying historical gene flow among populations, given its existing abundance in natural history collections. We hypothesize that the isolation of these montane habitats since the last glacial maximum has reduced or altogether eliminated gene flow between populations of *P. boylii* on different sky islands. To test this hypothesis, we generated DNA sequences (derived from whole genome shotgun sequencing) from individuals of 12 different mountains in the Madrean Sky Island system using both toe clips of historical voucher specimens (n=93; collected 1921-2001) and liver samples from more recently collected specimens (n=18; 2021-2023). Initial PCA analysis on individuals from five different sky islands (Santa Catalinas, Rincons, Pinaleños, Chiricahus, Huachucas) shows that the variation between individuals is not based on geographic location. This finding suggests that a lack of forest habitat connectivity does not present a strong barrier to gene flow in *P. boylii*. Furthermore, populations of this species, as well as other species of small mammals in the Madrean Sky Islands, may not be as isolated as is currently assumed.
**Student

Isabel Robertson; Bosque School Wildlife Student. 4000 Bosque School Rd NW, Albuquerque, NM 87120; isabel.robertson@bosquestudents.org

North American porcupine home ranges and use of recent fire landscapes in New Mexico through GPS collaring
The North American porcupine's (*Erethizon dorsatum*) range extends from Canada to the northern tip of Mexico, meaning New Mexico is approaching the southernmost end of its range. As a species, they are greatly understudied in the southwest region of the United States. Aiming to fill some of these natural history gaps, this project looks at porcupine space use trends, focusing in a ~40-hectare section of an urban riparian cottonwood forest in central New Mexico. This has been carried out through radio telemetry and GPS collaring. A fire burned intensely across approximately 25% of the studied area in May of 2022, raising questions about how porcupines use recent fire landscapes. This project aims to uncover home ranges of these animals, how they vary between sexes and across seasons, and space use within these recent wildfire sites. This project also incorporates collaboration with local elementary schools, providing youth with hands-on field experiences to learn about the importance of conservation. By

involving the community in these efforts to learn more about The North American porcupine, younger generations of students develop a greater sense of the natural world around them, ultimately promoting environmental consciousness.
**Student (Highschool)

Iona M. Rohan, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; irohan@nmsu.edu
Jennifer K. Frey, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; jfrey@nmsu.edu
Theresa M. Laverty, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; tlaverty@nmsu.edu

Evaluating the effects of wind energy developments on mule deer and pronghorn occupancy in central New Mexico rangelands
Rangelands in central New Mexico are undergoing rapid expansion of wind energy development in areas that harbor economically and ecologically important terrestrial mammals, such as mule deer and pronghorn. While birds and bats are known to be negatively impacted by this form of energy development, little information exists on how terrestrial mammals are affected. Therefore, we designed a study to address this gap in which we applied wildlife occupancy modeling, a technique widely used to draw inferences regarding wildlife use, selection and avoidance of habitats in relation to environmental resources, anthropogenic disturbances, and the presence of other species. We surveyed a total of 152 sites using remotely activated cameras between May and September 2024, following a 2023 pilot season. For each site, we compiled both remotely sensed and field-collected data that we hypothesized would influence our target species' probabilities of detection and occupancy. To determine environmental factors affecting the habitat selection of our target species, we initially accounted for the effects of vegetation, climate, and interspecific interactions by creating standard occupancy models with site-level variables predicted to affect their detection and occupancy probabilities. We then added wind energy variables to the top occupancy model, allowing us to draw conclusions as to how the wind energy infrastructure may be affecting the habitat selection of these ungulate species. We have designed our study to inform wildlife management agencies of these potential effects on ungulates so that targeted conservation efforts, if needed, can be implemented as renewable energy projects expand in this region.
**Student

Esteban O. Rosario Sánchez, University of New Mexico, Biology Department 219 Yale Blvd NE, Albuquerque, New Mexico 87106; erosariosanchez99@unm.edu
Lisa N. Barrow, University of New Mexico, Biology Department 219 Yale Blvd NE, Albuquerque, New Mexico 87106; lnbarrow@unm.edu
Mariah King, Gettysburg College, 300 N Washington St, Gettysburg, PA 17325; mariahk4500@gmail.com
Marin Romero, San Francisco State University, 1600 Holloway Ave, San Francisco, CA 94132; marinromero@outlook.com

Investigating the effects of invasive species and climate change in the populations of freshwater turtles in the southwestern United States
The increasing global temperature, with an average increase of 1°C in the last century, is anticipated to induce significant alterations in wildlife habitats and populations around the world. Particularly, ectothermic organisms like reptiles, which rely on external temperatures for thermoregulation, are projected to be disproportionately affected by these climatic shifts. This research aims to explore the impacts of climate change and habitat loss on freshwater turtles in New Mexico, focusing on their dietary patterns. Employing stable isotope analysis (δ15N and δ13C), we studied the dietary habits of turtle populations across four distinct sites, correlating these with varied habitat and environmental conditions. We also conducted a temporal dietary comparison between present-day isotopic values of western painted turtles (*Chrysemys picta bellii*) and those from the 1960s-1980s using museum specimens. The site-to-site analysis showed differences in isotopic values between species at Elephant Butte State Park and the Rio Grande Nature Center State Park. The historical comparison of *Chrysemys picta bellii*

showed differences in isotopic values between present and historical turtles at the Sevilleta National Wildlife Refuge and the Rio Grande Nature Center State Park. Next season, we will assess the genetic structure of the turtle populations across the Rio Grande. Genetic data will allow us to calculate the effective population size, connectivity between populations and hybridization between the native Big Bend slider (*Trachemys gaigeae*) and the invasive red-ear slider (*Trachemys scripta elegans*).
**Student

Chris Sanderson, Tetra Tech, Albuquerque, NM, USA; chris.sanderson@tetratech.com

Southwestern willow flycatcher habitat assessment and monitoring in the U.S. southwest: methods and resources

Riparian ecosystems in the arid regions of the US southwest support high levels of biodiversity and provide vital habitat to obligate riparian avian species, including the southwestern willow flycatcher (*Empidonax traillii extimus*; “flycatcher”). Repeatable evaluations of interactions between site biotic and abiotic characteristics and flycatcher habitat suitability, occurring at various spatial and temporal scales, are crucial to inform management decisions. These approaches are confounded by high interannual hydrographic variability and riparian habitat dynamism and disturbance processes at the local and reach scale. Several monitoring approaches related to flycatcher habitat suitability are presented here including the use of occurrence datasets, field-based data collection, and multi-spectral satellite imagery for assessing riparian biodiversity in arid ecosystems at the landscape and reach scale. Three case studies related to the assessment of flycatcher habitat suitability will be presented including the use of remote sensing to evaluate tamarisk beetle (*Diorhabda* spp.) herbivory on flycatcher breeding habitat, post-fire evaluation of flycatcher habitat, and a flycatcher restoration site selection model. This review will highlight riparian vegetation assessment linkages between these resources and the relative strengths and weakness of each approach in the context habitat management for the flycatcher.

Ginny Seamster, New Mexico Department of Game and Fish, 1 Wildlife Way, Santa Fe, New Mexico 87507; virginia.seamster@dgf.nm.gov

2025 review and revision of the State Wildlife Action Plan for New Mexico

The State Wildlife Action Plan for New Mexico (SWAP) identifies the state’s Species of Greatest Conservation Need (SGCN) and their associated habitats, threats, and conservation actions. The New Mexico Department of Game and Fish must have a SWAP in order to continue its partnership with the U.S. Fish and Wildlife Service (USFWS) in its application for, and implementation of projects with, State Wildlife Grant funds and with others who work on SGCN in New Mexico. A comprehensive revision of the SWAP was last approved by the USFWS in 2017. The next such comprehensive revision must be completed and submitted to the USFWS by October 1, 2025. This presentation will summarize SWAP key elements and progress on their revision. Ongoing review and revision activities include: 1) revising the SGCN selection criteria, categories, and list, including adding insect pollinators; 2) describing emerging threats; 3) more fully addressing climate adaptation in conservation actions; and 4) incorporating Riparian Conservation Opportunity Areas (RCOAs), climate refugia, and a climate change vulnerability assessment of vertebrate SGCN. RCOAs encompass large and smaller blocks of native riparian vegetation and adjacent areas in need of restoration to enhance the size and connectivity of native riparian vegetation. Identifying RCOAs statewide will complement the COAs developed for the 2017 SWAP and inform future restoration efforts in biodiverse riparian areas. Adding information on climate refugia across the state and climate change vulnerability for more than half of identified SGCN will help conservation practitioners target climate-related threats to SGCN and their habitats.

Emma Sudbeck, Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 1064 E Lowell St., Tucson, AZ 85721; esudbeck@arizona.edu
Audrey Owens, Arizona Game and Fish Department, 5000 W Carefree Hwy, Phoenix, AZ 85086; aowens@azgfd.gov

Javan M. Bauder, U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, 1064 E Lowell St., Tucson, AZ 85721; jbauder@arizona.edu

Dispersal of invasive American bullfrogs in southeast Arizona

Native to eastern North America, the American bullfrog (*Lithobates catesbeianus*) was introduced to western North America where it has a detrimental effect on native herpetofauna and come to dominate many aquatic systems. Bullfrogs have high reproductive and dispersal potential allowing them to readily invade unoccupied habitats. Landscape-scale efforts to eradicate bullfrogs are therefore challenging yet can be successful with sufficient resource commitment. Region-specific information about bullfrog dispersal ecology is particularly important for optimizing the success of eradication projects. Previous bullfrog studies are predominately from cooler regions where bullfrog ecology may differ markedly from that in southeast Arizona. The goal of this study is to identify pond- and landscape-level factors influencing bullfrog dispersal distances in southeast Arizona. We marked 330 adult and juvenile bullfrogs with site-specific toe-clips across four ponds (i.e., source populations) in the San Rafael Valley during May–July 2024. Following the onset of the 2024 monsoon rains, we surveyed surrounding ponds up to 8 km from source populations through mid-September 2024 to identify dispersing individuals. We recaptured five marked bullfrogs (one adult female [160 mm snout-vent length] and four juveniles [54-69 mm snout-vent length]) at distances of 1.1–2.8 km from each individual's source population. The movement from source populations to recapture sites was uphill with a change in elevation ranging from 25-62 meters. This study can provide information to help better understand the movement ecology of bullfrogs in arid landscapes and inform future eradication efforts.
**Student

Luis A. Tarango-Arámbula, Colegio de Posgraduados, Campus San Luis, Iturbide #73, Col. San Agustín, San Luis Potosí, México. C.P. 78 622; ltarango@colpos.mx
Raul Valdez, Research Affiliate, New Mexico State University, Dept. of Fish, Wildlife and Conservation Ecology, Las Cruces, NM 88046 (USA); rvaldez@nmsu.edu

The TWS Mexico Chapter: a successful accomplishment

In Mexico, there is a growing number of wildlife professionals actively involved in education and research programs, but there is no national society that unites their efforts. At a national wildlife conference in Mexico, we discussed the formation of a TWS Mexico Chapter with Dr. Gary White, then president of TWS, and Dr. Fidel Hernandez, who encouraged our efforts. Subsequently, wildlife professionals in Mexico began the formal process to establish a Mexico Chapter of TWS. It was first necessary to establish a national Mexico wildlife conservation NGO (titled Wildlife Mexico Chapter TWS A.C.), a goal accomplished in 2023. The Mexico NGO objective is to unite professionals, students and the public in an integrated effort of promoting the sustainable management of Mexico's wildlife resources. The Wildlife Mexico Chapter TWS A. C. and The Wildlife Society combined efforts to successfully establish a Mexico Chapter. The formation of this Chapter has received full support from the TWS Council, with additional support from the Southwest Section of TWS. The Mexico Chapter is affiliated with the Southwest Section and will have a website linked to this Section to facilitate membership registration and promote the chapter's activities.

Ellen R. Tierney, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; ellentierney@arizona.edu
August Walser, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; walsair@arizona.edu
Bret Pasch, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; bretpasch@arizona.edu

Small mammal diversity in the Pinaleño Mountains of the Madrean Sky Island Archipelago in southeastern Arizona

As global desire to preserve natural places intensifies, attention has turned towards biodiversity hotspots such as the Madrean Sky Island Archipelago, located in the southwest United States and home to the

highest mammal diversity in North America north of Mexico. However, peer-reviewed mammal research, especially of rodents, in the archipelago is lacking. The Pinaleño Mountains (Dził Nchaa Si'an) of southeastern Arizona contains the highest peak in Madrean Sky Island Archipelago that spans diverse life zones, including upper-Sonoran semi-desert grassland, Madrean evergreen woodland, Canadian lower montane forest, Madrean montane conifer forest, and Hudsonian Rocky Mountain subalpine forest. In this talk, we present mark-recapture data from live-trapping across these 5 life zones in the Pinaleño Mountains in the spring and fall of 2024. We captured 427 individuals from 939 captures in a total effort of 5000 trap nights. We identified 12 species, including the white-throated woodrat (*Neotoma albigula*), Merriam's kangaroo rat (*Dipodomys merriami*), desert pocket mouse (*Chaetodipus penicillatus*), rock pocket mouse (*Chaetodipus intermedius*), cactus mouse (*Peromyscus eremicus*), southern grasshopper mouse (*Onychomys torridus*), brush mouse (*Peromyscus boylii*), cliff chipmunk (*Neotamias dorsalis*), long-tailed vole (*Microtus longicaudus*), black-eared deer mouse (*Peromyscus melanotis*), Mexican woodrat (*Neotoma mexicana*), and montane shrew (*Sorex monticolus*). Our work helps remedy the paucity of small mammal research in the ecologically rich Madrean Archipelago and can be used to better understand the patterns of elevational diversity gradients.
**Student

Cuauhcihuatl, Vital-García, Departamento de Ciencias Veterinarias, Universidad Autónoma de Ciudad Juárez, Anillo Envolvente y Estocolmo s/n Colonia Progresista AP 1729-D Cd. Juárez, Chihuahua CP 32310, México; cuauhcihualt.vital@uacj.mx
Diana M. Beristain-Ruiz, Departamento de Ciencias Veterinarias, Universidad Autónoma de Ciudad Juárez, Anillo Envolvente y Estocolmo s/n Colonia Progresista AP 1729-D Cd. Juárez, Chihuahua CP 32310, México; diana.beristain@uacj.mx
John F. Aristizabal, Departamento de Ciencias Químico-Biológicas, Instituto de Ciencias Biomédicas, Universidad Autónoma de Ciudad Juárez, Av. Plutarco Elías Calles 1210, Fovissste Chamizal, Ciudad Juárez, Chihuahua, México; john.aristizabal@uacj.mx
Martha P. Olivas-Sánchez, Departamento de Ciencias Químico-Biológicas, Instituto de Ciencias Biomédicas, Universidad Autónoma de Ciudad Juárez, Av. Plutarco Elías Calles 1210, Fovissste Chamizal, Ciudad Juárez, Chihuahua, México; polivas@uacj.mx

Mammals of the APFF Médanos de Samalayuca, interactions and conservation

The Chihuahuan Desert is characterized by low precipitation, extreme temperatures, and overall harsh environmental conditions, creating a challenging landscape for wildlife. Desert mammals face significant survival challenges and have evolved unique physiological and behavioral adaptations to thrive in these arid conditions. However, their struggles are not limited to coping with the environment. Complex ecological interactions among desert animals play a crucial role in shaping community composition and biodiversity. To better understand these dynamics, we conducted a three-year study using camera traps to monitor the mammal community in a natural protected area within the Chihuahuan Desert. Using spatial analysis, we assessed mammal diversity, richness, and habitat use. We report patterns of habitat use observed among prey species, such as ungulates and lagomorphs, as well as predators, including felines and canines, and report the interactions between these groups. Furthermore, we evaluated the influence of habitat characteristics, such as vegetation types, altitude, and distance to water, on the distribution and behavior of these mammals. Our findings reveal that the distribution of mammals in the study area is primarily influenced by habitat characteristics, with interspecies interactions playing a secondary yet significant role. These insights contribute to a deeper understanding of the factors shaping mammal communities in desert ecosystems and underscore the importance of conserving diverse habitats within protected areas to maintain ecological processes and biodiversity.

Madilyne T. Von Rotz, University of Arizona, School of Natural Resources and the Environment, 1311 E 4th St, Biological Sciences East 206, Tucson, Arizona 85719; mv214@arizona.edu
Mallory L. Davies, University of Arizona, School of Natural Resources and the Environment, 1311 E 4th St, Biological Sciences East 206, Tucson, Arizona 85719; mallorydavies@arizona.edu
Kathryn E. Stoner, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell St, Environment and Natural Res. 2 #137, Tucson, Arizona 85721; kstoner@arizona.edu

MAPPING bat activity through sound: acoustic monitoring and heat map analysis of lesser long-nosed bat visitation to *Agave palmeri*

The lesser long-nosed bat (*Leptonycteris yerbabuenae*) is a key migratory pollinator, traveling 1,200 km each spring along a "nectar corridor" of columnar cacti and agave species to give birth in northern Mexico and the southwestern U.S. However, climate change threatens to fragment this corridor, with agave habitat expected to decline significantly in the next 50 years, potentially disrupting bat migration. In New Mexico, bat arrival typically aligns with Palmer's agave (*Agave palmeri*) blooming, but regional droughts have disturbed this synchrony, reducing flowering agave populations and creating mismatches between bat presence and agave availability. To investigate bat visitation, we monitored 15-20 flowering Agave palmeri plants annually within 50 km of the Big Hatchet roost in 2020, 2022, and 2023. AudioMoth acoustic recorders were deployed on fresh blooms, with weekly visits from May to October to track plant phenology and maintain devices. Acoustic files are being analyzed with Sonobat to identify species and visitation frequency, with results used to create heat maps of bat activity. These findings will guide future agave restoration efforts, potentially identifying foraging patterns of lesser long-nosed bats and informing conservation strategies to address climate-induced corridor fragmentation.

Maximus Youngman; Bosque School Wildlife Student. 4000 Bosque School Rd NW, Albuquerque, NM 87120; Max.youngman@bosquestudents.org

Detection and diet analysis of collared peccary in Valencia County (NM)

Building upon Myers and Bosque School's 2023 documentation of collared peccary (*Pecari tajacu*) in Bernalillo County (NM) we work to document the species in adjacent Valencia County (NM). The species' now known extent in Bernalillo (NM), Torrance (NM), and Socorro (NM) Counties left a hole in their known range as the species expands northward. Our work attempts to fill in the knowledge "donut hole." Employing detection methods including observation, camera traps, track detection, crowd-sourced community (citizen) science reporting, and hair snares, we have worked to document the species' emerging presence in Valencia County. Using a novel hair snare method involving a wood frame, stakes, and wire brushes we attempted to collect hair from collared peccary along the Rio Grande's riparian cottonwood (*Populus deltoides*) dominated forest. The collection of hair allows us to employ stable isotope analysis (specifically $\delta^{13}C$ and $\delta^{15}N$ measurements) to further understand their diet in the area they are expanding into and how those values compare to those of collared peccary in surrounding New Mexico Counties.

**Student (high school)

Wildlife Posters

Samantha Aguilar, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 101, Las Cruces, New Mexico 88003; sam1604@nmsu.edu
Jeanne Fair, Los Alamos National Laboratory, SM-30 Bikini Atoll Rd, Los Alamos, New Mexico, 87545; jmfair@lanl.gov
Audrey Sanchez, Los Alamos National Laboratory, SM-30 Bikini Atoll Rd, Los Alamos, New Mexico, 87545; Audrey_a@lanl.gov
Aaron Young, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 120, Las Cruces, New Mexico 88003; aarony@nmsu.edu
Martha Desmond, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 129, Las Cruces, New Mexico 88003; mdesmond@nmsu.edu

An examination of long-term population trends and demographics of a cavity nesting songbird in the American Southwest

Climate change poses significant challenges for many cavity nesting species. Recent declines in populations of cavity nesters may be reflected in the trends and patterns of nest box occupancy. Western bluebirds (WEBL) are one such species and have been listed as a species of greatest conservation concern in New Mexico. Long-term population studies are valuable but rare and can reveal the long-term implications of climate change. In northern New Mexico, data has been collected for the past 30 years on nest box use by WEBL and other species at Los Alamos National Laboratory. The purpose of this study is to examine the trends and drivers of nest box occupancy by WEBL. Occupancy data collected from 1997 to 2024 will be combined with various habitat and climate variables to test the influence of multiple variables within the landscape on probability of box use. Nest site locations are limited because cavity nesters rely on rare natural cavities or nest boxes, and increasing temperatures may limit reproduction capacity. Therefore, understanding the factors that most influence cavity nesting populations will be vitally important for making effective conservation decisions and mitigating the ongoing effects of climate change on songbird populations.
**Student

Martha Susana Bautista De Luna, Colegio de Postgraduados, Campus Montecillo, Km 36.5 México 136, Montecillo, Texcoco, Estado de México, México, 56264; bautista.susana@colpos.mx
Luis Antonio Tarango Arámbula, Colegio de Postgraduados, Campus San Luis Potosí, Iturbide 73, Salinas de Hidalgo, San Luis Potosí, México, 78620; ltarango@colpos.mx
Eloy Alejandro Lozano Cavazos, Universidad Autónoma Agraria Antonio Narro, Calzada Antonio Narro 1923, Saltillo, Coahuila, México, 25315; alejandrolzn@yahoo.com
José Luis Alcántara Carbajal, Colegio de Postgraduados, Campus Montecillo, Km 36.5 México 136, Montecillo, Texcoco, Estado de México, México, 56264; jlalcant@colpos.mx
Octavio César Rosas Rosas, Colegio de Postgraduados, Campus San Luis Potosí, Iturbide 73, Salinas de Hidalgo, San Luis Potosí, México, 78620; octaviocrr@colpos.mx
Genaro Olmos Oropeza, Colegio de Postgraduados, Campus San Luis Potosí, Iturbide 73, Salinas de Hidalgo, San Luis Potosí, México, 78620; olmosg@colpos.mx

Occupancy and detectability model of Montezuma quail in southern Zacatecas, Mexico

Habitat selection of Montezuma quail (*Cyrtonyx montezumae*) has allowed the persistence of its populations in environments affected by human activity. Although the species' distribution range is known, it is important to understand the environmental characteristics of the sites it inhabits. The objective was to estimate the probability of occupancy and detectability of Montezuma quail in southern Zacatecas, Mexico. To achieve this, 20 call recording points were randomly established, which were sampled five times from June to September 2024. The call count consisted of a 5-minute period of passive listening followed by another 5 minutes using a female call recording. At each counting site, in addition to recording the calls, the time of day, cloud cover percentage, and wind speed were recorded as variables influencing the calling process. This information, along with data on vegetation type, canopy cover, vegetation height, visual obstruction, number of food plants, slope orientation, inclination, and elevation,

will be used to construct a simple occupancy model capable of estimating the probability of occupancy and detectability of Montezuma quail. It was found that call counting through passive listening detected Montezuma quail at 10 of the 20 counting points, while the use of the recording increased detection to 18 of the 20 points. The Montezuma quail occupancy model will help to understand its main habitat requirements, the variables influencing its distribution, and its detection in an area with significant livestock activity.
**Student

Lucas J. Begeman, Department of Fish, Wildlife and Conservation Ecology, New Mexico State University, Las Cruces, NM 88003, USA
James W. Cain III, U.S. Geological Survey, New Mexico Cooperative Fish and Wildlife Research Unit, 123 Knox Hall, Las Cruces NM 88003, USA

Influence of anthropogenic structures on pronghorn movements and habitat selection in the Chihuahuan Desert
Globally, the damaging impacts of human infrastructure on wildlife habitat have been widely recognized. These anthropogenic impacts include habitat loss, habitat fragmentation, direct mortality, and degradation of population processes like migration and animal movements. Pronghorn (*Antilocapra americana*) in southwestern New Mexico encounter a major US Interstate Highway, several state highways, and frequent fences with livestock grazing as the primary land use. This portion of the Chihuahuan Desert receives just over half of its yearly rainfall during the monsoon season, with rainfall events characterized by patchy spatial and temporal distribution. The highly localized and patchy distribution in summer rainfall, resulting in high spatial variation in forage availability and nutritional quality, requires herbivores to seek resources as they emerge on fine spatial and temporal scales. However, anthropogenic structures may interfere with the adaptive use of the nutritional landscape by pronghorn. Our research seeks to assess the home range utilization patterns and movement characteristics of pronghorn across the study area with the goal of identifying the anthropogenic and natural determinants of pronghorn movement. We have captured and fitted 89 adult female pronghorn with GPS telemetry collars. Assessing the resource selection and population connectivity of pronghorn under these conditions will aid in efficient population management and identify areas where anthropogenic barriers may be modified to enhance landscape permeability for pronghorn.
**Student

Abbie M. Brozich, Department of Biological Sciences, Northern Arizona University, S Beaver St., Flagstaff, Az 86011; amb3235@nau.edu
Jacob G. Matney, Department of Biological Sciences, Northern Arizona University, S Beaver St., Flagstaff, Az 86011; jgm258@nau.edu
Erika M. Nowak, Center for Adaptable Western Landscapes, Northern Arizona University, S Knoles Dr., Flagstaff, Az 86011; erika.nowak@nau.edu

Reproduction in captive narrow-headed gartersnakes
Despite extensive efforts to conserve the sensitive species, our knowledge of the reproductive habits of narrow-headed gartersnakes (*Thamnophis rufipunctatus*) is still evolving. A captive population of these snakes in the Gartersnake Research Program at Northern Arizona University has exhibited breeding behaviors previously undocumented for the species. We hope to further understand such behaviors and how living in captivity under different husbandry conditions influences them. Notably, at least three captive-bred snakes that were never paired with a male and kept indoors are apparently pregnant: two from one litter that were housed together, and a third from a different litter that was housed separately. This discovery suggests the first documented occurrences of parthenogenesis in narrow-headed gartersnakes. To further investigate, we will closely monitor these pregnancies and conduct genetic analyses of offspring to rule out sperm retention and confirm parthenogenesis. Additionally, we have observed cases of premature breeding in individuals under a year old, resulting in stillborn offspring. Finally, we have documented sperm storage in females for up to three years after breeding. These

findings provide insights that alter what was previously understood about the species' biology and reproduction.
**Student

Sebastian D. Summo Elias, Department of Biology, Eastern New Mexico University, ENMU Station 33, 1500 S Avenue K, Portales New Mexico 88130, USA; sebastian.summoelias@enmu.edu
Drew R. Davis, Department of Biology, Eastern New Mexico University, ENMU Station 33, 1500 S Avenue K, Portales New Mexico 88130, USA and Biodiversity Collections, Department of Integrative Biology, The University of Texas at Austin, 10100 Burnet Road, PRC 176-R4000, Austin, Texas 78758, USA; drew.davis@enmu.edu

Understanding the distribution of and threats to imperiled western ribbonsnakes (*Thamnophis proximus*) in eastern New Mexico

The western ribbonsnake (*Thamnophis proximus*) is a semi-aquatic species found along the Pecos and Canadian rivers in eastern New Mexico. Although these snakes are more common in other states, few records of this species exist in New Mexico, leading to them being listed as a state-threatened species. Possible threats of this species in the state include loss of riparian habitat, alterations to hydrology, invasive species, and disease, however there is a paucity of information this species in New Mexico, impeding conservation efforts. A habitat suitability model created for the western ribbonsnake by the New Mexico Department of Game and Fish has identified potential suitable habitat for this species. To better understand this species, and to test this previous model, we have begun surveying for this species across eastern New Mexico. In 2024, 40 sites were surveyed, and we collected habitat and community characteristics at each site, and swabbed snakes for Snake Fungal Disease. Our work has revealed three new localities of western ribbonsnakes and confirmed the persistence of previously discovered populations in New Mexico. These snakes were mainly found around water bodies with dominantly vegetated margins and amphibians present. This research will give us a better understanding of this threatened species' current distribution across New Mexico, identify habitat correlates, and provide insight into potential threats that may have attributed to their decline, providing land managers with data needed to conserve these snakes for the future.
**Student

J. L. Lara-Galván, Posgrado en Innovación en Manejo de Recursos Naturales. Campus San Luis Potosí, Colegio de Postgraduados. Iturbide 73, Salinas de Hidalgo, San Luis Potosí, México, CP. 78622; phrynosomatidae17@gmail.com
J. F. Martínez-Montoya, Posgrado en Innovación en Manejo de Recursos Naturales. Campus San Luis Potosí, Colegio de Postgraduados. Iturbide 73, Salinas de Hidalgo, San Luis Potosí, México, CP. 78622; altiplanooeste@gmail.com
J. Sigala-Rodríguez, Colección Zoológica. Universidad Autónoma de Aguascalientes. Aguascalientes, Ags. México, C.P. 20131; jjsigala@gmail.com
Márcia Barbosa, Departamento de Biologia. Universidad de Évora. 7004-516. Évora. Portugal; barbosa@uevora.pt
E. Peredo-Rivera, Posgrado en Innovación en Manejo de Recursos Naturales. Campus San Luis Potosí, Colegio de Postgraduados. Iturbide 73, Salinas de Hidalgo, San Luis Potosí, México, CP. 78622. peredo.ernesto@colpos.mx

Rattlesnake traditional uses, human conflicts and conservation in Zacatecas, Mexico

Rattlesnakes function as predators and rodent pest controllers in ecosystems. In Mexican culture, rattlesnakes provide medicinal and nutritional benefits and have spiritual significance. The objective of this research was to conduct research on the ethnobiology, human-wildlife conflicts, and practical uses of rattlesnakes by residents in the state of Zacatecas, Mexico. The study focused on nine species: *Crotalus aquilus, C. atrox, C. basiliscus, C. lepidus, C. molossus, C. polystictus, C. pricei, C. scutulatus,* and *C. willardi*. A total of 240 semi-structured interviews were conducted in 48 localities across 22 municipalities in the state. The interviewees were selected from within the potential distribution of these species. Forty percent of the interviews included livestock herders, farmers, ranchers, and trade skin collectors, while

the remaining 60% were conducted randomly. The participants included 142 men and 98 women, with ages ranging from 10 to 90 years. Of those interviewed, 93.7% were familiar with rattlesnakes and 71.7% reported having observed them, primarily during summer on unpaved roads. Additionally, 57.5% mentioned having killed at least one snake, citing risks to themselves or their livestock, medicinal use, skin trade, or unspecified reasons. Furthermore, 61.2% noted a significant decrease in rattlesnake sightings. One of the aims of the study was to raise awareness among rural communities of the importance of rattlesnake conservation: 83.7% of respondents expressed an interest in learning more about rattlesnake biology and management.
**Student

Luis D. García-Ángeles, Colegio de Postgraduados, Campus San Luis. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; Luis12da.irf@gmail.com
Genaro Olmos-Oropeza, Colegio de Postgraduados, Campus San Luis Potosí. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; olmosg@colpos.mx
Luis A. Tarango-Arámbula, Colegio de Postgraduados, Campus San Luis Potosí. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; ltarango@colpos.mx
Juan F. Martínez-Montoya, Colegio de Postgraduados, Campus San Luis Potosí. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; fmontoya@colpos.mx
Jorge Palacio-Núñez, Colegio de Postgraduados, Campus San Luis Potosí. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; jpalacio@colpos.mx
Saúl Ugalde-Lezama, Universidad Autónoma Chapingo. Texcoco, Estado de México, México. C. P. 56230; biologo_ugalde@hotmail.com

Abundance and diversity of birds in three habitat conditions in the Altiplano Potosino-Zacatecano, Mexico.

Birds face various threats including habitat fragmentation, land use change, overgrazing, and climate change, among others. However, low-intensity agricultural habitats could contribute to the conservation of birds by providing food provisioning, nesting and resting sites. Our objective was to determine the abundance and diversity of birds in three habitats: irrigated, dryland farmed, and rangeland habitats in the semiarid Altiplano Potosino-Zacatecano region, central Mexico. In each habitat, we established six plots with a fixed radius of 25 m and a minimum distance between plots of 150 m. In each plot, we recorded the species and number of individuals of each species during a period of ten minutes from 6:00 to 10:00 am and from 5 to 7:30 pm from February to March 2023. We measured diversity using the Relative Abundance (RAI) and Shannon-Wiener (H) diversity indices. We identified 37 bird species of 17 families and five orders. We recorded 27 species in irrigated habitats, 23 in dryland farming, and 17 in range lands. In the irrigated habitat, the most abundant species (RAI) were *Euphagus cyanocephalus* (31%) and *Zenaida asiatica* (13.5%); in the dryland farming: *Z. asiatica* (30.7%), E*. cyanocephalus* (19.0%), and *Melanerpes aurifrons* (10.2%); in the range lands: *Z. asiatica* (18.1%), *Campylorhynchus brunneicapillus* (16.9%), *Toxostoma curvirostre* (12%), and *Haemorhous mexicanus* (10.8%). The H value was 2.5, 2.3, and 2.4, respectively. The highest diversity of species (27) and of number of individuals (200) were recorded in the irrigated habitat. This habitat could be important for bird conservation under drought conditions.
**Student

Helena Garza, Texas Tech University, 2500 Broadway W, Lubbock, TX 79409; helgarza@ttu.edu
Mariangel Lopez, Texas Tech University, 2500 Broadway W, Lubbock, TX 79409; mariangl@ttu.edu
Holden Hobbs, Texas Tech University, 2500 Broadway W, Lubbock, TX 79409; hohobbs@ttu.edu
Sarika Rao, Texas Tech University, 2500 Broadway W, Lubbock, TX 79409; kakrao@ttu.edu
Catie Castagnet, Texas Tech University, 2500 Broadway W, Lubbock, TX 79409; catcasta@ttu.edu
Nathan Gill, Texas Tech University, 2500 Broadway W, Lubbock, TX 79409; nathan.gill@ttu.edu

Evaluating co-occurrence of cattle and Mexican gray wolves in the Apache and Gila National Forests

Mexican gray wolves (*Canis lupus baileyi*) are the most genetically distinct lineage and have been in the mountains of central Mexico, southeastern Arizona, and southwestern Texas since the mid-1800s. However, the large population of wolves reduced populations of deer and elk, leading the wolves to predation on livestock. Efforts to eliminate Mexican gray wolves in southwestern Texas followed. The U.S. Fish and Wildlife Service listed Mexican gray wolves as endangered in 1976. The coexistence between wolves and cattle is possible and necessary for the wolves' survival rate, however, it requires extra labor and time. In June 2024, we placed cameras in the Apache and Gila National Forests. Eighteen cameras recorded photos for 12 weeks near six Mexican gray wolf packs' den and rendezvous sites to evaluate spatiotemporal co-occurrence of wolves and cattle. We visually identified all photos of wolves and cattle that were recorded during the study. We recorded the number of cattle observations that were followed by wolves at the same location within 24 hours. We expect results to support one of two hypotheses. First, we may find that wolves are not more likely to be observed in co-occurrence with cattle than random. Alternatively, we may find that wolves have a significant pattern of occurring in the same time and place as cattle. The interaction between Mexican gray wolves and cattle affects the cattle population and the management and safety of the wolves. Our findings will help inform cattle management as well as Mexican grey wolf conservation.
**Student

Alyssa Girard, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, Las Cruces, New Mexico, 88003, USA; alyssasg@nmsu.edu
Nathan Green, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, Las Cruces, New Mexico, 88003, USA; nsgreen@nmsu.edu
Esteban Rosario Sanchez, Department of Biology, University of New Mexico, Albuquerque, New Mexico, 87131, USA; erosariosanchez99@unm.edu
Obed Hernandez-Gomez, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, Las Cruces, New Mexico, 88003, USA; ohg@nmsu.edu
Donny Kelley-Currens, Bosque School, Field and Community Science Program, Albuquerque, New Mexico, 87120, USA; donny.kelley-currens@bosqueschool.org
Daniel Shaw, Bosque School, Field and Community Science Program, Albuquerque, New Mexico, 87120, USA; dan.shaw@bosqueschool.org

Shell disease, pathogen prevalence and body condition of turtles in rural and urban settings across New Mexico

Newly discovered diseases are on the rise and the growth of metropolitan areas affects many species. The rise of infectious disease risk demands more research, and considering its impact on major species is important. This project evaluates the health of freshwater turtles (Testudines) an important group that can be an immense indicator of environmental change. We measured the effects of human land use on the body condition and disease prevalence in metropolitan and rural areas along the Rio Grande and between Albuquerque and Las Cruces. (how many) We trapped 270 turtles (174 red-eared sliders, 58 western painted turtles, and 36 spiny softshell turtles) using baited hoop traps/hand nets and measured their plastron length (cm) and body weight (mm) to calculate body composition from 2017 to 2024. We also obtained swabs from turtles in 2024 and tested them for the presence of *Emydomyces testavorans,* Ranavirus, *Mycoplasma* sp, *Salmonella sp.,* and Herpesvirus using qPCR. We did not find significant differences in body composition between urban and rural populations in all three species; however, we noted a trend towards increased body conditions in western painted turtles collected in rural environments. Pathogen prevalence in 2024 was also low throughout all populations, although we did observe signs of shell disease in red-eared sliders living in urban environments. The growth of metropolitan areas across the state of New Mexico may be correlated with the prevalence of shell disease we observed in freshwater turtles.
**Student

Eduardo Gracia Escalante, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell St, Tucson, Arizona, 85721; egracia@arizona.edu
Jesse Alston, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell St, Tucson, Arizona, 85721; jmalston@arizona.edu
Javan Bauder, U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 1064 E Lowell St, Tucson, Arizona, 85721; jbauder@arizona.edu

Evaluating wildlife use of small wildlife crossing structures on the US/Mexico border wall in Organ Pipe National Monument

The US/Mexico border wall (hereafter BW) runs along 700 of the 2,000 miles of the boundary between these countries. The BW bisects areas with high biological diversity and represents a novel landscape feature. The effects of the BW on the mammalian community of the Sonoran Desert in Arizona and Sonora remain poorly understood. Small wildlife crossing structures (hereafter cat gates) have been installed in parts of the BW in southern Arizona in an effort to mitigate the effects of the BW on wildlife movement. However, wildlife use of cat gates within the Sonoran Desert is largely unknown. Our objective is to quantify and measure wildlife use and crossing rates of cat gates along 30 miles of the border between Arizona, USA, and Sonora, Mexico at Organ Pipe Cactus National Monument (OPCNM). We will deploy camera traps at 16 cat gates and at randomly selected locations along the BW without cat gates. Our results can be used to inform the future placement of additional cat gates.
**Student

Greta N. Gurdikian, University of Arizona, Department of Molecular and Cellular Biology, Tucson, Arizona 85721; ggurdikian@gmail.com
Beth Hasl, University of Arizona, Department of Conservation Genetics, Tucson, Arizona 85721; bhasl@arizona.edu
Jessica Rick, University of Arizona, Department of Natural Resources and the Environment, Environment and Natural Resources Building, 1064 E Lowell St, Tucson, AZ 85721; jrick@arizona.edu

MHC class ii gene association with chytrid fungus in populations of lowland leopard frogs

Chytrid fungus, or *Batrachochytrium dendrobatidis* (Bd), is an infection that is detected in more than one-third of all amphibian species surveyed around the world. *Bd* colonizes the keratinized epithelial cells of its host's skin, and can lead to paralysis and heart failure. Immune response to *Bd* in lowland leopard frogs (*Lithobates yavapaiensis*) and other amphibians is linked to the major histocompatibility complex (MHC) loci. In lowland leopard frogs, immune response is not directly correlated with survival, and has been documented to differ among populations and locations of these frogs. Variation in survival in lowland leopard frogs corresponds to heterozygosity of alleles within the MHC Class II (MHC-II) locus, and the expression of MHC genes may depend on environmental factors. Our objective is to investigate the association between *Bd* infection prevalence and the presence of different MHC-II alleles in lowland leopard frogs in the areas surrounding Tucson, Arizona. To accomplish this, we collected over 500 tissue samples from frogs and tadpoles in southern Arizona. For each frog, we are sequencing the MHC-II locus and testing for the presence of Bd using a real time PCR (RT-PCR) assay. With this data, we are investigating how immune response genes not only affect the survival of lowland leopard frogs infected with the Chytrid fungus, but how environmental factors can influence the interaction between MHC expression and survival across southern Arizona.
**Student

Jeffrey D Haight, Global Institute of Sustainability and Innovation, Arizona State University, 777 E. University Drive, Tempe, Arizona, USA, 85281; jdhaight@asu.edu
Fabio Suzart, Albuquerque, College of Integrative Sciences and Arts, Arizona State University, 7271 E Sonoran Arroyo Mall, Mesa, Arizona, USA 85212-6415; fsuzartd@asu.edu
Heather L. Bateman, College of Integrative Sciences and Arts, Arizona State University, 7271 E Sonoran Arroyo Mall, Mesa, Arizona, USA 85212-6415; Heather.L.Bateman@asu.edu

Amy E. Frazier, Department of Geography, University of California – Santa Barbara, 1832 Ellison Hall, Santa Barbara, California, USA, 93106-4060; afrazier@ucsb.edu
Kelli L. Larson, School of Geographical Sciences and Urban Planning, Arizona State University, 975 S Myrtle Ave, Tempe, AZ 85281, USA; kelli.larson@asu.edu
Susannah L. Lerman, USDA Forest Service, Northern Research Station, Amherst, MA, USA; susannah.b.lerman@usda.gov
Paige S. Warren, Department of Environmental Conservation, University of Massachusetts, Amherst, MA, USA; pswarren@umass.edu

Are urban species adapting to climate change? Dynamic avian habitat use and implications for future coexistence

Conserving and managing wildlife communities across shifting landscapes requires understanding of how dynamic environmental factors that shape habitat vary across space and time. Declines in wildlife diversity due to landscape development and changing climate conditions are widely documented. However, the combined future impacts of these multiple environmental stressors on wildlife community composition remain unclear, in part due to the lack of data at the spatiotemporal scales necessary for predicting how wildlife with diverse habitat needs respond to long-term anthropogenic change. Furthermore, wildlife community dynamics have uncertain outcomes for the nature of human-wildlife interactions, as sensitivities to interacting environmental changes can vary among species of conservation need and among wildlife groups that people perceive as contributing ecosystem services (e.g., recreational opportunities, pollination, seed dispersal) and disservices (i.e., human- wildlife conflicts). With these gaps in mind, here we ask: how have combinations of long-term environmental changes impacted ecologically and culturally significant wildlife and their contributions of ecosystem dis/services? We analyzed long-term drivers of bird communities by combining newly produced long-term seasonal datasets of environmental conditions (urbanization, vegetation, climate) with avian point-survey data collected across the rapidly developing metropolitan region of Phoenix, AZ during the same periods (spring; 2001-2016), as part of the Central-Arizona Phoenix Long- Term Ecological Research program. Results show that, on average, bird species presence was negatively associated with impervious surface area, with seasonally variable temperature and vegetation influencing site use across the gradient of urbanization. However, these relationships varied widely among functional guilds and many species of designated conservation concern at state and federal levels. By improving understanding of how long-term trends in environmental conditions interact to shape wildlife community dynamics, our findings – and the methodology used to produce them – can facilitate prediction of how conservation needs may evolve as landscapes and the communities inhabiting them adapt to change.

Beth Hasl, University of Arizona, Genetics Interdisciplinary Program, 1548 E. Drachman Street, Tucson, AZ 85719; bhasl@arizona.edu
Javan Bauder, University of Arizona, Arizona Cooperative Fish and Wildlife Research Unit, 1064 E. Lowell Street, Tucson, AZ 85721; jbauder@arizona.edu
Jessica Rick, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell Street, Tucson, AZ 85721: jrick@arizona.edu

Genetic structure and connectivity of the lowland leopard frogs, *Lithobates yavapaiensis*, in Southeastern, Arizona

The lowland leopard frog, *Lithobates yavapaiensis*, is a species of conservation concern particularly in arid regions where populations are increasingly fragmented due to habitat loss and water scarcity. Understanding the genetic structure and connectivity of these populations is crucial for understanding the dynamics within and between populations. This study aims to examine the genetic diversity, population structure, and gene flow among lowland leopard frog populations. Individuals were sampled from 35 sites in Southeastern Arizona encompassing a multitude of habitat types within 5 distinct regions: Catalina Mountains, Rincon Mountains, Las Cienegas, San Pedro River, and Galiuros Mountains. Genomic sequencing by ddRAD is being used to assess genetic variation, population differentiation, and connectivity across these diverse environments. Ultimately, this research will inform conservation strategies aimed at preserving genetic connectivity and enhancing the long-term viability of lowland leopard frog populations, and guiding potential translocation and reintroduction efforts.

**Student

Shane Ashton Henderson, Arizona State University, College of Integrative Sciences and Arts, 650 East Tyler Mall #674, Tempe, Arizona, 85281; Shane.Henderson@asu.edu
Heather L. Bateman, Arizona State University Polytechnic Campus, College of Integrative Sciences and Arts, 6073 South Backus Mall Wanner Hall 301B, Mesa, Arizona, 85212; Heather.L.Bateman@asu.edu

Key elements shaping winter waterbird communities along the salt river

Waterbird communities contribute significant social and ecological values to landscapes, offering recreational opportunities, cultural engagement, and essential ecosystem functions such as herbivory and trophic support. Historically, waterbird research has primarily focused on the breeding season, making overwinter studies crucial for a more comprehensive understanding of these communities. Previous studies along the Salt River in Phoenix, Arizona, have explored the relationships between waterbird diversity and habitat characteristics, aiming to inform wildlife habitat designs that incorporate public amenities. However, these studies have not explored the influence of climatic variables on these relationships. Our research aims to address these gaps by assessing how habitat and climate variables collectively shape winter waterbird community composition and diversity. Additionally, we will identify which waterbird species and guilds are most associated with these factors and map critical habitats along the Salt River. Between January 2017 and January 2023, we conducted 6 point-count surveys at 7 sites along the Salt River. This prospectus research will offer insights into habitat management and conservation strategies, highlighting effective approaches to support diverse waterbird populations. Our goal is to bring attention to local wildlife communities that may be in decline while emphasizing their social and ecological significance within a landscape. We hope that our findings will be as insightful as they are encouraging, fostering a deeper appreciation for the value of these communities.
**Student

Hayden K. Hutcherson, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; hhutcherson@azgfd.gov
Reilly T. Jackson, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; rjackson@azgfd.gov
Brianna M. Russo, Wildlife Contracts Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; brusso@azgfd.gov
Andrew S. Jones, Field Operations Division, Arizona Game and Fish Department, 3500 S. Lake Mary Road, Flagstaff, Arizona, USA 86001; ajones@azgfd.gov
Esther S. Rubin, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; erubin@azgfd.gov

Evaluating the effect of large herbivores and human activity on riparian health

The health of riparian areas is critical for dryland ecosystem function as these areas often support higher diversity and density of terrestrial wildlife than other surrounding systems. Despite their importance, riparian ecosystems experience significant modifications with severe ecological impacts. Riparian areas in the White Mountains of east-central Arizona have undergone repeated influxes of non-native and reintroduced herbivores, causing concern for their health. Thus, our study sought to evaluate the impacts of large ungulate, including elk (*Cervus canadensis*), domestic cow (*Bos taurus*), and domestic horse (*Equus caballus*), and human use on riparian system health in these mountains, using native wildlife presence as an indicator of overall riparian health. We deployed remote camera traps, acoustic recording units (ARUs), track plates, and coverboards, and quantified the relative abundance of 32 selected species and the species richness of riparian mammal, bird, and herpetofauna communities at 40 study plots. We collected 1,684,685 photos, 3,898 recording hours, and conducted 10,198 track plate trap nights. We detected 26 vertebrate species on cameras, 118 bird species using ARUs, four herpetofauna species using ARUs and coverboards, and detected small mammals at 82.7% (n=35) of plots. We observed cattle and horses at 50% (n=20) of plots, elk at 100% (n=40) of plots, and humans at 83% (n=33) of plots. Native wildlife species responded variably to the presence of non-native species; however, specific

results are pending and will be presented. These results provide critical information on riparian systems and will inform the policy and land management of these ecosystems.

Cassidy A. Klovanish, Arizona Game and Fish Department, 5000 West Carefree Highway; Phoenix, Arizona 85086; cklovanish@azgfd.gov
Hayden K. Hutcherson, Arizona Game and Fish Department, 5000 West Carefree Highway; Phoenix, Arizona 85086; hhutcherson@azgfd.gov
Samuel D. Lisak, Arizona Game and Fish Department, 5000 West Carefree Highway; Phoenix, Arizona 85086; slisak@azgfd.gov
Esther S. Rubin, Arizona Game and Fish Department, 5000 West Carefree Highway; Phoenix, Arizona 85086; erubin@azgfd.gov
Reilly T. Jackson, Arizona Game and Fish Department, 5000 West Carefree Highway; Phoenix, Arizona 85086; rjackson@azgfd.gov

Ecological impacts of off-highway vehicle use on Arizona wildlife: a review of current literature and management recommendations

Off-highway vehicle (OHV) recreation has increased throughout Arizona and the southwestern US, with recent technological advancements enabling OHVs to maneuver through previously inaccessible areas. Due to these developments, there is growing concern among wildlife and land managers to understand the potential impacts of OHVs on wildlife, though existing information resources are lacking. We conducted a systematic literature review to identify previously published information on the effects of OHVs on wildlife species found in Arizona. Our search terms initially returned 3,067 publications. After screening with predetermined inclusion criteria, we included 48 publications in our review. From these publications, we extracted location, wildlife, OHV, study design, and impact data, as well as the qualitative/quantitative effect of OHVs. Our review included 89 species that occur in Arizona; however, these studies were conducted in 12 U.S. states and three Canadian provinces. Mammals (n=23 studies) were the most studied taxonomic group, followed by reptiles (n=18 studies), birds (n=11 studies), and amphibians (n=1 study). Indirect effects were most commonly studied (n=45 studies), followed by direct effects (n=5 studies), which exclusively pertained to reptiles. Further results are pending as we plan to summarize the qualitative direction of impacts, published best management practices, impacts per taxa group, and the gaps in knowledge for future research. Our review serves as a resource for wildlife and land managers as they make informed decisions to balance recreation and environmental health.

Grace A. Laskey, Amphibian and Reptile Conservancy (ARC), 6844 Bardstown Rd STE 677, Louisville, KY 40291; glaskey@arcprotects.org
Mayteana Morales, Amphibian and Reptile Conservancy (ARC), 6844 Bardstown Rd STE 677, Louisville, KY 40291; mmorales@arcprotects.org
Jacob Bartley, Amphibian and Reptile Conservancy (ARC), 6844 Bardstown Rd STE 677, Louisville, KY 40291; jbartley@arcprotects.org
Rebecca A. Cozad, Amphibian and Reptile Conservancy (ARC), 6844 Bardstown Rd STE 677, Louisville, KY 40291; bcozad@arcprotects.org

What's for lunch? Diet of the invasive American bullfrog (*Lithobates catesbeianus*) in southwestern New Mexico

Invasive species pose a significant threat to biodiversity and ecosystem stability worldwide. Therefore, measures to mitigate their impact are crucial. American Bullfrogs (*Lithobates catesbeianus*) are among one of the most prolific invasive species. Originally from the Eastern United States, American Bullfrogs have expanded westward where they are predating on, outcompeting, and spreading disease to native amphibian populations. In the Southwest, bullfrogs have been confirmed to eat many native species including Rio Grande Leopard Frogs (*Rana berlandieri*), Mexican Garter Snakes (*Thamnophis eques*), and Sonoran Gopher Snakes (*Pituophis catenifer affinis*). In order to better understand what these invasive frogs are utilizing as food sources, diet studies are crucial. Sample collection for American Bullfrogs started in the beginning of 2024 in southwestern New Mexico (focused primarily within and around the Gila National Forest). To date, samples have been collected and analyzed from 68 adults

across 5 different sites in New Mexico. This poster will be used to present our preliminary findings thus far, though we plan to further increase the sample size in this study as well as to expand to additional sites to gain a better understanding of how bullfrogs are impacting our native species in the Southwest.

Ian M. Latella, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086; ilatella@azgfd.gov
Audrey Owens, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086
Ryn Davison, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086

Tarahumara frog conservation in Arizona

The Tarahumara frog (*Rana tarahumarae*) was historically widespread throughout Mexico and was known from only 7 drainages in extreme south-central Arizona near the U.S.-Mexico border. Declines of U.S. populations of this species were observed starting in 1974, with the last individual found dead in Big Casablanca Canyon in 1983. Conservation efforts for this species began in 1992 with the development of the multi-agency Tarahumara Frog Conservation Team (TFCT), with the ultimate goal of reintroducing this species into sites across its' historical range in Arizona. This presentation will summarize the past conservation efforts of the TFCT, current status, and our plans for future conservation action in Arizona.

Jaiden Lee, Bosque School Wildlife Student, 4000 Bosque School Rd NW, Albuquerque, NM 87120; jaiden.lee@bosquestudents.org
Pranav Joshi, Science Student, La Cueva High School 7801 Wilshire NE, Albuquerque NM 87122; vnarpjo@gmail.com

Understanding North American deer mouse diet across a riparian to upland gradient

Through stable isotope analysis we investigated North American deer mouse (*Peromyscus maniculatus*) diet variation along and adjacent to the Rio Grande in Bernalillo County (NM). To do that we placed Sherman small mammal traps along a roughly 1 km gradient from the east bank of the Rio Grande's riverside forest, *bosque*, to adjacent upland habitat. We set traps in rows of at least 4 lines of 9 traps each. Each trapping line was aligned parallel with the river and distributed through four different habitat types: recently burned riverside riparian cottonwood (*Populus deltoides*) dominated; irrigation ditch adjacent coyote willow (*Salix exigua)* dominated; cottonwood dominated and landscaped playing fields ecotone; and upland fourwing saltbush (*Atriplex canescens*) dominated. Captured small animals were identified to species, hair samples were collected, and animals were then released. We took those hair samples to the University of New Mexico, Center for Stable Isotopes, prepared samples and analyzed isotopic signatures of individuals within each of the four habitats. Furthermore, we compared our isotopic values for *P. maniculatus* with that of other rodents found in those habitats.
** Student (high school)

Ellen F. Liebig, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86011; efl37@nau.edu
Daniel E. Sanchez, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86011; Daniel.Sanchez@nau.edu
Savannah J. Marriott, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86011; Savannah.Marriott@nau.edu
Anna L. Riley, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86011; ar3955@nau.edu
Faith M. Walker, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86011; Faith.Walker@nau.edu
Clare E. Aslan, Northern Arizona University, School of Earth and Sustainability, Room A108 Building 11 Ashurst, 624 S Knoles Dr, Flagstaff, AZ 86011; Clare.Aslan@nau.edu

Evaluating the merits of environmental DNA to assess pollinator biodiversity

Environmental DNA (eDNA) is an emerging technology that allows researchers to detect species through DNA fragments that are shed into the environment including in water, air, and soil. In recent years, researchers have confirmed that pollinator eDNA can be isolated from the surface of flowering plants. Because traditional monitoring methods for pollinators are time intensive and invasive, eDNA could be a faster, less-invasive approach to gain insight on declining pollinator populations. Powerline rights-of-way (ROWs) are key habitats for pollinators as they are linear strips of sun-exposed grassland supporting abundant and diverse flowering plants. In this study, we evaluate eDNA as a monitoring tool for assessing pollinator biodiversity in ROWs in north-central Arizona. We analyzed 107 swabs from insects and 173 whole flower samples collected over four days using eDNA metabarcoding. eDNA was successfully recovered from all the six plant taxa and six insect taxa targeted during collections. Laboratory analyses identified 103 plant genera and 55 insect genera in total, including four families of native bees. Estimates of diversity from eDNA were higher for plants than via traditional sampling, although the opposite was true for insects. Although eDNA demonstrated certain limitations such as cost and snapshots of DNA presence from a limited time period, our results indicate that this technology can rapidly and non-invasively collect pollinator diversity and taxon occurrence information. In the future, eDNA could be used as a complementary method to traditional field surveys to better understand both plant-pollinator interactions and assess biodiversity in an area.
**Student

Samuel D. Lisak, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; slisak@azgfd.gov
Cassidy A. Klovanish, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; cklovanish@azgfd.gov
Esther S. Rubin, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; erubin@azgfd.gov
Reilly T. Jackson, Research Branch, Arizona Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, Arizona, USA 85086; rjackson@azgfd.gov

Assessing the effectiveness of movement-based methods to detect pronghorn parturition
Identifying wildlife parturition timing and location provides critical information on population dynamics and key habitats to land managers. Movement-based methods detect parturition by analyzing location data patterns, and are increasingly used over other resource-intensive methods. However, these methods have not been tested on American pronghorn (*Antilocapra americana*), a highly mobile species with unique movement patterns. Using previously established methods, we explored the potential of five movement-based parturition models to detect pronghorn parturition using 2024 GPS location data from 28 collared adult female pronghorn in north-central Arizona. We conducted behavioral observations of collared females with fawns (n=4) to estimate parturition date and then used GPS location data to analyze female movement parameters (i.e., home range size, velocity, and turn angle) and determine model thresholds. We compared each method's parturition date predictions with individual field-validated parturition timing, as well as predicted and literature-based population level metrics, including parturition rate, peak fawning dates, and parturition synchrony. The analysis of parturition indicators (API) and rolling minimum convex polygon (rMCP) methods were the top performing methods, both correctly identifying the estimated parturition dates of all four females observed with fawns. Our work shows that methods incorporating space-use components (e.g., the API and rMCP methods) work best for pronghorn, as mothers reduce their home range size to remain close to their concealed fawns. We provide preliminary evidence supporting the ability of movement-based methods to reliably identify pronghorn parturition events. However, these methods would benefit from additional validation using precisely known parturition dates.

Caleb L. Loughran, Western New Mexico University, Department of Natural Sciences, Silver City, NM 88061; cloughran@wnmu.edu
David Rogowski, Arizona Game and Fish Department, Flagstaff, AZ 86004; drogowski@azgfd.gov

Herpetological pilot surveys of the Grand Canyon: Species distributions, body conditions, and implications for hydrological impacts on assemblage composition

The Grand Canyon supports a diverse herpetofaunal assemblage shaped by its complex habitat and hydrology. However, thorough studies on factors that drive assemblage dynamics (i.e., microhabitat, hydrology) are lacking. In May 2024, we conducted a herpetological survey along the Colorado River corridor from Lee's Ferry to Pearce Ferry to assess species diversity and assemblage composition across distinct stretches of the canyon. Using visual encounter surveys, we documented amphibians and reptiles across riparian and upland habitats. Blood samples were collected from select species for future stable isotope analysis to investigate dietary relationships to daily and seasonal river flow pulses. Preliminary findings indicate distinct herpetofaunal assemblages associated with microhabitat variability. Amphibians, such as Woodhouse's toad (*Anaxyrus woodhousii*), were largely confined to riparian zones close to the river's edge, while reptiles, including side-blotched lizards (*Uta stansburiana*), desert spiny lizards (*Sceloporus magister*), utilized a broader range of habitats. These patterns suggest that species distributions are shaped by localized environmental conditions along the canyon's gradient. Stable isotope samples will be analyzed to assess dietary connections to the Colorado River and the influence of river flow pulses on trophic dynamics. This approach offers a novel means of linking species ecology to riverine processes. This pilot study is an attempt to integrate species distribution data with ecological processes to better understand biodiversity in desert riparian systems. Our findings will inform future research and conservation efforts, particularly in addressing the impacts of river flow management and habitat alteration on the Grand Canyon's herpetofaunal communities.

Sean M. Mahoney
School of Natural Resources & the Environment, The University of Arizona, Tucson, Arizona 85721; seanmahoney@arizona.edu
Bret Pasch
School of Natural Resources & the Environment, The University of Arizona, Tucson, Arizona 85721; bretpasch@arizona.edu

Accipiter visual discrimination influences squirrel pelage coloration via background matching crypsis

Coloration helps animals avoid predation by matching the background environment color (i.e., crypsis). Recent advances in color science allow researchers to assess fundamental questions about animal coloration, such as the role of crypsis through background matching by using reflectance spectrometry and visual discrimination models. Accipiter hawks are important predators of squirrels, and pelage may have evolved to avoid detection by visual predators like hawks. For example, fox squirrel (*Sciurus niger*) pelage provides crypsis against tree bark and ground substrates, supporting the background matching hypothesis. An unexplored aspect about avian discrimination and pelage color is the role of camouflage while prey cache food. Squirrels may be especially vulnerable to hawk predation as they bury or exhume food from caches, and predation pressure may select pelages that match the background of cache locations. Squirrels that larder food in central locations (termed middens) spend significant time on middens and thus may evolve pelage color to match their midden background. In contrast, scatterhoarding squirrels likely benefit from color matching the ground substrates. We used spectrometry and visual discrimination models to evaluate if Accipiter hawks can discriminate Western gray (*S. griseus*), Abert's (*S. aberti*), Douglas' (*Tamiasciurus douglasii*), red (*T. fremontii*), and Mearns' squirrels (*T. d. mearnsi*) against middens and the forest floor. We found larderhoarding squirrels color-match their middens but are conspicuous against the forest floor. In contrast, scatterhoarding squirrels are distinguishable against middens but color-match the forest floor. Our results indicate hawk predation can drive interspecific phenotypic variation based on background color matching.

Noelle M. Mason, University of New Mexico, Department of Biology, Albuquerque, NM 87106; masonnm@unm.edu
Lisa N. Barrow, University of New Mexico, Museum of Southwestern Biology and Department of Biology, Albuquerque, NM 87106; lnbarrow@unm.edu

Hybridization dynamics and range expansion across environmental variables in spadefoot toads

Environmental and climatic change has been a constant throughout biological history, but the rate and extent of these changes has accelerated because of anthropogenic influences. As plant and animal ranges inevitably shift in response to these changes, questions emerge about hybridization dynamics between closely-related species that may be differentially adapted to their environments. Plains spadefoot toad females (*Spea bombifrons*) have been known to choose desert-adapted New Mexico spadefoot toad (*S. multiplicata*) males as mates under hot and dry conditions. Past studies using mtDNA and nuclear microsatellites have suggested that heterospecific *S. multiplicata* loci persist in the *S. bombifrons* genome after several generations. Additionally, the stepping-stone model has been posited for *S. bombifrons*' range expansion into the desert after the Last Glacial Maximum. In tandem, these hypotheses suggest that there is an adaptive advantage to hybridization between the two species that may facilitate range shifts of *S. bombifrons*. I aim to use nuclear genetic data from ddRAD sequencing to determine the direction of introgression in these species as well as identify environmental factors that may drive hybridization, and thus range expansion, in *S. bombifrons*. The results from this research will illuminate the role of hybridization in response to changing environmental conditions and species distributions as these factors continue to change because of human impacts.
**Student

Eleanor McArthur; Bosque School Wildlife Student. 4000 Bosque School Rd NW, Albuquerque, NM 87120; eleanor.mcarthur@bosquestudents.org

Comparing bird species composition in historically burned and unburned sites in the Rio Grande bosque ecosystem

In 2003, there was a devastating fire on the west side of the Rio Grande south of Montaño bridge. In the winter of 2017 (14 years later), Bosque School began bird banding under the permit of master bander and in partnership with the Bosque Ecosystem Monitoring Program (BEMP). The goal of this project is to explore the bird species composition differences between a site that experienced both fire and mechanical vegetation removal (Montaño) and a second site located 200 meters south that only underwent mechanical vegetation removal (Savannah). BEMP provided decades worth of ecological data including vegetation species composition for both sites. The bird banding procedures were conducted on a near-monthly basis, with four mist-nets per site in collaboration with BEMP until 2019. After this, Bosque School continued the ongoing bird research project with the same procedures. The bosque ecosystem is a senescing forest that continues to experience catastrophic fires. It is critical to understand the impacts these fires are having on bird populations and how restoration efforts affect bird species composition.
**Student (high school)

Emi McGuire, Grand Canyon University, College of Natural Sciences, 3300 W Camelback Rd, Phoenix, Arizona 85017; emi.mcguire1@gmail.com
Grace Salima, Grand Canyon University, College of Natural Sciences, 3300 W Camelback Rd, Phoenix, Arizona 85017; grace.e.salima@gmail.com
Marian Madueno-Nunez, Grand Canyon University, College of Natural Sciences, 3300 W Camelback Rd, Phoenix, Arizona 85017; mmaduenonu@my.gcu.edu
Autumn Bileen, Grand Canyon University, College of Natural Sciences, 3300 W Camelback Rd, Phoenix, Arizona 85017; abileen@my.gcu.edu

Gray fox rabies spillover transmission and future host shift preventative measures in Arizona

There is a concerning uprising in infectious diseases, most of which are zoonotic. Rabies is the most well-known of these zoonotic diseases as its implications extend beyond human health, incorporating ecological and wildlife management components. Additionally, reducing rabies spillover is vital to prevent future host shift events, which could cause increases in rabies incidence and contribute to monitoring challenges. Our objectives were to investigate rabies spillover from gray foxes (*Urocyon cinereoargenteus*) in Arizona and offer testing recommendations and a monitoring plan to assist the United States Department of Agriculture (USDA) in mitigating rabies transmission. Arizona rabies data was collected from 2010-2024 by the USDA and analyzed to identify research gaps and inform future public health initiatives. We found the counties with the highest incidence of gray fox rabies were Cochise, Coconino, and Yavapai, with peak cases reported between 2017 and 2019, indicating a rabies outbreak in 2018. This was congruent with gray fox rabies cases throughout Arizona, which experienced a 61.8% increase from 2017-2018. The data also revealed that bobcats were the most common spillover hosts for gray fox rabies, providing evidence for the potential of a future host shift. Trends indicate that cases have risen roughly 39.3% over the past three years, indicating probability of another rabies outbreak in the coming years. Future efforts to mitigate rabies spillover should focus on understanding the ecological interactions between gray foxes and spillover hosts while prioritizing targeted surveillance and prevention strategies in high-incidence areas like Cochise, Coconino, and Yavapai counties.
**Student

DeeAnne T. Meliopoulos, U.S. Fish and Wildlife Service, 435 NM Hwy 281, Las Vegas, NM 87701; deeanne_meliopoulos@fws.gov

Of mice and Mora: The New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) on Rio Mora National Wildlife Refuge

The New Mexico meadow jumping mouse (*Zapus hudsonius luteus;* hereafter NMMJM) is a small rodent that has significantly declined throughout its historic range, resulting in its listing as a federally

endangered species in 2014. Declines are primarily attributed to loss of the riparian habitat the NMMJM requires, characterized by flowing water, dense herbaceous vegetation, and moist soils. The majority of research on NMMJM has occurred in relatively pristine, undisturbed river systems, and indicates selection for areas with herbaceous vegetation $\geq$ 61 cm tall and avoidance of dense woody vegetation. In 2022, potential river restoration sites on channelized portions of the Mora River at Rio Mora National Wildlife Refuge (RMNWR) were surveyed for NMMJM using track plates, to ensure compliance with the Endangered Species Act prior to restoration. NMMJM were detected in riparian areas with short herbaceous vegetation and dense willow (*Salix* spp) thickets, and surveys were expanded in 2023. Across both years, 453 track plates were deployed for an average of 9.18 nights each. Average number of detections per trap-night was 0.11, with 39.73% of track plates yielding detection(s). Only one NMMJM was detected in the river restoration area in 2023, the year following restoration. Sampling will resume in 2025 to assess whether low detections in restoration areas may be due to a time lag effect, habitat characteristics, or interactions between these factors. The RMNWR population of NMMJM presents a unique opportunity to study a novel habitat for this species, and its real-time response to completed and ongoing restoration activity.

Margaret Mercer, University of Arizona, 1064 E. Lowell St., Tucson, AZ 85721, mmercer3@arizona.edu
Cheryl Mollohan, Bobcats in Tucson Project, 48351 SR 255, Sardis, OH 43946, cherylmmollohan@gmail.com
Kerry Baldwin, Bobcats in Tucson Project, deceased
Al LeCount, Bobcats in Tucson Project, 400 North Jefferson Street #75, Wickenburg AZ 85390, albertlecount@gmail.com
Jesse Alston, University of Arizona, 1064 E. Lowell St., Tucson, AZ 85721, jmalston@arizona.edu

Why did the bobcat cross the road? Urban bobcat behavior and roadkill mitigation strategies

Bobcats (*Lynx rufus*) have had success persisting in urban areas, but vehicle collisions are a large source of mortality. Identifying how bobcats alter behavior near roads can help wildlife managers develop management strategies to reduce mortality from vehicles. To determine how roads affect bobcat movement, we analyzed GPS data from bobcats collared by the Bobcats in Tucson Research Project using continuous-time movement analyses. Our study focused on three questions regarding bobcat movement near roads: 1. Do bobcats avoid crossing roads? 2. Do bobcats use culverts and underpasses to cross roads? 3. Does bobcat behavior change when road density increases? We found that bobcats crossed roads 11% less frequently than expected from random chance, but we found no evidence that bobcats use culverts or underpasses to cross roads or that bobcat movement behavior (i.e., speed or home range size) varies with road density. Our results suggest that managers interested in reducing bobcat mortality from vehicle collisions need to do more than simply providing crossing structures. Fences to funnel bobcats toward crossing structures, rumble strips to scare bobcats from roads, reduced speed limits, and wildlife warning signs for drivers may be effective tools to reduce bobcat mortality from vehicle collisions.

Robyn Montelongo, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, Las Cruces, New Mexico, 88003, USA; rmonte13@nmsu.edu
Adia Baker, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, Las Cruces, New Mexico, 88003, USA; arbaker@nmsu.edu
Abigail Tobin, Washington Department of Fish and Wildlife, Olympia, Washington, 98501, USA; Abigail.Tobin@dfw.wa.gov
Katherine Haman, Washington Department of Fish and Wildlife, Olympia, Washington, 98501, USA; Katherine.Haman@dfw.wa.gov
Obed Hernandez-Gomez, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, Las Cruces, New Mexico, 88003, USA; ohg@nmsu.edu

Assessing the effects of White Nose Syndrome probiotic treatment on the gut microbiota of *Myotis* bats

With fungal diseases on the rise, wildlife scientists are looking for ways to manage diseases in the wild and evaluate the effects of treatment. For example, probiotic treatments using anti-fungal bacteria applications have been proposed as a way to prevent disease in herps and mammals. The Washington Department of Fish and Wildlife is currently evaluating the use of a four *Psuedomonas sp.* topical probiotic treatment to combat white nose syndrome in bats. Given the fact that gut microbiotas are important to host health, we evaluated how cutaneous administration of probiotic treatments influenced the gut microbiome in wildlife. We applied 16s rRNA amplicon sequencing to characterize the gut microbiota of control and probiotic-treated *Myotis lucifugus* and *M. yumanensis* bat colonies in the state of Washington. We observed a reduction in community richness and diversity of the gut microbiota of treated bats. In addition, the composition of the gut microbiota shifted in the treated bats compared to the control group. We observed increased relative abundances of several Enterobacteraceae and Aerococcaceae in treated bats. As we found an effect of a topical treatment on the gut microbiota, we recommend that future studies evaluate the effects of topical probiotic treatment using a higher sample size and controlled laboratory experiments to derive the mechanisms behind the patterns we observed.
**Student

Leighanna Olaker, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 8572l; leighannaolaker@arizona.edu
Henrik Combrink, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; henricombrink@arizona.edu
Vicki L. Greer, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; vgreer@arizona.edu
Sean M. Mahoney, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; seanmahoney@arizona.edu
Nikki Reck; School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 8572l; nlreck@arizona.edu
Jacob Simon, The University of Arizona Insect Collection, Department of Entomology, The University of Arizona, AZ 8572l
Ellen R. Tierney, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 8572l; ellentierney@catworks.arizona.edu
August Walser, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 8572l; walsair@arizona.edu
Bret Pasch, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; bretpasch@arizona.edu

Beetles on squirrel islands on a sky island

Endangered Mt. Graham red squirrels (*Tamiasciurus fremonti grahamensis*) develop middens from accumulated conifer cone debris that serve as refrigerators for subsequent food stores. Middens that are continuously occupied by squirrels over generations are deeper and cooler. As climate islands in a warming world, understanding connections between squirrel middens and biodiversity, including ground-dwelling arthropods, can inform conservation and management. In this study, we placed four pitfall traps around middens (n = 45) of various squirrel occupancy histories (since 2017) and collected samples every 14 days throughout summer 2024. Island biogeography theory predicts higher taxonomic richness on older middens due to longer times for species to accumulate via arrival of new immigrants. We present preliminary results of our findings, including identification of *Rhadine* sp., a genus that typically dwells in caves, and *Scaphinotus* sp., a snail-eating kind. Ongoing work includes integrating beetle functional traits, accounting for various habitat features, incorporating distance (dispersal) among middens, quantifying diversity and abundance pre-and post- monsoon, and identifying other arthropods.
**Student

Natalie Payne, School of Natural Resources and the Environment, University of Arizona, Tucson, AZ 85721, USA; nataliermercer@arizona.edu
Desiree Andersen, School of Natural Resources and the Environment, University of Arizona, Tucson, AZ 85721, USA; desireeandersen@arizona.edu
Cheryl Mollohan, Bobcats in Tucson Research Project ©; cherylmmollohan@gmail.com
Koenraad Van Doorslaer, Department of Immunobiology, University of Arizona, Tucson, AZ 85724, USA; vandoorslaer@arizona.edu
Leigh Combrink, School of Natural Resources and the Environment, University of Arizona, Tucson, AZ 85721, USA; leighcombrink@arizona.edu
Melanie Culver, U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, School of Natural Resources and the Environment, University of Arizona, Tucson, AZ 85721, USA; mculver@arizona.edu

Urbanization and host relatedness shape virome composition in a widespread, generalist carnivore

Urban wildlife species have the potential to serve as links in disease transmission between wildlife, humans, and domestic animals at the wildland-urban interface (WUI), contributing to both sustained cross-species transmission of pathogens and the emergence of diseases in susceptible populations. However, the relative roles of host and environmental factors in shaping the composition of pathogen communities in urban wildlife is understudied. In this study, we integrated DNA and RNA virome data with host genomic and GPS datasets to investigate factors shaping virome composition in bobcats (*Lynx rufus*) at the wildland-urban interface (WUI) in the Tucson Mountains, Arizona, USA. Using a hybrid-capture approach for 31 scats and 17 buccal swabs, we identified multiple viruses that could affect carnivore health at the WUI, including canine parvovirus, feline astrovirus, Felis catus papillomaviruses 2 and 3, and Lyon-IARC polyomavirus. Models of virome composition and distribution of viral taxa indicated contributions of host genetic relatedness and factors relating to urbanization (such as percentages of urban land cover, road and building densities, and distances to roads). Genetic associations with virome compositions were particularly influenced by females. While females exhibit significant isolation by distance, partial Mantel tests revealed a significant correlation between beta diversity and host genetic distance in females only. To our knowledge, this study represents the first assessment of factors shaping virome composition in a wild felid. Our finding of known feline and canine pathogens in bobcats underscores the potential of the WUI to facilitate cross-species transmission between wild and domestic animals.

Raúl Peralta-Pardo, Colegio de Postgraduados Campus Montecillo, Km. 36.5 México 136, Texcoco, Estado de México, Mexico 56246; peralta.raul@colpos.mx
Luis A. Tarango-Arámbula, Colegio de Postgraduados Campus San Luis Potosí, Iturbide 73, Salinas de Hidalgo, San Luis Potosí, México 78620; ltarango@colpos.mx
Ricardo Bárcena-Gama, Colegio de Postgraduados Campus Montecillo, Km. 36.5 México 136, Texcoco, Estado de México, Mexico 56246; rbarcena@colpos.mx
David Hernández-Sánchez, Colegio de Postgraduados Campus Montecillo, Km. 36.5 México 136, Texcoco, Estado de México, Mexico 56246; sanchezd@colpos.mx
Genaro Olmos-Oropeza Colegio de Postgraduados Campus San Luis Potosí, Iturbide 73, Salinas de Hidalgo, San Luis Potosí, México 78620; olmosg@colpos.mx
Eloy A. Lozano-Cavazos, Universidad Autónoma Agraria Antonio Narro, Calzada Antonio Narro 1923, Saltillo, Coahuila, México 25315; alejandrolzn@yahoo.com

Reproductive and nutritional interaction of white-tailed deer in Zacatecas, Mexico

White-tailed deer is one of the most economically and culturally important animals in Mexico. Despite being a species with a wide distribution in the country, the change in land use, mainly due to agricultural activities, represents one of the main risks for its populations. Our objective was to evaluate the interrelationship between the reproductive cycle and the diet of the species during 2024 in an area with significant livestock activity in Zacatecas, Mexico. The reproductive cycle was described from photographic records with camera traps, while the diet was determined from the collection of feces and the use of the microhistological technique. Five hundred and twenty-six photographic records were

obtained, 421 for females and 105 for males. The reproductive period spans from January to March. In females, gestation was from March to September and conceptions occurred between September and October. Males had firm antlers until June and their growth was from July to October. To determine the diet, 118 groups of feces were collected, the analysis of which is currently in process. This study will allow us to understand the reproductive cycle of deer and the food they use during the different stages of this cycle. These results will serve as a basis for further studies on diet quality, nutritional balance and nutritional carrying capacity with emphasis on reproductive stages.
**Student

Lucy Pockman; Bosque School Wildlife Student. 4000 Bosque School Rd NW, Albuquerque, NM 87120; lucy.pockman@bosquestudents.org

Effectiveness of high school students ground truthing Gunnison prairie dog burrows

Prairie dog burrows are the best indicator of prairie dog populations, and reliable population numbers of prairie dogs is critical for the management of their species. Previous methods such as maximum above ground counts, minimum number known alive, and capture-mark-recapture are all labor intensive and time consuming. In efforts to solve this, researchers at the Wildlands Network built a machine learning program (artificial intelligence) to more efficiently identify Gunnison prairie dogs (*Cynomys gunnisoni*) using aerial imagery. The goal for this program is to be able to identify whether or not there are Gunnison prairie dog colonies large enough to support the reintroduction of endangered black-footed ferrets (*Mustela nigripes*). In the summer of 2024, we ground truthed burrows identified through AI across 12 days of fieldwork in the Valles Caldera National Preserve, Sandoval County (NM) to test and train the machine learning program. Of the 1,275 points identified as burrows by AI, 832 were confirmed by our team's ground surveys (65%) and of the remaining 35% where our ground surveys did not find a burrow, we often found boulders instead of burrows. This research determined that High School students can conduct reliable ground truthing in support of a machine learning program (artificial intelligence) to identify Gunnison prairie dog burrows.
**Student (high school)

Simone Vega Rabelo, Arizona State University, College of Integrative Sciences and Arts, 7271 E Sonoran Arroyo Mall, Mesa, Arizona, 85212-6415; svegarab@asu.edu
Heather L. Bateman, Arizona State University, College of Integrative Sciences and Arts, 7271 E Sonoran Arroyo Mall, Mesa, Arizona, 85212-6415; Heather.L.Bateman@asu.edu
Jeffrey D. Haight, Arizona State University, Global Institute of Sustainability and Innovation, 777 E University Drive, Tempe, Arizona, 85281; jdhaight@asu.edu

Trash removal by urban birds in Arizona

Wildlife behavior and interactions in urban ecosystems can vary across landscapes and species, with some birds dominating human-derived resources. This study investigates the relationship between urbanization, measured as impervious surface cover, and bird foraging behavior in the Phoenix metropolitan area. We focused on behaviors such as neophobia and neophilia (i.e., fear or attraction to novel items). Feeding trials were conducted at thirteen sites along a gradient of urbanization and bird interactions with anthropogenic food sources present. Trials were conducted using popcorn placed at random distances and orientation from a trash can. We recorded bird species visiting feeding stations and recorded time to first visit during 20-minute trials. We related timing, species richness, and species-specific body mass to impervious surface levels. Time to first visit was negatively correlated with amount of impervious surface with highly urban areas having birds feed on popcorn the soonest. Great-tailed grackles (*Quiscalus mexicanus*) comprised the most common visitor across all impervious surface levels. Results show that small urban-adapted generalists, like house sparrows (*Passer domesticus*), were more frequent visitors at highly urbanized sites demonstrating more neophilic tendencies compared to larger birds which appeared less frequently and exhibited longer visit times and more neophobic behavior. These findings highlight the role of urban-adapted birds in maintaining ecosystem services like trash removal and emphasize how species-specific foraging behaviors can differentiate resource use by birds in urban areas.

**Student

Nikki Reck, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 8572l; nlreck@arizona.edu
Sean M. Mahoney, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; seanmahoney@arizona.edu
Bret Pasch, School of Natural Resources & the Environment, The University of Arizona, Tucson, AZ 85721; bretpasch@arizona.edu

Assessing individual variation in the territorial rattles of Mount Graham red squirrels (*Tamiasciurus fremonti grahamensis*)

Many mammals produce acoustic signals to mediate a variety of social interactions. For example, North American red squirrels (*Tamiasciurus*) produce territorial rattle vocalizations to defend food larderhoards that are critical to survival during periods of food scarcity. In some populations, rattles encode individual identity to facilitate neighbor recognition, and familiarity with neighbors increases survival and reproductive success. Thus, assessing the nature of acoustic variation and vocal interactions is fundamental to understanding squirrel population biology. The Mount Graham red squirrel (*Tamiasciurus fremonti grahamensis*) is an endangered subspecies of southwestern red squirrel (*T. fremonti*) isolated to high-elevation mixed conifer and spruce-fir forests of the Pinaleño Mountains (Dził Nchaa Sí'an), Arizona. Because acoustic variation is largely determined genetically in rodents, reduced genetic diversity associated with population bottlenecks due to geographic isolation, habitat loss, insect outbreaks, and wildfires possibly limit their capacity to produce distinct rattles. In this study, we present preliminary results comparing within- vs. among-individual variation in rattle parameters from red squirrels on Mount Graham and the closest neighboring population in the White Mountains, Arizona. Preliminary results indicate that peak frequency varies among individuals in both Mount Graham ($F_{(2,12)} = 5.83$, $p = 0.017$) and the White Mountains populations ($F_{(2,12)} = 6.415$, $p = 0.0127$), while pulse rate showed some evidence of variation in the Mount Graham population ($F_{(2,12)} = 3.623$, $p = 0.0587$) but little to none in the White Mountains ($F_{(2,12)} = 0.766$, $p = 0.486$), and call duration shows minimal variation in both Mount Graham ($F_{(2,12))} = 1.202$, $p = 0.335$) and the White Mountains ($F_{(2.12))} = 1.622$, $p = 0.238$). Our findings indicate that Mount Graham red squirrel rattles may retain some vocal distinctiveness. Further acoustic analyses are ongoing to inform playback experiments to assess how rattle variation influences neighbor-stranger recognition.

**Student

Alexis C. Rickert, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St, ENR2 Tucson, AZ 85721; alexisrickert@arizona.edu
Javan Bauder, United States Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St, ENR2 N311, Tucson, AZ 85721; jbauder@arizona.edu
Larisa Harding, Arizona Game and Fish Department, 5000 W Carefree Hwy, Phoenix, AZ 85086; lharding@azgfd.gov
Jim Heffelfinger, Arizona Game and Fish Department, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St, ENR2 N319, Tucson, AZ 85721; jheffelfinger@azgfd.gov
Jesse M. Alston, University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St, ENR2 Tucson, AZ 85721; jmalston@arizona.edu

Gambel's quail trapping methods, survival, and nest success in southeast Arizona

Gambel's quail (*Callipepla gambelii*) is the most widespread, abundant, and heavily harvested species of game quail in Arizona. Gambel's quail population dynamics in Arizona are strongly influenced by seasonal weather conditions. This is particularly relevant for Gambel's quail management because drought conditions are expected to increase in Arizona, and this may exacerbate inter-annual variation in Gambel's quail abundance and recruitment. The goal of this study is to provide information on Gambel's quail population demographics and movement to inform management decisions for Gambel's quail in

southeast Arizona in a way that mitigates the effect of drought. We used multiple trapping methods to capture Gambel's quail from February–July 2024 and obtained more captures from noose mats (*n* = 29) than drop traps (*n* = 10) while walk-in traps did not capture any quail. We deployed 23 GPS backpack transmitters on female Gambel's quail to monitor quail movements and locate nests. We documented four mortalities of telemetered quail from apparent predation. Quail home range sizes ranged from 3 ha-100 ha (mean = 25 ha). We located three nests with 3-15 eggs and all nests were depredated. We collected vegetation measurements to examine nest and brood site selection. We will continue trapping and telemetering quail at our study site during 2025. The results from this study will help inform efforts to manage habitat conditions to increase Gambel's quail resiliency to drought conditions in Arizona.
**Student

Anna L. Riley, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86001; ar3955@nau.edu
Daniel E. Sanchez, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86001; daniel.sanchez@nau.edu
Ben Novak, Revive & Restore, 1505 Bridgeway, Suite 2203, Sausalito, California, 94965; ben@reviverestore.org
Marvin Stops, Crow Tribe, 43 Heritage Lane, Crow Agency, Montana, 59022; marvin.stops@crow-nsn.gov
Kristy Bly, World Wildlife Fund, 13 South Willson Avenue, Bozeman, Montana, 59715; kristy.bly@wwfus.org
Faith M. Walker, Northern Arizona University, School of Forestry, Pathogen and Microbiome Institute, 1395 Knoles Dr, Flagstaff, Arizona, 86001; faith.walker@nau.edu

Development of a qPCR assay for the detection of the endangered black-footed ferret
The black-footed ferret (*Mustela nigripes*) is the only ferret species native to North America and is considered one of the most endangered mammals in this continent. It was believed to be extinct by 1979 until 1981 when a population was discovered in Wyoming. Today, federal, state, tribal, and non-governmental organizations are focused on restoring this species in the wild. As of 2023, there were approximately 280 ferrets in captive breeding facilities and 370 ferrets in the wild. Surveillance of wild populations, however, can prove to be a challenge, as ferrets are nocturnal and inhabit prairie dog (*Cynomys spp.*) burrows that may be difficult to access by vehicle. The use of environmental DNA (eDNA) to monitor this species offers a potential solution to these challenges, as it enables species detection without the need for direct observation. We developed and optimized a novel qPCR assay for the detection of black-footed ferrets. We validated our assay for specificity by screening a panel of target DNA and non-target DNA from other mustelids. We used a six-level standard curve to determine the DNA input required for a 95% detection rate. Our next steps will be to validate our assay from swab and soil samples collected from burrows with known ferret habitation. The ultimate goal of this work is to detect black-footed ferrets from burrows with unknown ferret presence in Montana, and to provide a tool for monitoring the species across their distribution.
**Student

Sophia R. Rivera, University of New Mexico, Department of Biology, 219 Yale Blvd NE Room 204, Albuquerque, NM 87106; srivera14@unm.edu
Noelle M. Mason, University of New Mexico, Department of Biology, 219 Yale Blvd NE Room 204, Albuquerque, NM 87106; masonnm@unm.edu
Lisa N. Barrow, University of New Mexico, Department of Biology, Museum of Southwestern Biology, CERIA Building, 302 Yale Blvd NE Room 226, Albuquerque, NM 87106; lnbarrow@unm.edu

Landscape's impact on the genomic structure of the Great Plains Toad in New Mexico
The Great Plains toad (Anaxyrus cognatus) is distributed across diverse landscapes, including deserts, shrubland, chaparral, and grassland habitats. Their range extends from southern Canada to central Mexico; New Mexico represents a unique part of this the range due to the high variability of habitats. We aim to identify whether different landscapes play a role in facilitating or inhibiting genetic connectivity of

the Great Plains toad in New Mexico. We predict that urban development such as roads inhibit genetic connectivity, while agricultural land would increase genetic connectivity by facilitating movement of the species. Museum samples (n=29) were collected from 1999-2023 and obtained via loan. We used double digest restriction-site associated DNA sequencing (ddRAD-seq) to obtain 20029 loci and assessed population structure using PCA and DAPC analysis with the adegenet package in R. Bioclimatic variables (aspects of temperature and precipitation) were obtained from the Worldclim 2 database and used to model species distribution with the biomod2 package in R. Preliminary results suggest the New Mexico population contains two sub-populations, one eastern subgroup and one western subgroup, separated by the Rio Grande. Future work includes using an Estimated Effective Migration Surface (EEMS) to visualize and model population connectivity based on the genetic data. We will also obtain rasters for landscape features such as roads, land cover, elevation, and watersheds and compare models to elucidate drivers of genetic differentiation in this species. These results will be useful for assessing areas of high genetic connectivity and for developing conservation and management strategies for this species.
**student

Yamilex Rodriguez, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 S. Espina St., Knox Hall 132, Las Cruces, New Mexico 88003; yamirodz@nmsu.edu
Jonathan Jebosh Guzman Solis, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 S. Espina St., Knox Hall 132, Las Cruces, New Mexico 88003; moonhb22@nmsu.edu
Dominic Jimenez, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 S. Espina St., Knox Hall 132, Las Cruces, New Mexico 88003;
Aria Norwood, Dominican University of California, Department of Natural Sciences and Mathematics, 50 Acacia Ave, San Rafael, California, 94901; djimen62@nmsu.edu
Obed Hernández-Gómez, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 S. Espina St., Knox Hall 132, Las Cruces, New Mexico 88003; ohg@nmsu.edu

Population genetics of a plethodontid salamander distributed along an urban area
One of the factors affecting wildlife populations throughout the world is habitat loss due to human land use. The San Francisco Bay Area's natural habitats have been dramatically altered over the years as urbanization has progressed and continues to do so rapidly. We used modern genomics techniques to evaluate the population genetics of a small plethodontid salamander, the California slender salamander (*Batrachoseps attenuatus*), throughout the Bay Area. We collected tissues from contemporary populations, extracted DNA, and processed it for sequencing using a double digest RAD-seq sequencing library approach. We then evaluated for genetic structure among our populations, assessed levels of genetic diversity, and estimated the genetic relationships of our populations using phylogenetic analysis. We found genetic structure among our populations with the most support for the presence of three major subpopulations. Among these three subgroups, we found substantial genetic diversity and we found evidence for gene flow occurring longitudinally North to South potentially along green corridors. Our results suggest that while current populations maintain levels of genetic diversity, the presence of large preserves in the area that provide continuous habitat for these animals is crucial for their conservation.
**Students

Humberto Romero-Jiménez, Colegio de Postgraduados, Campus San Luis. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; humberto.romero.j@gmail.com
Luis A. Tarango-Arámbula, Colegio de Postgraduados, Campus San Luis. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; ltarango@colpos.mx
Jorge Cadena-Íñiguez, Colegio de Postgraduados, Campus San Luis. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; jocadena@colpos.mx
Genaro Olmos-Oropeza, Colegio de Postgraduados, Campus San Luis. Iturbide 73, Colonia Centro, Salinas de Hidalgo, San Luis Potosí, México 78620; olmosg@colpos.mx

Edible insects in north-central Mexico: A key stakeholders' perspective

Extensive livestock and dryland farming are the main productive activities in north-central Mexico. However, the collection and sale of escamolera ant larvae (*Liometopum apiculatum* M.), red worm (*Comadia redtenbacheri* H.), and white maguey worm (*Aegiale hesperiaris* W.) are carried out as an economically significant complementary activity. The price per kilogram of these larvae ranges between $16 and $53 USD, and an individual can annually collects up to 200, 30, and 20 kilograms of ant larvae, red worms, and white worms, respectively. Due to the economic importance of these insects, their harvesting is not conducted in an environmentally responsible manner. The objectives of this research were to identify the limitations associated with their exploitation and propose management and conservation strategies for these insects from the perspective of key stakeholders. To achieve this, a general diagnosis was carried out through 31 individual interviews and a regional forum attended by 35 collectors. The limitations and management and conservation initiatives were prioritized on a scale from 1 to 5 according to their importance. It was determined that the collection of edible insects faces 14 limitations, with the most frequently mentioned being improper nest management (17.7%), poaching extraction (14.8%), and absence of legal regulation (9.7%). Additionally, 21 initiatives were identified, the most important being reforestation (10.3%), control of buying/selling (9.1%), and communal organization (8.0%). It is concluded that ensuring the responsible use of these natural resources requires an appropriate legal regulatory framework, fostering collaboration among key stakeholders, and improving management practices through training programs.
**Student

Grace M. Salmon, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 South Espina, Knox Hall 132 Las Cruces, NM 88003; gsalmon@nmsu.edu
Julianna K. Diaz, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 South Espina, Knox Hall 132 Las Cruces, NM 88003; jkdiaz25@nmsu.edu,
Jodie M. Jawor, New Mexico State University, Department of Biology, 1305 Frenger St., Foster Hall 275 Las Cruces, NM 88001; jjawor@nmsu.edu
Timothy F. Wright (wright@nmsu.edu), New Mexico State University, Department of Biology, 1305 Frenger St., Foster Hall 275 Las Cruces, NM 88001

Innate Immune System Fluctuations of White-crowned Sparrows at Nonbreeding Grounds in New Mexico

Migration in birds is a strenuous activity that requires constant modulations and tradeoffs of physiological traits to maintain optimal fitness. Among these traits, the innate immune system likely plays a vital role in migratory success, as birds migrating from breeding areas may face novel pathogens during stopovers and at overwintering grounds. This work aims to observe the fluctuations of the innate immune system as long-distance migrants transition across life-history stages. To do this, we compared the strength of the innate immune system of overwintering White-crowned Sparrows (*Zonotrichia leucophrys)*, a long-distance migrant, during two periods: post-arrival from fall migration (November-December) and pre-spring migration (March-April). We captured birds and collected blood and morphometric data from White-crowned Sparrows during the two periods. Collected blood was used in bacterial killing assays (BKA) to measure the strength of their innate immune response. We noted a slight immune response decrease from the post-arrival period to the pre-spring migration period, changing from a mean BKA percentage of 50.41% (SE=3.52) to 43.4% (SE=5.83). This may suggest that sparrows have a lower immune response right before they leave for spring migration, potentially due to energetic trade-offs, or they may have a boosted immune response post-arrival.
**Student

Andres Saucedo-Rentería. Maestría Institucional en Ciencias Agropecuarias y Forestales. Av. Veterinaria #501, Durango, México. C.P. 34 120; andress.r96@outlook.com
Manuel A. Salazar-Borunda, Universidad Juárez del Estado de Durango. Constitución #404, Zona Centro, Durango, México. C.P. 34 000; borunda@ujed.mx
Luis A. Tarango-Arámbula, Colegio de Posgraduados, Campus San Luis. Iturbide #73, Col. San Agustín, San Luis Potosí, México. C.P. 78 622; ltarango@colpos.mx

Pablito M. López-Serrano, Universidad Juárez del Estado de Durango. Constitución #404, Zona Centro, Durango, México. C.P. 34 000; pmslopez@gmail.com
Martin E Pereda-Solís, Universidad Juárez del Estado de Durango. Constitución #404, Zona Centro, Durango, México. C.P. 34 000; mepereda@ujed.mx

Prevalence of blood biomarkers as indicators of environmental contamination in anatids from Durango, Mexico

Birds are often sensitive to changes in ecosystems, which is why they are sometimes used as biomarkers. This study evaluated the health status of migratory waterfowl through erythrocyte abnormalities. Samples were collected from two wetlands in Durango, Mexico, during the 2022-2023 hunting season. Peripheral blood samples were taken from 109 individuals of four waterfowl species: blue-winged teal (*Spatula discors*), green-winged teal (*Anas crecca*), northern shoveler (*S. clypeata*), and snow goose (*Anser caerulescens*). The number of micronuclei (EMN), polychromatic erythrocytes (EPC), and erythrocytes with nuclear protrusions (EPN) in peripheral blood were counted. The detected frequencies were: blue-winged teal (n = 33, EPC = 35.1, EMN = 0.06, EPN = 3.09); green-winged teal (n = 31, EPC = 25.3, EMN = 0.12, EPN = 2.20); northern shoveler (n = 15, EPC = 24.53, EMN = 0.08, EPN = 3.20); and snow goose (n = 30, EPC = 27.5, EMN = 0.0, EPN = 2.65). Although erythrocyte abnormalities were at baseline levels, the blue-winged teal showed higher values in nuclear alterations, potentially making it a bioindicator species for health status. This is the first study to determine the frequency of erythrocyte abnormalities in blue-winged teal and northern shoveler. The values calculated for *A. crecca* and *A. caerulescens* differed from those reported in other studies. This research used blood samples from only one hunting season. To determine the health status of migratory waterfowl arriving in Durango, Mexico, more accurately, it is recommended to monitor erythrocyte abnormalities annually and expand hematological studies.
**Student

Grace Soechting*, Department of Wildlife and Natural Resources, Tarleton State University, Stephenville, TX.
Autumn Patterson, Department of Wildlife and Natural Resources, Tarleton State University, Stephenville, TX.
Hemanta Kafley, Department of Wildlife and Natural Resources, Tarleton State University, Stephenville, TX.
David Johnston, Department of Wildlife and Natural Resources, Tarleton State University, Stephenville, TX.
Mamadou D. Kane, Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg.
Marcella J. Kelly, Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg.
Zachary J. Farris, Department of Public Health and Exercise Science, Appalachian State University, Boone, NC.
Heather A. Mathewson, Department of Wildlife and Natural Resources, Tarleton State University, Stephenville, TX.

Bushbuck and Common duiker's distributions in Niokolo Koba National Park, in Senegal

Large mammal populations are facing a global decline. Despite this, mammalian species, particularly ungulates, remain understudied. Ungulates can hold both ecological and socioeconomic importance, although this knowledge is uncommon throughout the general society. Bushbuck *(Tragelaphus sylvaticus)* and common duiker *(Sylvicapra grimmia)* are notable examples, with distributions ranging widely throughout Africa. However, written knowledge is limited on these species, especially in Senegal. Therefore, our first objective is to investigate bushbuck and common duiker distribution within two sites in Niokolo Koba National Park (NKNP), in Senegal, West Africa. Secondly, we will identify important landscape variables explaining those distributions. In 2013, we conducted a single-season camera survey at two study sites within the park: Linguekountou (04 February to 23 April) and Niokolo (30 April to 07 July). We deployed paired cameras and collected vegetation metrics at 30 locations per site. We deployed cameras for 2,014 trap nights in Linguekountou and 1,707 trap nights in Niokolo. These trap

nights resulted in 5,512 animal detections, which included 1,842 ungulates detections, consisting of 425 bushbuck detections (Linguekountou; *n* = 310, Niokolo; *n* = 115) and 145 common duiker detections (Linguekountou; *n* = 44, Niokolo; *n* = 101*)*. We used Maxent software and ArcGIS to model bushbuck and common duiker distribution in relation to habitat variables. This data provides us with a better understanding of the relationship between these ungulates within wooded savannah ecosystems. This information will provide us a better understanding of these species in the two sites in Senegal.

Diana L. Terrazas-Esparza, Universidad Autónoma de Ciudad Juárez, Departamento de Ciencias Veterinarias, 4650 Avenida Benjamín Franklin, Zona PRONAF, Ciudad Juárez, Chihuahua, México, 32315; al239985@alumnos.uacj.mx
Cuauhcihuatl Vital-García, Universidad Autónoma de Ciudad Juárez, Departamento de Ciencias Veterinarias, 4650 Avenida Benjamín Franklin, Zona PRONAF, Ciudad Juárez, Chihuahua, México, 32315; cuauhcihualt.vital@uacj.mx
Diana M. Beristain-Ruiz, Universidad Autónoma de Ciudad Juárez, Departamento de Ciencias Veterinarias, 4650 Avenida Benjamín Franklin, Zona PRONAF, Ciudad Juárez, Chihuahua, México, 32315; diana.beristain@uacj.mx
John F. Aristizabal, Departamento de Ciencias Químico-Biológicas, Instituto de Ciencias Biomédicas, Universidad Autónoma de Ciudad Juárez, Av. Plutarco Elías Calles 1210, Fovissste Chamizal, Ciudad Juárez, Chihuahua, México; john.aristizabal@uacj.mx

Urbanization effect on endoparasites of the burrowing owl at Ciudad Juárez, Chihuahua

Urbanization is a growing global trend across all human settlements affecting ecosystems and wildlife. This phenomenon influences not only wildlife populations but also the diversity and distribution of their parasites, which may have significant implications for species health and ecology. Our objectives are to assess the urbanization level of the burrowing owl (*Athene cunicularia*) nesting sites and characterize the endoparasite community at different levels of urbanization. Additionally, we would determine if urbanization level influence prevalence and diversity of the burrowing owl's endoparasites. To assess urbanization level, we used QGIS and made a 90-meter buffer of the nesting site, then we determined the percentage of impervious cover. To characterize the endoparasite community we took fecal samples from each nesting site and searched for endoparasites using the Faust technique. The evidence retrieved in this study suggests that burrowing owls prefer low urbanization levels for nesting sites, followed by high urbanization levels. The intermediate urbanization levels were the least used for nesting sites. These findings suggest that urbanization plays a dual role, influencing both habitat selection and parasite dynamics in burrowing owls. Understanding how urbanization affects wildlife-parasite interactions is critical for informing the management and conservation strategies for this species, particularly in urban and suburban environments. By addressing these dynamics, we can contribute to creating balanced ecosystems that support both wildlife and human communities.
**Student

Karla L. Vargas, The Biodesign Center for Fundamental and Applied Microbiomics, Center for Evolution and Medicine and School of Life Sciences, Arizona State University, Tempe, AZ 85287, USA; School of Natural Resources and the Environment, University of Arizona, Tucson, AZ 85721, USA; Baja GeoGenomics Consortium, Tempe, AZ 85287, USA; karlavargas@arizona.edu
Simona Kraberger, The Biodesign Center for Fundamental and Applied Microbiomics, Center for Evolution and Medicine and School of Life Sciences, Arizona State University, Tempe, AZ 85287, USA; simona.kraberger@asu.edu
Michael C. Lund, The Biodesign Center for Fundamental and Applied Microbiomics, Center for Evolution and Medicine and School of Life Sciences, Arizona State University, Tempe, AZ 85287, USA; mclund2@asu.edu
Joy M. Custer, The Biodesign Center for Fundamental and Applied Microbiomics, Center for Evolution and Medicine and School of Life Sciences, Arizona State University, Tempe, AZ 85287, USA; University of Texas at Austin, Austin, TX 78705, USA; Joy.Custer@asu.edu
Elise N. Paietta, Department of Biology, Duke University, Durham, NC 27708, USA; elise.paietta@duke.edu

Melanie Culver, U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, Tucson, AZ 85721, USA; School of Natural Resources and the Environment, University of Arizona, Tucson, AZ 85721, USA; Baja GeoGenomics Consortium Tempe, AZ 85287, USA; mculver@arizona.edu
Adrian Munguia-Vega, School of Natural Resources and the Environment, University of Arizona, Tucson, AZ 85721, USA; Baja GeoGenomics Consortium, Tempe, AZ 85287, USA; Applied Genomics Lab, La Paz, Baja California sur, 23000, Mexico; airdrian@arizona.edu
Greer A. Dolby, Baja GeoGenomics Consortium, Tempe, AZ 85287, USA; Department of Biology, University of Alabama at Birmingham, Birmingham, AL 35294, USA; gdolby@uab.edu
Arvind Varsani, The Biodesign Center for Fundamental and Applied Microbiomics, Center for Evolution and Medicine and School of Life Sciences, Arizona State University, Tempe, AZ 85287, USA; Structural Biology Research Unit, Department of Integrative Biomedical Sciences, University of Cape Town, 7925, Cape Town, South Africa; arvind.varsani@asu.edu

Bacteriophage diversity and biogeographic dynamics in wild rodents from the Baja California Peninsula

Despite being the most abundant biological entities on the planet, our understanding of bacteriophage diversity and composition in wild animals remains limited. Wild rodents harbor diverse microbial communities, making them an ideal system for characterizing novel bacteriophages. Here we present our work on the discovery and characterization of bacteriophages—specifically caudoviruses, inoviruses, and microviruses—in 90 fecal samples from seven wild rodent species in the families Heteromyidae and Cricetidae: little desert pocket mouse (*Chaetodipus arenarius*), Bailey's pocket mouse (*Chaetodipus baileyi*), spiny pocket mouse (*Chaetodipus spinatus*), Merriam's kangaroo rat (Dipodomys merriami), Dulzura kangaroo rat (Dipodomys simulans), Bryant's woodrat (*Neotoma bryanti*), and Northern Baja deer mouse (Peromyscus fraterculus) sampled across the Baja California peninsula, Mexico. From de novo assemblies, we identified 1350 complete bacteriophage genomes, which represent 1241 viral variants that share < 98% identity with each other, including caudovirus (n = 5), inovirus (n = 80), and microvirus (n = 1156) variants. In addition, we also examined the association between phage diversity and taxonomic grouping, geographic location, and seasonality to gain insights into the factors contributing to bacteriophage diversity of wild rodent populations. Our results indicate that alpha and beta diversity patterns in bacteriophage communities do not align with genetic discontinuities observed in vertebrate and plant species along the Baja California peninsula. Instead, rodent taxonomy, dietary behaviors, and localized environmental and geographical factors appear to significantly influence the diversity and composition of phage communities. This research addresses critical gaps in our understanding of the diversity and dynamics of bacteriophage communities associated with wild rodents in a natural environment.

Hal Ward, Arizona State University, College of Integrative Sciences and Arts, 7001 E Williams Field Rd, Mesa, AZ 85212, 1. hward10@asu.edu
Heather L. Bateman, Arizona State University, College of Integrative Sciences and Arts, 7001 E Williams Field Rd, Mesa, AZ 85212; heather.l.bateman@asu.edu

Saltcedar biocontrol effects on herpetofauna abundance, diversity, and habitat in Sonoran riparian forests

Southwestern herpetofauna have high diversity and abundances in riparian forests, especially in areas with high habitat complexity provided by native riparian vegetation. The effect of the introduced riparian shrub, saltcedar (*Tamarix*), on herpetofauna communities has been studied, but the impact of defoliating saltcedar via biocontrol beetle is less understood. We predict that in the short term, saltcedar defoliation will alter habitat structure in a way to reduce herpetofauna abundance due to shifts in microclimate. In 2024, during the second year of saltcedar biocontrol establishment along the Gila River, in Pinal County, AZ, we used live trapping methods across three distinct riparian forest types. Along the lower San Pedro River, sites were established in cottonwood/willow (*Populus/Salix*) forest and in mesquite (*Prosopis*) bosques. Near the confluence on the Gila River, we studied saltcedar monoculture stands. We measured field-collected habitat covariates at trapping sites and estimated capture rates at trap arrays (n=20). We compared this data with that collected at our same 20 sites prior to saltcedar defoliation. Using a two-way

ANOVA, we analyzed the effect of forest type and biocontrol condition on focal species abundance. The same species of lizards were captured in both time periods. We found that stand type, biocontrol condition, and the interaction of those factors influenced lizard abundance. Abundances increased in saltcedar sites post biocontrol. The subject of saltcedar's control carries controversy and question marks in the realm of active management and our findings will elucidate dynamics between ectotherms and their habitat.
**Student

Joao L. Weisshaupt, University of Arizona, Department of Natural Resources & the Environment, 1064 E. Lowell St, ENR2 N235, Tucson, Arizona 85719; joaow@arizona.edu
Brian Sanchez-Fishback, University of Arizona, Department of Natural Resources & the Environment, 1064 E. Lowell St, ENR2 N235, Tucson, Arizona 85719; bsanchezfishback@arizona.edu
Eduardo V. Cota, University of Arizona, Department of Natural Resources & the Environment, 1064 E. Lowell St, ENR2 N235, Tucson, Arizona 85719; eduardovcota@arizona.edu
Jesse M. Alston, University of Arizona, Department of Natural Resources & the Environment, 1064 E. Lowell St, ENR2 N235, Tucson, Arizona 85719; jmalston@arizona.edu

Assessing wildlife connectivity in urban Tucson
Though urbanization is a significant threat to biodiversity, urban areas can nevertheless offer valuable opportunities for conservation. Tucson, Arizona is a large urban area that borders extensive protected areas that provide potential to enhance landscape connectivity for wildlife. We are assessing wildlife connectivity across the Tucson metropolitan area using camera traps to map species presence and identify factors influencing their movement throughout the urban landscape, with special focus on the Cañada del Oro, Santa Cruz River, Rillito River, and Big Wash, which may provide corridors for movement across major roads such as Interstate 10, Highway 77, and Tangerine Road. During our project, we will deploy cameras at at least 150 sites across the urban footprint of Tucson, collecting more than 18,000 trap-nights of data over the next year. Camera locations will be selected to represent a broad range of urban and semi-urban habitats, with detailed metadata recorded at each site. Species will be identified from photos using camtrapR software, and data will be compiled into a publicly accessible database that includes maps of wildlife presence for individual species. This database will facilitate future research and provide valuable insights for wildlife managers. The results will inform conservation strategies aimed at improving wildlife movement through Tucson, with the goal of enhancing landscape connectivity and biodiversity conservation in this highly urbanized region.
**Student

Fisheries Presentations

Alexes P. Albillar, U.S. Fish and Wildlife Service, Science Applications, 6700 Edith Blvd NE, Albuquerque, NM 87113; alexes_albillar@fws.gov

Online portal for Bureau of Reclamation fish barrier information in the Gila River Basin

The U.S. Fish and Wildlife Service's Conservation and Adaptation Resources Toolbox (CART) Program is a peer-to-peer knowledge-sharing platform that enhances issue-based, landscape-scale conservation efforts through mediums such as webinars, workshops, and case studies. In particular, CART's Non-Native Aquatic Species Community of Practice facilitates co-production of tools and information sharing between diverse stakeholders and partners, such as the Gila River Basin Native Fishes Conservation Program (GRBNFCP). In partnership with the GRBNFCP, CART is developing the Gila River Basin Native Fishes Conservation Program Fish Barriers Portal (portal) to document Reclamation's completed fish barriers in the Gila River Basin and associated native fish restoration projects. The portal will provide information to fisheries biologists and managers implementing similar projects, educate the public on the purpose and benefits of fish passage barriers, and capture institutional knowledge of program staff, ensuring it can be shared with new staff. Phase I of the project included the development of content for the Blue River fish barrier. Phase II will include the development of similar content for each completed Reclamation fish barrier in the Gila River Basin, and eventually the publication of the portal online for use by both fisheries managers and the general public.

Adam L. Barkalow, New Mexico Department of Game and Fish, Fisheries Management Division, 7816 Alamo Rd. NW, Albuquerque, New Mexico 87120; adam.barkalow@dgf.nm.gov
Stephani L. Clark Barkalow, American Southwest Ichthyological Researchers, 800 Encino Pl. NE, Albuquerque, New Mexico 87102. *Current address: San Juan River Basin Recovery Implementation Program, New Mexico Ecological Service Field Office, U.S. Fish and Wildlife Service, 2105 Osuna Road NE, Albuquerque, NM, 87109* stephani_clarkbarkalow@fws.gov
Matthew P. Zeigler, New Mexico Department of Game and Fish, Fisheries Management Division, 1 Wildlife Way, Santa Fe, New Mexico 87507; matthew.zeigler@dgf.nm.gov
Steven P. Platania, American Southwest Ichthyological Researchers, 800 Encino Pl. NE, Albuquerque, New Mexico 87102; platania@unm.edu

Looking for love in all the right places: using mobile PIT tag antenna surveys to locate Razorback Sucker spawning locations in the San Juan River

Passive integrated transponder (PIT) tags are vital for evaluating fish movement, survival, and population dynamics. Portable PIT tag antenna systems (PITPASS) enhance these capabilities by providing a non-invasive method to detect tagged fish in river systems and identify spawning aggregations. Previously extirpated from the San Juan River, Razorback Sucker *Xyrauchen texanus* has been successfully repatriated through augmentation efforts. Although Razorback Sucker spawn annually in the San Juan River, recruitment remains rare, resulting in a population dominated by stocked, PIT-tagged fish that can be detected remotely. PITPASS surveys were performed during putative peak spawning periods in 2022 and 2023 to evaluate Razorback Sucker spawning movements and aggregations. Surveys detected 5,000 Razorback Sucker tags and identified 2,846 unique live or assumed live individuals across 46.5 river kilometers. These surveys revealed 32 high-density hotspots, 21 of which were sampled to evaluate habitat conditions and spawning activity. Spawning was confirmed at 20 of these locations through the collection of Razorback Sucker embryos. Site fidelity was evident between years, with 23% of individuals in 2023 returning to the prior year's spawning sites. While most fish remained within discrete river segments, some fish traveled over 40 km during the spawning period. This study underscores PITPASS as a critical tool for identifying spawning locations, informing restoration of spawning and nursery habitats, and ensuring migration pathways remain accessible. By advancing knowledge of Razorback Sucker spawning behavior and habitat use, these findings support conservation strategies aimed at promoting recruitment and sustaining this endangered species in the San Juan River.

William H. Bass IV, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; wbass@nmsu.edu
Zachary B. Klein, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; zklein@nmsu.edu
Edward E. Enriquez, New Mexico Department of Game and Fish, 2715 Northrise Drive, Las Cruces, NM 88011; edward.enriquez@dgf.nm.gov

Factors Influencing Growth of Blue Catfish and Walleye in Caballo Reservoir, New Mexico

Many traditional freshwater fisheries throughout New Mexico may be negatively influenced by the effects of climate change, chiefly poor water quality and low water levels. In response, the New Mexico Department of Game and Fish initiated a hybrid Striped Bass introduction pilot study in Caballo Reservoir. The species is highly resilient and has the potential to improve warmwater fisheries statewide. However, hybrid Striped Bass and a changing climate may negatively affect existing sport fisheries in the reservoir. Thus, we sought to evaluate the potential influence of hybrid Striped Bass introduction as well as several other climatic variables on the growth of popular sport fishes in Caballo Reservoir. Aging structures were collected from Blue Catfish *Ictalurus furcatus* and Walleye *Sander vitreus* in March 2022 and 2024. Data collected from aging structures were analyzed using mixed-effects models to estimate year-specific growth coefficients, which were then compared to biological and environmental data using multiple regression. Hybrid Striped Bass introduction did not appear to directly influence the growth of Blue Catfish or Walleye. Instead, Blue Catfish and Walleye growth was most influenced by mean spring reservoir surface area. The importance of surface area may be attributable to changes in suitable Gizzard Shad *Dorosoma cepedianum* spawning habitat. In the face of drought and competing demands for water in the lower Rio Grande basin, managers may consider monitoring Gizzard Shad abundances in relation to spring water levels. If major prey shortages were to become evident, alterations to predator stocking regimes may be warranted.
**Student

Zachary S. Beard, Arizona Game and Fish Department, Phoenix, Arizona.

An overview of Arizona's recent native fish translocation and stocking efforts

The Arizona Game and Fish Department (Department) works to conserve and protect 35 species of native fish within the state. As part of this work the Department actively translocates and stocks native fish species into waterbodies statewide to start new populations and augment existing populations. Translocations and stocking native species can expand the range and distribution of native fish species and help maintain or improve genetic diversity in existing populations. These efforts greatly contribute towards achieving recovery and conservation goals for native fish species. Over the past 5 years the Department has completed 287 translocations and stockings for 19 different native fish species into 140 waterbodies statewide. This has led to the establishment of new populations for several of Arizona's native fish species and has improved the conservation status of native fish populations statewide. This talk will provide an overview of the Department's native fish translocation and stocking efforts over the past decade and how those efforts have benefitted Arizona's native fish populations.

Alex Cameron, Arizona Game and Fish Department, 5000 W. Carefree Highway Phoenix Arizona, 85086; acameron@azgfd.gov
Brian Hickerson, Arizona Game and Fish Department, 5000 W. Carefree Highway Phoenix, Arizona, 85086; bhickerson@azgfd.gov

Current status and management of Sonora chub (*Gila ditaenia*) in Arizona

Sonora chub (*Gila ditaenia*) is a small species of *Gila* endemic to the Rio de la Concepcion of Sonora, Mexico and extreme southern Arizona. Sonora Chub is a federally protected species in the U.S. in part due to their restricted geographic distribution, as the species is found in two headwater streams of the Rio Magdalena watershed in Santa Cruz Co., AZ. Despite receiving federal protection, a finalized monitoring plan is currently not in place. The Arizona Game and Fish Department begun conducting surveys within Sycamore Canyon on annual basis starting in 2022 that include collecting basic information regarding size-class distribution and measures of relative abundance. Here we present results from population

monitoring and other management activities conducted by the Arizona Game and Fish Department from 2022-2024. Surveys have consistently documented the presence of multiple size-classes, suggesting the population is comprised of multiple age-classes and there continues to be spawning and recruitment within Sycamore Canyon. Measures of relative abundance fluctuated across annual surveys seemingly in relation to water availability at the time of sampling. Finally, we highlight some of the challenges presented by this system and highlight future work for Sonora Chub.

Sean W. Deery, Arizona Game and Fish Department, 555 N. Greasewood Road, Tucson, Arizona 85741; sdeery@azgfd.gov

Utilizing R markdown to dynamically summarize single and multi-year sportfish survey data

Effective sportfisheries management begins with comprehensive sportfish stock assessment analyses. Rigorous and uniform sportfisheries data analysis is a key component to producing high quality, reproducible results that allow technical reports to be cohesive and robust across work units. Each metric analyzed, from CPUE to PSD to relative weight, plays a crucial role in piecing together the story of the health and balance of a water body. Nevertheless, the analysis of large datasets can be time consuming and daunting. Utilizing the FSA Package and R Markdown functionality within R Studio, I created two separate R Markdown documents that dynamically accommodate sportfisheries data to calculate important statistics. One R Markdown document is designed to analyze data from a single survey, while the second can handle multiple years' worth of data from the same water body, allowing for more temporally contextualized analysis. When data is passed through the R Markdown code, a word document bearing report-ready tables, figures and relevant statistical tests will open. The word document is set up to be easily navigable with appropriate headings, captions, and descriptions explaining the output to the user. The robustness of the code allows for these resources to be accessible to those with little to no experience in Program R or statistics. These R Markdown documents leverage the power of open source statistical programming paired with modern data storage tools to help already busy sportfish managers analyze sportfisheries data easier, faster, and more accurately.

Regan Doss, University of Arizona, School of Natural Resources and the Environment, Tucson, AZ, 85721; rdoss@arizona.edu
Scott A. Bonar, U.S. Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, School of Natural Resources and the Environment, Tucson, AZ, 85721; sbonar@arizona.edu

Ageing the anomaly: Sonora suckers subjected to uncharacteristic flow regime

Age estimation of native desert catostomids is essential for understanding sucker population dynamics, but is poorly studied. Flow of the lower Salt River in central Arizona is controlled by a hydroelectric dam, with fish growth subject to the modified flow regime and temperatures of the reservoir's hypolimnion. These flows differ from natural flow patterns and temperatures characteristic of Southwestern rivers, which may affect growth and ageing patterns of the fish present. There is little research on ageing of Sonora suckers *Catostomus insignis*, with less information on the ageing of these fish subjected to an abnormal hydrologic regime. This research demonstrates the effects of irregular flow regimes on ageing and the growth of native catostomids. To quantify the environmental-driven variation in ageing, weight, length, and age estimates from Sonora suckers from two Arizona river systems are compared, one's flow controlled by a hydroelectric dam and another undammed. Using otoliths and pectoral fin rays, differences in reader agreement and ageing bias are assessed. Age-at-length keys, length frequencies, minimum and maximum ages, growth rates, and visible comparison of the annuli production between both populations demonstrate the variability caused by abnormal flow peak timing.
**Student

Breanna L. Graves, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 South Espina Street, Knox Hall 132, Las Cruces, New Mexico 88003; bre94@nmsu.edu
Zachary B. Klein, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 South Espina Street, Knox Hall 132, Las Cruces, New Mexico 88003; zklein@nmsu.edu
Michael E. Ruhl, New Mexico Department of Game and Fish, 1 Wildlife Way, Santa Fe, New Mexico 87507; michael.ruhl@dgf.nm.gov

Comparison of the survival and growth of age-0 wild ($M_{XY} \times F_{XX}$) and hybrid ($M_{YY} \times F_{XX}$) brook trout

Nonnative brook trout *Salvelinus fontinalis* can adversely affect native fish populations through predation, competition, and hybridization. To mitigate these effects, natural resource managers in western North America frequently attempt to control brook trout populations. Unfortunately, chemical and mechanical removal methods are often ineffective due to logistic challenges and negative public perception. The limitations of current control methods have led managers to seek alternative approaches. The Trojan Y-Chromosome approach uses sex-reversed fish to alter sex ratios and potentially eradicate a population. This approach offers promise for controlling wild brook trout populations, but little is known about the reproductive success of M_{YY} males and wild males. To address these knowledge gaps, we evaluated the survival and growth of brook trout progeny. Wild males (M_{XY}) and M_{YY} fish were crossed with wild female Brook Trout in the field and the fertilized eggs were transported to New Mexico State University. We assessed the fertilization success, survival to different developmental stages, and post-hatch growth of progeny resulting from crosses with wild males and M_{YY} fish. Our results suggest that the relative survival of eggs is not different between male types among years. The mean relative survival for progeny of wild and M_{YY} males in 2023 was 68.1% and 59.1%, respectively (P = 0.46). In 2024, mean relative survival for M_{YY} progeny was 61.7% and wild progeny was 55.1% (P = 0.15*).* These preliminary findings provide further information on the reproductive success of M_{YY} fish and on the efficacy of the Trojan Y-Chromosome approach.
** Student

Hudman Evans Jr., Arizona Game & Fish Department, 1970 N. Page Springs Road, Cornville, AZ 86325; hevans@azgfd.gov
Ryan Mann, Arizona Game & Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086; rmann@azgfd.gov

Using vital dyes to mark Gila topminnow for mark-recapture abundance estimation

Natural and reestablished populations of the endangered Gila topminnow are managed by Arizona Game and Fish (AZGFD) in conjunction with federal partners, with the recovery goal of downlisting the species to threatened and eventually delisting the species. AZGFD currently monitors Gila topminnow through relative abundance estimates as catch-per-unit-effort. While beneficial for monitoring trends, measures of absolute abundance are necessary to quantify population status and to better inform management. Mark-recapture sampling can be used to estimate absolute abundance; however, a viable “mark” is necessary, but can be a challenge for small bodied fish. In this study, we tested four vital dyes (Bismarck brown, Nile red, neutral red, Nile blue) used to mark adult and juvenile Gila topminnow. Dye retention was assessed 24, 48, 72, and 120 hours after immersion to determine how long dye marks remained visible and discernible. Discernibility was assessed by testing whether a naive observer could correctly identify fish as marked or non-marked in trials where the researcher placed both into a bucket together. Fish survival was also evaluated at 1 day, 7 days, 1 month, and 3 months post-marking. Trials are ongoing, and full results are expected in spring 2024. Results will inform managers on the efficacy of using vital dyes in mark-recapture population estimates of Gila topminnow.

Dale Fonken, Arizona Game and Fish Department 5000 W Carefree Highway, Phoenix, Arizona 85086

Angling within Grand Canyon as a means of monitoring fishes

Monitoring abundance and distribution of fishes is not a trivial exercise, and sampling approaches often vary depending on habitat, species, financial constraints, and logistics. Employing multiple gear types generally increases inference into population parameters of interests. However, using a suite of sampling techniques is not always financially or logistically feasible, and life history characteristics of certain species may preclude efficacy of certain sampling techniques. In the Colorado River within Grand Canyon, traditional gear types such as electrofishing and passive netting were unable to effectively target Channel Catfish, a deleterious predator known to prey upon native, imperiled species. Here, we demonstrate the utility of angling as a method to detect changes in relative and abundance and distribution of Channel Catfish within Grand Canyon, as well as other native and nonnative fishes.

Wesley Franklin, Marsh & Associates, 5016 S Ash Ave Ste 108 Tempe, AZ 85282;
wfranklin@nativefishlab.net

Documenting native desert fish communities in the American Southwest

Scientists are achieving success in researching species with greater efficiency and less resources expended due to the advances in fisheries technology such as PIT scanning, environmental DNA, and acoustic telemetry. Along with breakthroughs in fisheries technology, we have seen an advance in methods to document what we are experiencing while collecting data in the field. Videography is a medium that conveys data and stories in a way that numbers and figures cannot and to groups that scientific papers do not reach. I received a small grant through the Western Division of the American Fisheries Society (WDAFS) to purchase a GoPro Hero 12. With this camera, I have been recording underwater footage of desert fish species throughout Arizona and creating short films of these species. I interact directly with 9 Arizona native fish species: the Loach minnow *Tiaroga cobitis*, Gila topminnow *Poecelops affinis*, speckled dace *Rhinichthys osculus*, Spikedace *Meda fulgida*, Sonora sucker *Catastomus insignus*, desert sucker *Pantosteus clarkii*, roundtail chub *Gila robusta*, Gila chub *Gila nigra*, and razorback sucker *Xyrauchen texanus*. Over half of these species are listed as endangered or threatened by the Endangered Species Act (ESA). There is currently little video content (if any) of these species. Thus far, I have created two shortfilms titled: “Roundtail Chub” & “Desert Sucker” and plan to develop species overview films for each of the species listed above.

Jakob Harris, Bosque School Fisheries Student. 4000 Bosque School Rd NW, Albuquerque, NM 87120;
jakob.harris@bosquestudents.org

Isotopic signatures of individual fish species in Rio Grande del Norte National Monument (NM)

The North American River Otter (*Lontra canadensis*) was reintroduced to New Mexico in 2008 after its extirpation likely in the 1950s. Restorative efforts in northern New Mexico, specifically on the Rio Grande and Rio Pueblo de Taos, have proven effective over the past 15 years. With the otter population estimated to have tripled since their reintroduction, concerns have arisen regarding how much impact otter feeding has on fish, particularly sportfish resources in that area. As part of a larger river otter food web investigation, I worked to isotopically analyze fish samples from the Rio Grande del Norte National Monument (NM) to further understand otter food resource opportunities in this unique ecosystem. Our two methods of sample collection were electro-fishing and angling, with safe catch and release being a priority. Samples gathered from electrofishing were part of a US Department of Interior and New Mexico Department of Game Fish survey. A small section (~3cm x 3cm) of the upper section of the caudal fin of each sampled fish was carefully removed and stored until lab analysis could be done at the University of

New Mexico, Center for Stable Isotopes. My work establishes isotopic signatures for the assemblage of fish species found at Rio Grande del Norte National Monument.
**Student (high school)

Crosby Hedden, Caroline Mallinson, Crystal Castillo, Ryan Mann
Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086

Assessing Detection of New Zealand mudsnails at low densities using quadrats in Arizona streams

The New Zealand mudsnail is a small-bodied gastropod that has successfully invaded waters across multiple continents and has exhibited effects on many aquatic organisms. This species has the ability to reach extremely high densities in streams and displace aquatic macroinvertebrates which higher trophic levels rely on as a food source. While the effects of NZMS is well studied, early detection methods for this species are limited almost entirely to eDNA. While eDNA is a valuable tool, false negatives can occur delaying the time of detection and make it more difficult to respond and control AIS species. Due to this, low density sampling protocols are also essential to confirm the precise location of the invasion so that management may be implemented on these areas. The goal of our study is to evaluate and compare the efficacy of various quadrat sampling protocols to detect NZMS, and to determine at which densities detection may become uncertain using these protocols. We tested 10-, 20-, and 30-quadrat grids within 100m reaches, using both random and strategic selection of quadrat sites, to assess each designs performance in probability of detection. We found that a non-random strategic sampling design was significantly more effective at detection of NZMS than a random design. Additionally, we found that detection was relatively high for all streams utilizing the non-random strategic sampling design, even at the lowest densities detected over the course of this study. Results of this study highlight the importance of selecting adequate sites when attempting to physically detect NZMS at low densities following an invasion which is critical for effective management and mitigation efforts.

Skyler Hedden, Arizona Game and Fish Department, 5000 W Carefree Highway, Phoenix, AZ 85086; shedden@azgfd.gov
Julie Carter, Arizona Game and Fish Department, 5000 W Carefree Highway, Phoenix, AZ 85086; jcarter@azgfd.gov
George Cathey, Oxbow Ecological Engineering, 3491 S Gillenwater Dr, Flagstaff, AZ 86605; george@oxbow-eco-eng.com

Destruction is easy, but can we undo degradation and improve riverscapes?

Desert aquatic habitats have been negatively impacted for centuries by human induced changes, and it is likely that these impacts will continue into the future. Given that habitat loss and alteration are among the leading causes of imperilment of aquatic species, conservationists should focus on improving habitats whenever possible. But how successful are we at improving previously altered habitats? We assessed if habitat improvement projects could enhance aquatic habitat conditions across three different projects in the upper Little Colorado River basin, Arizona. For the first project, a disconnected side channel was reestablished, creating novel pool and riffle habitats that were 67% and 43% deeper than control sites. For the next project cut banks were stabilized and floodplain swales and back waters were created to reduce river stress and sediment loading. Based on pre and post construction data, the proportion of silt in the river was reduced by 37% immediately downstream of the project area. For the last project, we attempted to reduce head cutting, while simultaneously attempting to increase water availability in the stream channel. In control reaches, the number of perennial pools were consistent through time, however in the improved reach, perennial pools increased by three-fold, allowing for native fish translocations to occur. We show that all three habitat improvement projects have met their desired results and have improved habitat conditions for fish, likely contributing to species recovery. Therefore, when clear objectives are set and the proper personnel are involved, habitat improvement projects can contribute to successful conservation management.

Brian T. Hickerson, Arizona Game and Fish Department, 5000 W Carefree Highway, Phoenix, AZ, 85086; bhickerson@azgfd.gov
Paul Reap, Marsh and Associates, 5016 South Ash Avenue, Tempe, AZ 85282; preap@nativefishlab.net
Kent R. Mosher, U.S. Bureau of Reclamation, 6150 W. Thunderbird Road, Glendale, AZ 85306; kmosher@usbr.gov
Betsy Hedden, U.S. Bureau of Reclamation, 6150 W. Thunderbird Road, Glendale, AZ 85306; egrube@usbr.gov

Success, setbacks and perseverance: Native fish conservation efforts in the Blue River, Arizona 2012-2024

Outcomes of native fish translocation projects can often take years to determine and depend on stocking strategies employed, prevailing environmental conditions, collaboration with partners and unforeseen circumstances. Native fish conservation efforts have taken place in the Blue River (Greenlee County, Arizona) since 2009. Efforts were initially focused on eradicating warmwater nonnative fishes from the lower 18 km of the river through barrier emplacement and mechanical removals, followed by translocation of three focal species: spikedace *Meda fulgida,* loach minnow *Tiaroga cobitis,* and roundtail chub *Gila robusta*. Remarkable success was achieved by 2019 with the eradication of nonnative warmwater fishes, establishment of spikedace and roundtail chub populations, and reestablishment of the loach minnow population. Due to the initial success, the project was extended upstream with translocation of spikedace and roundtail Chub to the middle and upper reaches of the river. The outbreak of the Bringham Fire and Cow Canyon Fire within the Blue River watershed during the summer of 2020 began a period of dramatic changes to the fish community throughout the river. Post-fire impacts coupled with extreme fluctuations in the flow regime caused populations of native fish to crash throughout the river by 2022. Stockings of spikedace and roundtail chub that coincided with strong spring runoff in 2023 contributed to the quick rebound of the spikedace population. This project demonstrates the importance of a long-term adaptive management approach and continued effort, regardless of short-term setbacks, for long term success in native fish conservation projects.

Christopher J. Jenney, University of Arizona, School of Natural Resources and the Environment, 1064 E Lowell Street, Tucson, Arizona 85319
Scott A. Bonar, USGS Cooperative Fish and Wildlife Research Unit Arizona,m 1064 E Lowell Street, Tucson, Arizona, 85319

Survival of razorback sucker stocked into a river-reservoir complex: Insights for native fish recovery

The razorback sucker (*Xyrauchen texanus*) faces ongoing challenges to its recovery throughout its historical range. Efforts to reestablish self-sustaining populations align with broader conservation strategies aimed at improving the success of native fish stockings throughout the Colorado River Basin. In central Arizona, over 200 km of the Verde River is designated critical habitat for the razorback sucker. However, decades of stocking efforts have failed to reestablish a viable population in this river system. This study sought to (1) evaluate whether the Verde River is a suitable location for reestablishing razorback sucker populations by stocking individuals into new locations, including Horseshoe Reservoir, and (2) identify factors influencing the survival of native fish to enhance future reintroduction efforts. Over three years, 7,000 razorback suckers were stocked into the Verde River—half in the mainstem river and half in Horseshoe Reservoir, an impoundment managed by the Salt River Project to support native fish recovery. All fish were PIT-tagged, and ~198 adult fish were equipped with radio transmitters to monitor post-stocking behavior and survival. We found survival rates improved annually (range: 0% - 15%) and were positively related with water availability (reservoir elevation). Key sources of mortality included predation (terrestrial, avian, and aquatic) and poor water quality (low dissolved oxygen, high temperatures, and thermocline depth) during summer months. Most river stocked fish dispersed downstream and reached Horseshoe Reservoir within months of their stocking or died during dispersal. This study highlights critical behavioral and environmental factors limiting razorback sucker survival in Arizona streams and offers valuable insights to inform future management and conservation strategies for native fishes in the Colorado River Basin.
**Student

Alex Loubere, Arizona Game and Fish Department, Research Branch, 5000 W. Carefree Hwy, Phoenix, AZ 85086; aloubere@azgfd.gov
Devon C. Oliver, Minnesota Department of Natural Resources, 5000 W. 1801 S. Oak St., Lake City, MN 55041; Devon.Oliver@state.mn.us
Ryan Mann, Arizona Game and Fish Department, Research Branch, 5000 W. Carefree Hwy, Phoenix, AZ 85086

Estimating persistence and movement probability of hatchery Gila Trout in an Arizona stream

The Gila trout is one of two species of Salmonid native to Arizona. The Arizona Game and Fish Department is investigating the potential for recreational stockings of Gila trout in put-and-take stream fisheries. However, it is unknown whether in-stream persistence and movement patterns of hatchery reared Gila trout make them suitable for this purpose. To address these management questions, 222 catchable size Gila trout implanted with radio tags were stocked in six locations on the East Verde River (EVR) near Payson during the stocking seasons of 2020, 2021, and 2023. Tracking was conducted on foot using ATS© hand-held receivers coupled with portable Yagi antennae. A stationary Lotek Wireless© receiver was used to estimate emigration out of the study area. Trout were tracked daily for the first seven days post stocking, then weekly for the 16 week battery life of the tags. Trout locations were approximated in stream and location was recorded in UTM via handheld GPS unit along with macro habitat (e.g. riffle, run, pool). Multi-state models assessed probability of detection and probability of transition between high and low angler traffic sections of the river at daily and weekly timescales. The same models estimated daily/weekly survival in both section types of the river. These data will help shape management of the put-and-take trout fishery in the EVR.

Matthew Mayer, University of Arizona, School of Natural Resources and the Environment
Peter Reinthal, University of Arizona, Department of Ecology and Evolutionary Biology

Gila topminnow (*Poeciliopsis occidentalis*) demographics and morphology (2016-2024) in the Santa Cruz River, Arizona

Gila topminnow *Poeciliopsis occidentalis,* A USFWS Listed Endangered Species, was rediscovered in the main stem of the Santa Cruz River in the mid-2010s. Genetic analyses in 2023 revealed the presence of an exotic *Poeciliopsis* species, the hybridogenic *Poeciliopsis monacha–occidentalis*. We examined demographics among *P. occidentalis*, *P. monachal-occidentalis* and mosquitofish (*Gambisua affinis)* in the river across eight geographic localities in the United States from 2016-2023. Sites are located from where the Santa Cruz River reenters the United States to Marana north of Tucson. Subsamples were originally collected during fall fish survey efforts in the Santa Cruz River to determine mosquitofish and topminnow populations given the difficulty in field identification of these species. These collections are part of the Sonoran Institute annual Living River Reports. They provide an invaluable opportunity to determine geographic and temporal changes in the distributions of the three species during this period of changing ichthyofauna composition in the Santa Cruz River. Currently we have completed a preliminary analysis regarding abundance and sex ratios of both topminnow and mosquitofish across the sites and years. The faunal composition shows a decreasing number of mosquitofish, an increasing abundance of female *Poeciliopsis* species, and a shift in fish sizes across sites and time.

Brett J. Montgomery, Arizona Game and Fish Department, 5000 West Carefree Highway, Phoenix, AZ 85086

Topminnow and pupfish: Social animals

Topminnow and pupfish are unique species in Arizona that are primarily managed in isolated closed systems, often managed by private citizens or organizations. The usual threats and issues that these native fish species experience are habitat loss, invasive species, and genetic bottlenecks. Added threats in these highly managed closed systems include threats caused by the stewards of the properties, intentional or not. These can manifest as dewatering, water pump issues, or invasion of non-native plants and animals. As a manager of the species, it is important to educate and mitigate these issues as they happen, or even prevent them from happening. The purpose of this presentation is to shed some light on the social aspect of managing topminnow and pupfish populations, as well as provide a case study on some of the unnatural ends of populations.

David L. Rogowski, Arizona Game and Fish Department, Research Branch, 5000 W Carefree Hwy, Phoenix AZ, 85086. drogowski@azgfd.gov
Ron J. Rogers, BIO-WEST, 1063 West 1400 North, Logan, Utah 84321-2291. rrogers@bio-west.com

The emergence of Pearce Ferry Rapid, Colorado River – and fish movement

With the ongoing drought and declining water levels of Lake Mead, the Colorado River is now re-emerging from what was once lake habitat. This has been occurring since about 2010, and about 90 km of river has re-emerged. The increase of riverine habitat has been beneficial to native fishes, with warmer and more turbid water than upstream areas closer to Glen Canyon dam, leading to an increase in native fishes in the western Grand Canyon. However, during this time a new rapid, Pearce Ferry Rapid located about 26 km from Lake Mead has developed. This rapid did not exist prior to Lake Mead forming and is a result of the channel shifting as Lake Mead receded. This rapid may be a barrier to native fishes as well as nonnative fishes. We have been monitoring the reaches upstream and downstream of the rapid using a variety of gear: electrofishing, hoop nets, angling and an array of PIT tag antennas. The fish assemblage differs upstream and downstream of the rapid, with native fishes dominating the upstream reach and nonnative fishes dominating the downstream reach. We have detected fish movement downstream, and very limited movement upstream past the rapid by some native fishes. These results suggest that the rapid is a hindrance to fish movement, but not a complete barrier. Prevention of nonnative fishes from moving into the Grand Canyon is beneficial, but the rapid may also hinder the endangered Razorback Sucker from utilizing the inflow area and returning to reaches above the rapid.

Taylor E. Saucier, University of Arizona, School of Natural Resources and the Environment, Tucson, AZ, 85721; tsaucier@arizona.edu
Scott A. Bonar, U.S. Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, School of Natural Resources and the Environment, Tucson, AZ, 85721; sbonar@arizona.edu
Kevin M. Fitzsimmons, University of Arizona, Department of Environmental Science, Tucson, AZ, 85721; kevfitz@arizona.edu
Matthew Recsetar, University of Arizona, Department of Biosystems Engineering, Tucson, AZ, 85721; msrecs@arizona.edu

Techniques to induce spawning of Sonora suckers *Catostomus insignis* in captivity

The difficulty of spawning fish in captivity can vary drastically by species. Determining a species' requirements for gonadal development and spawning in captivity is made more challenging when a species is data-limited, as is the case with Sonora suckers *Catostomus insignis*. The existing literature on the reproduction of Sonora suckers *Catostomus insignis* is primarily from observations of the wild populations and information on culture techniques is scarce. With little research specifically on the captive

breeding techniques of this species, we assessed a variety of methods to spawn Sonora suckers in captivity. We simulated the mesohabitats used by Sonora suckers in the wild in a tank environment. We controlled known environmental cues for reproduction, such as temperature, photoperiod, and flow. We provided an abundance of food, including supplementation with aquatic macroinvertebrates. We used hormonal injections to induce ovulation and spermiation. After having no natural spawning, we used manual expression to strip eggs and milt from the fish. This presentation will discuss the various interventions and their levels of success in the captive spawning of Sonora suckers.
**Student

Fisheries Posters

Crystal Castillo, Crosby Hedden, Caroline Mallinson, Ryan Mann
Arizona Game and Fish Department, 5000 W Carefree Hwy, Phoenix, AZ 85086

Age and growth of warm water sportfish in three Arizona reservoirs

Understanding age and growth dynamics is necessary for assessing the health of a sportfish population and is therefore critical for effective management of a fishery. Although warmwater sportfish are managed for reservoir-specific goals throughout the state, growth and mortality data remain scarce for many species, limiting management potential. Additionally, the efficacy of aging fish in Arizona waters, which can function quite differently from other temperate locations, using bony structures, such as otoliths and fin rays, has not been widely explored. We performed a comprehensive evaluation of age-length relationships of flathead catfish (*Pylodictis olivaris*) and largemouth bass (*Micropterus nigricans*) in three Arizona reservoirs (Lake Pleasant, Bartlett Lake, and Roosevelt Lake) and compared precision and bias of ages estimated from otoliths and fin rays in varying size classes. Preliminary analyses indicate that relative weights of flathead catfish in Lake Pleasant and Roosevelt Lake are satisfactory, whereas those in Bartlett Lake are comparatively lower. Similarly, the overall relative weight of largemouth bass in sampled reservoirs appears fair, although tend to skew to below average condition. Calculated PSD values show a majority flathead catfish and largemouth bass populations in all sampled reservoirs are above stock value, with small trophy populations of flathead catfish inhabiting Roosevelt and Bartlett Lake. Further analyses of data through von Bertalanffy growth models and age-bias plots of processed structures will provide further insight on growth and mortality rates, and an assessment on the efficacy of aging Arizona sportfish through lethal versus nonlethal structures.

Paulino F. Emmeline, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; epauli22@nmsu.edu
Elizabeth A. Brock, New Mexico State University, Water Science and Management Program, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; lizbrock@nmsu.edu
Wiebke J. Boeing, New Mexico State University, Department of Fish Wildlife and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, New Mexico 88003; wboeing@nmsu.edu

Observations of habitat and water quality at La Llorona Park wastewater effluent site before restoration

This project presents the findings from preliminary habitat and water quality surveys conducted at La Llorona Park, located in Las Cruces, New Mexico. Currently, a 100-m long concrete channel carries wastewater effluent from the Las Cruces Wastewater Plant to the Rio Grande. During non-irrigation season when the Rio Grande runs dry south of Caballo Reservoir, the effluent water partially wets up to 7 km of the river. In 2025, the concrete canal will be turned into a meandering stream to enhance ecological health and water quality. Here, we assessed habitat features, including vegetation types and riparian zones as well as aquatic life and water quality parameters such as temperature, pH, dissolved oxygen, and nutrient levels. Preliminary results indicate several areas of concern, including elevated ammonia levels that might limit aquatic biodiversity. Our surveys serve as a first step to evaluate improvements in water quality, biodiversity, and ecological resiliency due to a restoration project in the semi-arid Southwest.
**Student

Mattie L. Diedrick, Arizona Game and Fish Department Research Branch, 506 N. Grant St., Suite L , Flagstaff, AZ 86004; mdiedrick21@gmail.com
David L. Rogowski, Arizona Game and Fish Department Research Branch, 506 N. Grant St., Suite L, Flagstaff, AZ 86004; drogowski@azgfd.gov

Weather impacts on angler usage of Lees Ferry rainbow trout fishery in Northern Arizona

Lees Ferry is a Blue Ribbon rainbow trout fishery located on the Colorado River within Glen Canyon National Recreation Area, Arizona. Angler surveys are an important management tool to estimate angler usage of Lees Ferry; however, the Arizona Game and Fish Department (AZGFD) only conducts surveys six days a month. AZGFD operates a game camera at the Ferry's boat launch to quantify angler usage based upon the number of fishing boats launched each day. Using daily boat counts from our game camera analysis, we compared angler usage to weather parameters including minimum temperature, maximum temperature, maximum wind speed, and precipitation to create an algorithm to predict angler usage during each month of the year. During the shoulder season months of April, May, September, and October, and during June and July, there are more anglers at Lees Ferry than in extremely warm (August) or extremely cold (November, December, January, and February) months. Maximum wind speeds and maximum temperatures are the biggest weather factors impacting angler presence. In the shoulder months, wind affects angler counts most significantly and in extremely warm or cold months, maximum temperature affects angler counts most significantly, with 14 miles per hour wind speed and 7.78 degrees Celsius as significant points that cause fewer anglers. This algorithm will augment angler surveys to gain a better understanding of how anglers are using the fishery year-round, not just the six days a month we are there for angler surveys, and inform management decisions.
**Student

Caroline Mallinson, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086
Crosby Hedden, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086
Crystal Castillo, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086
Ryan Mann, Arizona Game and Fish Department, 5000 W. Carefree Highway, Phoenix, AZ 85086

Patterns in growth and condition of striped bass (*Morone saxatilis*) and white bass (*Morone chrysops*) in Arizona reservoirs

Analyzing hard structures to determine fish age and recording individual morphological metrics enables managers to develop growth models for individual sport fisheries. These models can then be used to predict potential issues and stressors, helping to assess the overall health of the population and aiding in effective management. Striped bass (*Morone saxatilis*) and white bass (*Morone chrysops*) are two important recreational species within Arizona that are managed in multiple reservoirs to maintain a healthy population, however age and growth data is currently limited. In an effort to address the data gap in Lake Pleasant, a range of size classes from both species were collected using multiple capture methods to gather insight into the status of their populations. Von Bertalanffy Growth Models were constructed and good model fit was observed for both species. However, when looking at overall condition, both species have noticeably lower relative weight percentages, indicating potential lower than normal fish growth, although the specific mechanism for this has yet to be identified. Additionally, we have begun to collect Striped Bass from additional reservoirs in western Arizona, which will be compared to the results from Lake Pleasant to reveal if patterns are consistent across other Arizona fisheries.