Audubon | Appleton-Whittell Research Ranch

2025 Annual Report

The Research Ranch is a 7,734-acre grassland sanctuary, research station, ecological reference site, and conservation action center in the Sky Islands region of southeastern Arizona. Here, we work to better understand grassland ecosystems, develop land management best practices, and connect communities with southwestern grasslands.

We are pleased to provide you with this report and celebrate some of our 2025 accomplishments including:

- Leading or supporting over 20 on-site research projects in collaboration with over 15 institutions and organizations
- Connecting with nearly 1,000 people through research, conservation, and programming on and off the Research Ranch
- Launching a 5-year effort to survey Western Yellow-billed Cuckoo on the Research Ranch
- Completing another season of sparrow tagging as part of our Grassland Sparrow Motus Project
- Hosting the Las Cienegas National Conservation Area Bioplanning annual meeting
- Taking significant steps toward prescribed fire on the Research Ranch
- Enhancing our network of wildlife water stations and Safe Harbor sites
- Improving safety and visitor experience through significant infrastructure investments
- …and more!

Bewick's Wren. Photo: Mick Thompson

Field discussions during the 2025 Las Cienegas National Conservation Area BioPlanning annual meeting.
Photo: Tahnee Robertson/Southwest Decision Resources

Healthier Grasslands Through Collaboration

Las Cienegas National Conservation Area (LCNCA) BioPlanning

Invasive species, drought, erosion, disrupted fire regimes, a warming climate – whether you're managing grasslands for birds or cattle, you're facing similar challenges.

This overlap becomes abundantly clear 20 miles to our north on the LCNCA where the Bureau of Land Management (BLM) is tasked with managing the land for grazing, wildlife, recreation, historic preservation, and more. As part of their planning, the BLM organizes a group of agency staff, non-profits, ranchers, and other stakeholders, known collectively as the Las Cienegas BioPlanning Team, to share data, best practices, and resources that, along with input from each member, inform the LCNCA's management.

Part of the LCNCA but physically separated and ungrazed, the Research Ranch is treated as a reference site in these conversations. This year, we leaned into this role by hosting the LCNCA BioPlanning Team's annual meeting on the Research Ranch. During this visit, we highlighted our successes and challenges to nearly 40 participants, and we're excited by the renewed relationships and opportunities for further collaboration that emerged.

Prescribed Fire on the Research Ranch

Still in its early planning phase, the Research Ranch's prescribed fire program is making progress.

While working on our burn plan with BLM and others, we're rallying our community of researchers to take advantage of eventual burns. So far, research partners include Arizona State University, Northern Arizona University, Tucson Bird Alliance, and Borderlands Restoration Network, and potential areas of study include invasive and woody vegetation management; burn impacts on birds, reptiles, small mammals, and Emory Oak; and comparisons between Indigenous and modern burning practices.

There is still much to be done before implementing burns on the Research Ranch, and we're grateful to our partners for their help along the way. Stay tuned for updates in the coming year!

Headquarters pond during the summer green-up following its installation.
Photo: Steven Prager/Audubon Southwest

Water for Wildlife

Old Wells Put to an Even Older Use

The Research Ranch's network of ponds and artificial wetlands in ways replicate the many seeps and springs that once dotted the landscape in and between Arizona's Sky Islands. As these and other natural water sources become less common due to human consumption and a changing climate, our managed sites grow increasingly valuable to birds and other wildlife.

Thanks to support from Resolution Copper and RESOLVE, this year we were able to add one more site to our network of wildlife water stations. Not in service since the Ryan Fire of 2002, Appleton Well, a well once used by the Appleton family on their private property to the southwest of what is now Research Ranch Headquarters, is again up and running. Instead of filling the original concrete storage tank, however, it now feeds two concrete troughs. Birds we've observed using nearby water stations include Chihuahuan Meadowlark, Northern Harrier, and Great-horned Owl, and wildlife has included everything from bobcats to pronghorn. We have game cameras on the new site at Appleton Well, and we're excited to see how wildlife responds as they become aware of this new resource.

Headquarters Pond Reinstallation

Not new but greatly improved is the pond behind Research Ranch Headquarters. Thanks to the South32 Hermosa Community Fund (a fund of the Community Foundation for Southern Arizona), a group of 11 Audubon Southwest volunteers, and nearly 20 participants in our weeklong Sierra Club visits (over 200 volunteer hours!), what was once a water-hungry, muddy mess is now a fully lined pond with plenty of surface water.

Situated directly behind our main office, Headquarters Pond brings many of the critters that inspire love for the Research Ranch right to our windows and gives us opportunities to connect even the most casual of visitors with our work. Thank you to everyone who helped make the project possible!

A freshly installed Research Ranch sign along our newly graded Main Loop Road.
Photo: Steven Prager/Audubon Southwest

Research Ranch Infrastructure Improvements

New Signs Across the Ranch

If you asked for directions on the Research Ranch in the past, you might've received an answer like "take the first left on the main loop and then hang a sharp left after the sacaton ends but before your cross the wash." While this makes for an adventure, it's less exciting when trying to direct emergency response.

Thanks to a generous donation of time, labor, materials, and talent from local volunteer Steve Johnson, we now have new building, road, and navigational signs installed across the ranch. Not only does this improvement add to visitor safety, but it also improves overall experience at the Research Ranch. Now all we have to do is wait for someone to ask us for directions!

Fire Breaks and Emergency Access

Knowing what road you're on is only useful if that road is in good enough condition to get you where you need to go, and it's more than that on the Research Ranch. Our 21-mile network of roads doesn't just help staff and researchers get around the ranch, it also acts as a network of fire breaks, or lines at which firefighters can halt the forward progression of an active wildfire. These lines also come in handy during prescribed fires like those being planned for the area bordered by our Main Loop Road.

As wildfire becomes more common, more intense, and less predictable, and as we work toward implementing prescribed burns on the Research Ranch, it is critical that we make sure our roads are suitable for emergency vehicles, are useful as fire breaks, and are ready to serve as emergency response and evacuation routes. We're able to keep our roads fuel-free (mowed) thanks to support from the Arizona Department of Forestry and Fire Management, and thanks to support from Resolution Copper and RESOLVE, we were able to have most of our roads graded this year – the first treatment in what will be a four-year project.

Not to mention, all this work makes for a much more pleasant drive into the Research Ranch. Your back will thank us next time we see you!

Our 2025 Appleton-Whittell Research Fellows
Left: Heaven Perez Sanchez. Photo: Adam Stein. Right: Matt Jenkins. Photo: Matt Jenkins

The Appleton-Whittell Research Fellowship

An Increased Award for 2025 Fellows

Since 2010, the Appleton-Whittell Research Fellowship Program has been supporting early-career scientists in their field studies on and near the Research Ranch. This program gives us the opportunity to both help develop the next generation of conservation scientists and support projects that may yield solutions to challenges facing the region's birds, other wildlife, habitats, and communities.

This year, thanks to a generous gift from the Research Ranch Foundation, we were able to offer larger award packages. With these increased incentives, we were able to attract two 2025 Research Fellows with projects that directly support our conservation mission.

Matt Jenkins: University of Arizona

Matt put this year's award to work studying Arizona's bluebirds as he pursues his PhD from The University of Arizona's Department of Ecology and Evolutionary Biology. Following up on his previous efforts, Matt works across Arizona, New Mexico, and Montana using Western Bluebirds (*Sialia mexicana*) as a model to study the ecological and evolutionary processes that shape adaptive behaviors.

Heaven Perez Sanchez: Arizona State University

Heaven has been instrumental in helping us launch the AWRR Grassland Motus Project, a collaboration between the Research Ranch, Arizona Game and Fish Department, Sonoran Joint Venture, and Arizona State University aimed at exploring the use of Motus technology in southwestern grasslands. Motus (Latin for "movement"), is a network of radio stations equipped to pick up signals sent from tiny, radio-emitting tags that can be affixed to insects, bats, and of course birds.

Research Fellow Webinars

As part of the Research Ranch Fellowship Program, fellows present about their work and experience on the Research Ranch to a virtual Audubon Southwest audience. Check out this year's presentations on Audubon Southwest's YouTube channel!

2025 Research Summary

Community engagement, hands-on conservation, and education are all priorities on the Research Ranch, but research will always be our primary focus. A premier southwestern field research station, the Research Ranch elevates the next generation of scientists and facilitates the investigations needed to answer the questions most critical to the conservation of birds, other wildlife, and grassland ecosystems. Read on to learn more about this year's efforts and to dig into publications resulting from past work.

2025 Projects on the Research Ranch

* New to the Research Ranch this year
** Research Ranch Research Fellow

(Did you conduct research on the Research Ranch in 2025 that is not represented below? Let us know by reaching out to researchranch@audubon.org.)

- **Audubon Southwest – Appleton-Whittell Christmas Bird Count:** Each year in early January, the Research Ranch contributes to the annual Christmas Bird Count, North America's longest-running community science project, by coordinating the Appleton-Whittell count. The effort takes the form of a 15-mile diameter circle with groups of volunteers recording all birds heard and seen within their preassigned area. The results serve both to track trends in southeastern Arizona's wintering bird populations and to inform our conservation efforts. Check out this year's and past years' results here.

- **Audubon Southwest – Invasive Grass Management:** Although native vegetation dominates much of the Research Ranch, the rapid spread of non-native grasses, namely Boer and Lehmann lovegrasses (*Eragrostis curvula* and *E. lehmanianna*), threaten its ecological integrity and mission. In response to this growing threat, AWRR staff began experimenting in the late 1990's with methods to protect and rehabilitate native grasslands. Methods explored included fire, mowing, physical removal, alteration of soil carbon-nitrogen ratios, and grazing by domestic livestock, but only chemical treatment proved effective. In 2004, Research Ranch staff began working to employ this treatment method in the area between AWRR's Headquarters and Researcher complexes, resulting in a mostly native control patch that now spans nearly 350 acres. This year's treatment and monitoring effort was made possible by the Arizona Department of Forestry and Fire Management, and a report summarizing this year's effort and outcomes is available upon request.

- **Audubon Southwest – Nightjar Survey:** One night each spring, Research Ranch staff drives into the night to survey the area's nightjars (poorwills and nighthawks) as part of a nationwide community science project coordinated by the Nightjar Survey Network and the Center for Conservation Biology. Information about how to get involved and data from this and previous years' surveys are available here.

- **Audubon Southwest – Upland Vegetation Monitoring:** In 2003, twenty-three vegetation transects were established across the Research Ranch by then-Director Linda Kennedy. Every fall since, ranch staff and volunteers have surveyed a rotating subset of these transects to build a long-term dataset describing the Research Ranch's post-monsoon flora. Sited using data provided by the USDA-Natural Resource Conservation Service, there are transects within our invasive species treatment area, on each of the ecological zones present on the Research Ranch, and on lands administered by each of our landowning partners. Data from these transects identify trends in vegetative cover and diversity, provide support for research projects, help us assess our management efforts, and are used by agency personnel, ranchers, and other landowners as a reference against which to compare nearby working lands. Data from this and previous years' efforts are available upon request.

- **Audubon Southwest – Western Yellow-billed Cuckoo Survey:** The Western Yellow-billed Cuckoo was listed as a threatened species under the Endangered Species Act in 2014, and since 2015 we've been surveying for this imperiled bird within the riparian areas and oak woodlands of the Research Ranch. Past years' efforts have been limited and sporadic, but this year's surveys, made possible by Resolution Copper and RESOLVE, represent the first of a five-year, coordinated effort to better understand how and when this species

uses the Research Ranch. Reports were provided to the Arizona Game and Fish Department and U.S. Fish and Wildlife Service and are available upon request**.**

- **Audubon Southwest, Tucson Bird Alliance, Arizona Important Bird Area Program – Grassland Sparrow Survey:** The Research Ranch's designation as an Important Bird Area (IBA) is in part because of a suite of breeding grassland sparrows – Botteri's, Cassin's, Grasshopper, Rufous-winged, and others. To monitor these priority birds and to track differences between the Ranch and adjacent working lands, we survey each year three point-count transects, two on the Research Ranch and one on the adjacent Babacomari Ranch. Data from this and previous years, as well as our most recent (2016) ten-year summary are available upon request.

- **Audubon Southwest, Arizona Game and Fish Department, University of Arizona – Chiricahua Leopard Frog Monitoring and Safe Harbor Site Management:** At multiple locations across the Research Ranch, natural and artificial wetlands support populations of Desert Pupfish (*Cyprinodon macularius;* listed as Endangered in 1986) and Chiricahua Leopard Frogs (*Rana chiricahuensis;* listed as Threatened in 2002). These sites are part of the U.S. Fish and Wildlife Service's and Arizona Game and Fish Department's efforts to bring these species back from the brink, and to do our part we conduct annual Chiricahua Leopard Frog surveys. Data from these surveys include counts of adult frogs, tadpoles, and egg masses as well as information describing the condition of the sites. These data are submitted annually to the Arizona Game and Fish Department.

- **Audubon Southwest, Arizona Game and Fish Department, Arizona State University, Sonoran Joint Venture – Appleton-Whittell Grassland Sparrow Motus Project:** Installed atop Bald Hill in the March of 2022 in collaboration with the Bird Conservancy of the Rockies, the Research Ranch Motus (Latin for "movement") station was first put to work last year when nearly 20 Research Ranch sparrows (Botteri's, Cassin's, and Grasshopper) were equipped with radio signal-emitting Motus tags. Developments this year include confirmation that these species do make seasonal migratory journeys to and from the Research Ranch, the deployment of an array of mini receivers known as Motus nodes, the tagging to 10 more Botteri's Sparrow, and the first instance of a visiting researcher (a Research Ranch Fellow) making use of our station. Questions remain about the winter destinations of our grassland sparrows and how they make use of habitat when on the Research Ranch, and we are already prepared to deploy additional tags next field season. Follow our Motus station and the birds it detects here.

- **Audubon Southwest, Bureau of Land Management, Northern Arizona University, Arizona State University, Tucson Bird Alliance, Borderlands Restoration Network – Prescribed Fire on the Appleton-Whittell Research Ranch of the National Audubon Society:** Still in its early stages, this effort, which will take place in the roughly 550-acre area encircled by our Main Loop Road, aims to study the impact of prescribed fire on a grasslands modified by land use and climate change and to identify potential best practices to be used in native grassland restoration and management. Areas of study will include the effect of altered burn timing and intensity and of combined treatments on native and non-native grass frequency and cover; problematic woody species; overall vegetative cover; bird, small mammal, and reptile abundance and diversity; and Emory Oak productivity. Additionally, through our collaborators at Northern Arizona University, this project may offer the opportunity to compare the effects of Indigenous burning practices with modern prescribed fire methods.

- ***Javan Bauder and Chris Prewitt (University of Arizona Cooperative Fish and Wildlife Research Unit) – Metapopulation Dynamics of Chiricahua Leopard Frogs on the Appleton-Whittell Research Ranch:** Through a focused mark/recapture effort, this project studies the movement of Chiricahua Leopard Frogs (*Rana chiricahuensis*) between sites on the Research Ranch and aims to document frog emigration from the Research Ranch to the nearby Babocomari River. Animals are marked during the early summer before the start of the monsoon and follow-up surveys are conducted throughout the rainy season in an effort to relocate tagged individuals.

- **Sam Fernald (New Mexico State University) and Anne Cross (Tulsa Community College) – Soil Moisture and Lehmann Lovegrass:** Lehmann Lovegrass (*Eragrostis lehmanniana*) is among the most

problematic invasive species found on the Research Ranch. Better understanding of water, soil, nutrients, and plant relationships as they relate to this species may help improve its management and reduce its impact on ecosystem health. This longitudinal study, which measures soil moisture, vegetation cover, density of invasive and native grasses, and occasionally production, nutrients, and other parameters, helps inform our understanding of invasion dynamics.

- **Bryan Hughes (Rattlesnake Solutions) – Experimental Relocation of Rattlesnake Overwintering Dens:** To assess the usefulness of the two artificial rattlesnake overwintering dens installed on the Research Ranch in 2024, Rattlesnake Solutions and Research Ranch staff are now actively capturing, tagging, photographing, relocating, and monitoring snakes observed returning to the historic den sites beneath buildings on the Research Ranch. Work still needs to be done to perfect the artificial den design, and monitoring and relocation is ongoing. If successful, this project could serve as a model for other humane relocation efforts and habitat installations for threatened species.

- ****Matt Jenkins (University of Arizona) – Signals in sister species - plumage as a driver of range dynamics:** By observing several populations of bluebirds across two different species (Western and Eastern Bluebirds) and multiple habitats, this project explores the role plumage signals play in the asymmetries between aggression and dominance that ultimately influence range dynamics of recently radiated species. Understanding the competitive dynamics of these two species and how they arrange themselves in the environment will help us understand how they may be affected by a changing climate and may inform conservation efforts. This is especially important for the "Azure" Bluebird, a unique and distinct subspecies of the Eastern Bluebird found only in Arizona and northern Mexico and listed by the Arizona Game and Fish Department as a Species of Greatest Conservation Need.

- **Linda Kennedy – Appleton-Whittell Research Ranch Flora and - Herbarium Update:** In response to recent taxonomic changes, past Research Ranch Director Dr. Linda Kennedy completed a much-needed update to our on-site herbarium and digitally-available flora. The on-site herbarium continues to be an invaluable resource for staff and visiting researchers, and the most up-to-date flora can be found in the Appleton-Whittell Research Ranch website library.

- **Richard F. Lance (U.S. Army Engineer Research and Development Center) – eDNA Bioindicators of Soil Provenance:** There is likely a wealth of environmental information that can be obtained from soil environmental DNA (eDNA). However, for eukaryotic taxa, the reservoir of environmental information represented by soil eDNA is largely undescribed. This project focuses on understanding patterns in eukaryotic eDNA in soil and the degree to which these patterns can be used as bioindicators for soil ecological affiliations and points of origin. Soil collected on the Research Ranch during this and in previous year will be used as test samples for evaluating developing soil classification models, and results may contribute to eventual soil eDNA capabilities useful in natural resource management and conservation.

- **Rachel Laura (University of Arizona) – Shining a Light on an At-Risk Species - Investigations into the Abundance and Habitat Requirements of an Imperiled Arizona Firefly:** Petitioned for listing by the U.S. Fish and Wildlife Service in 2023, the Southwest Spring Firefly (*Bicellonycha wickershamorum wickershamorum*) can be found at marshy, ephemeral sites along canyons and streams and at seeps and springs in the mountains and foothills of the Madrean Sky Islands. This project aims to identify and assess populations of this firefly in preparation for the upcoming species status assessment. The Research Ranch is home to significant populations of this imperiled firefly, and was added as a survey location last year. This year, wildlife cameras were deployed at the Research Ranch's most densely populated site as part of an AI-assisted monitoring effort.

- **Meryl Mims (Virginia Tech) – Simulating Metapopulations and Removal Tactics for Strategic Invasives Management (SMARTSIM) - a Data-Driven, Multi-Species Simulation Framework for Effective Management of Aquatic Invasive Species in the United States:** Managing invasive species is complex, and tools with which to address spatial and multi-species challenges are limited. Through collaboration with the U.S. Forest Service and with a focus on American bullfrogs (*Rana catesbeianus*) and Chiricahua leopard frogs (*Rana chiricahuensis*), this project aims to test and transfer efficient and effective

management strategies that optimize the control of invasives while promoting the persistence of at-risk species. By developing strategies and tools to inform efficient management decisions, this research has the potential to benefit land managers, conservationists, and priority species across the southwest.

- **Laura Nicholson (Northern Arizona University) – Emory Oak and an Investigation of the Emerging Pathogen *biscogniauxia:*** A keystone plant in southeastern Arizona, Emory Oak (*Quercus emoryi*) feeds birds like the Montezuma Quail, Mexican Jay, and Acorn Woodpecker. Just as importantly, Emory Oak acorns have long been gathered and consumed by Indigenous communities including the Yavapai, Tonto, San Carlos, and White Mountain Apache Tribes. This project aims to understand how emerging pathogens, drought, climate change, and other threats may be impacting Emory Oak survival and to provide practical steps that can be taken to protect this tree and the southwestern ecosystems and communities that depend on it.

- **Grace O'Malley (Virginia Tech) – Investigating the Breeding Phenology of a Threatened Amphibian (*Hyla wrightorum*):** The Arizona Treefrog (*Hyla wrightorum*) is a small green and black treefrog listed as a Species of Greatest Conservation Need by the Arizona Game and Fish Department that is found mostly above the Mogollon Rim in Arizona and eastward into New Mexico. Smaller and less well understood populations exist in Huachuca Mountains and Canelo Hills, and animals are periodically encountered on the Research Ranch. This project is using acoustic recorders to investigate this species' breeding phenology and to address knowledge gaps in its spatial and temporal dynamics in the region.

- **Andrew Salywon (Desert Botanical Garden) and Ron Tiller (Arizona Department of Environmental Quality) – Long-Term Groundwater Monitoring:** This project monitors three shallow groundwater wells installed in the late-1990's. These wells are in the bottomlands of Post and O'Donnell canyons, two of the Research Ranch's primary drainages, and were initially installed to understand the water requirements of the bunchgrass Big Sacaton (*Sporobolus wrightii*) and the floodplain grasslands it dominates. Now, however, these wells are helping to understand how groundwater levels respond to precipitation, stormflows, drought, and extreme temperatures. In June 2015, all three wells were outfitted with transducers to measure water levels at 30-minute intervals. Since then, the project has accumulated an almost continuous record of water levels.

- ****Heaven Perez Sanchez (Arizona State University) – Evaluating Habitat Use and Movements of Three Grassland-Obligate Sparrows:** As part of the Appleton-Whittell Grassland Sparrow Motus Project, this effort aims to explore the use of Motus technology (stations and nodes) as a tool with which to study the long-distance movements and on-ranch behavior of three grassland-obligate sparrows – Cassin's, Botteri's, and Grasshopper. A far cry from the high-flying long-distance migrants Motus technology is best known for tracking, these sparrows spend much of their lives within a few feet of the ground and as such present a set of unique challenges. This project will identify potentials and limitations of this tool and will inform the direction of the overall Appleton-Whittell Grassland Sparrow Motus Project going forward.

- **Sara Souther (Northern Arizona University) – Projecting Socio-Ecological Impacts of Drought in Southwestern Ecosystems to Prioritize Restoration:** For Indigenous communities, culture and ecology are intertwined and local species are often used for practical and/or ceremonial purposes. In Arizona and New Mexico, several tree species important to local Tribes are facing declines resulting from unprecedented ecological change, putting habitats and traditions at risk. As part of a broader, regional effort focused on several species, study plots on the Research Ranch are focused on identifying abiotic and biotic drivers of decline and resiliency in populations of Emory Oak. Using these monitoring data, researchers hope to inform the development of effective, science-based management strategies to sustain the species long-term.

- **Sara Souther (Northern Arizona University) – Conservation of the Endangered Species *Pectis imberbis*:** *Pectis imberbis*, known by its common name "beardless chinchweed", is a relative of the sunflower that was listed as an endangered species by the U.S. Fish and Wildlife Service in 2021. In the United States is known only from the Coronado National Memorial, portions of the Coronado National Forest, and the Research Ranch. Study of *Pectis imberbis* on the Research Ranch is aimed at better understanding how this recently listed and often overlooked plant responds to grazing, competition with invasive species, fire, and human disturbance. Data from this work will serve to inform ongoing recovery efforts.

- **Emma Sudbeck (University of Arizona) – Population Ecology of the Invasive American Bullfrog in Southeast Arizona:** Stocked into Arizona's waters by the Arizona Game and Fish Department from the 1920s into the early 1980s as a game (huntable) species, American bullfrogs (*Rana catesbeianus*) were quick to overwhelm native aquatic wildlife and those tasked with managing it. Using mark-recapture and radio telemetry techniques, this study will help further our knowledge of American bullfrog natural history and provide wildlife managers with information that allows them to leverage their limited resources by identifying sites and seasons during which removal efforts will have the greatest impact.
- **Matt Webb (Bird Conservancy of the Rockies) – Chihuahuan Birds Motus:** Chihuahuan desert grasslands are disproportionately valuable to North America's breeding grassland birds (of the 34 grassland obligate species nesting in the Great Plains, 85% overwinter in the Chihuahuan desert). Unfortunately, this habitat type is in decline and data describing Chihuahuan desert grasslands bird distribution, abundance, and habitat requirements are limited. Using the Motus station installed during a workshop on the Research Ranch in 2022 as one of the westernmost outposts in their monitoring network, the Bird Conservancy of the Rockies is seeking to fill these data gaps and, through partnerships in both the United States and Mexico, develop a platform for Chihuahuan desert grassland bird conservation.
- ***Ashlee Wolf (National Park Service) and Finn Anderson (Borderlands Restoration Network) – Seeds of Success Collection and Burned Area Rehabilitation Program:** Through the collection and propagation of native seed, this project aims to assist the Department of Interior and their partners in enhancing the resiliency of six ecoregions, including the Madrean Archipelago, that are vulnerable to future wildfires. Currently, the commercial native seed market in the southwestern United States does not produce sufficient affordable and locally adapted native seed. This project aims to address that gap by producing native plant materials to meet immediate restoration needs and increase the availability of these materials in the commercial market, enabling broader use by land managers throughout the region. Wildland seed collected on the Research Ranch will be cultivated through agricultural seed increase and prioritized for use in post-fire recovery efforts on Department of Interior-managed lands.

Publications Received Since the 2024 Field Season

(If you published work in the past year resulting from time spent on the Research Ranch that is not listed below, or if you have at any time published Research Ranch-related works that are not listed in our online bibliography, please send information to researchranch@audubon.org.)

Bauder, Javan Mathias, and Chris L. Prewitt. *Control of introduced American bullfrogs and support of Chiricahua leopard frog conservation in southeast Arizona*. No. CSS-156-2024. US Fish and Wildlife Service, 2024.

Brann, Mia Abigail. *Resilience Through Adversity: Exploring the Effects of Disturbance on Persistence of the Rare Plant Pectis imberbis*. MS thesis. Northern Arizona University, 2024.

Drake, Joseph, et al. "Combining graph theory and spatially-explicit, individual-based models to improve invasive species control strategies at a regional scale." *Landscape Ecology* 39.11 (2024): 185.

Gilb, Scott, et al. "Population structure and genetic connectivity in the endangered Pectis imberbis: addressing conservation and genetic gaps in the Arizona Sky Islands." (2025).

Goerge, Tyler M., and Donald B. Miles. "Territorial status is explained by covariation between boldness, exploration, and thermal preference in a colour polymorphic lizard." *Ecology and Evolution* 14.10 (2024): e70321.

Gucker, Corey L., and Nancy L. Shaw. "Spreading fleabane (Erigeron divergens)." *In: Gucker, CL; Shaw, NL, eds. Western forbs: Biology, ecology, and use in restoration. Reno, NV: Great Basin Fire Science Exchange. Online: https://westernforbs. org/species/spreading-fleabane-erigeron-divergens/.* (2024).

Palka-Flores, Elena. *Grasshopper Diversity and Community Ecology in the Madrean Sky Islands of Arizona*. MS thesis. Arizona State University, 2024.

Ramos, Laura Melissa González. "Escalamiento de la evapotranspiración en una ecorregión semiárida." (2025).

Souther, Sara, Martha W. Sample, and Clare E. Aslan. "Climate Drives Landscape Variation in Demographic Response of the Endangered Plant, Pectis Imberbis (Gray)." *Pectis Imberbis (Gray)*.

Sison, Ke'alani Bel. *Form, Function, and Flight: Urbanization Impacts on Trait Relationships in Ornate Tree Lizards*. MS thesis. Christopher Newport University, 2025.

Sudbeck, Emma L., and Javan M. Bauder. "Population Ecology of the Invasive American Bullfrog (Rana catesbeiana) in Southeastern Arizona."

Westeen, Erin Paige. *Resource Partitioning and Ecomorphology across Levels of Biological Organization in Spiny Lizards, genus Sceloporus*. Diss. University of California, Berkeley, 2024.

Zamudio-Beltrán, Luz E., et al. "Parallel and convergent evolution in genes underlying seasonal migration." *Evolution Letters* 9.2 (2025): 189-208.

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