Great Plains Science

2025 Impact Report

Welcome Letter

Dear Friends of the Great Plains Science Program,

I'm thrilled to be joining the Great Plains Science Program as Director. In the few short months since I arrived, I've been struck by the talent, care, and commitment of the experts on our team.

I join the Smithsonian with 14 years of experience in conservation ecology. Most of that time was spent asking different versions of the same question: how do we support healthy landscapes where both people and wildlife can thrive? From the savannas of East Africa, where I worked to protect both elephant movement corridors and local livelihoods, to evaluating bighorn sheep population health to inform management decisions in Colorado, I have found that lasting conservation outcomes start with understanding place and including people.

For Great Plains Science, 2025 was a year of growth and transition. We welcomed a soil scientist whose expertise is expanding our capacity for novel soil health research. In addition, we now have a community coordinator for the Inter-Tribal Grassland Network who is growing Tribal community engagement and incorporating cultural perspectives into the education and research activities of the Network.

Our core science programs continued to move forward with rigor and depth. We are developing cutting-edge methods to investigate the unknown underground ecology of prairie dogs and endangered black-footed ferrets. Across the Great Plains biome, from Canada to Mexico, we are discovering the key habitats that support vulnerable grassland songbird migration. With our Tribal Nation and American Prairie partners, we are advancing knowledge of grassland function and resilience, while monitoring the outcomes of buffalo restoration to inform land and herd management.

Despite the challenges facing grassland conservation, the Great Plains have enormous potential to support abundant wildlife and the communities that call grasslands home. I'm grateful for the opportunity to contribute to a team working to realize that potential, and excited to bring new momentum and perspective to this work.

Thank you for being a part of this effort. Together, we are building the future we hope to see: healthy, biodiverse grasslands and thriving communities. I look forward to sharing more of what we are building together on the pages that follow.

Sincerely,

Sarah Louise Carroll, Ph.D.
Director, Great Plains Science Program

Great Plains Science Team

New Staff

Sarah Carroll, Ph.D., Program Director[1]

Sarah leads our dynamic team of scientists working to understand, sustain, and restore Great Plains habitats and the species that depend on them. Sarah is focused on cultivating networks of research and conservation practice with landowners, Tribal Nations, NGOs, government agencies, and other stakeholders to secure a future for grassland systems and the communities they support.

Jaron Adkins, Ph.D., Ecologist[2]

Jaron focuses on how soils support healthy ecosystems. His work identifies how conservation, restoration, and management actions in the habitats of the Great Plains impact the soil functions that provide valuable benefits to plants, wildlife, and humans.

Maya Rayle, Ecologist[3]

Maya leads the research component of a multi-stakeholder effort to restore degraded streams on working lands. She collaborates with ranchers, organizations, and agencies to research whether a new stream restoration strategy is leading to improvements in climate resilience, vegetative productivity, and biodiversity in grasslands. Her work provides information on ecosystem health while uniting a diverse array of stakeholders.

Kai Baker, Community Coordinator[4]

Learn more on page 5.

Current Staff

Andy Boyce, Ph.D., Research Ecologist[5]

Olivia Cosby, Ecologist[6]

Jesse Boulerice, Research Ecologist[7]

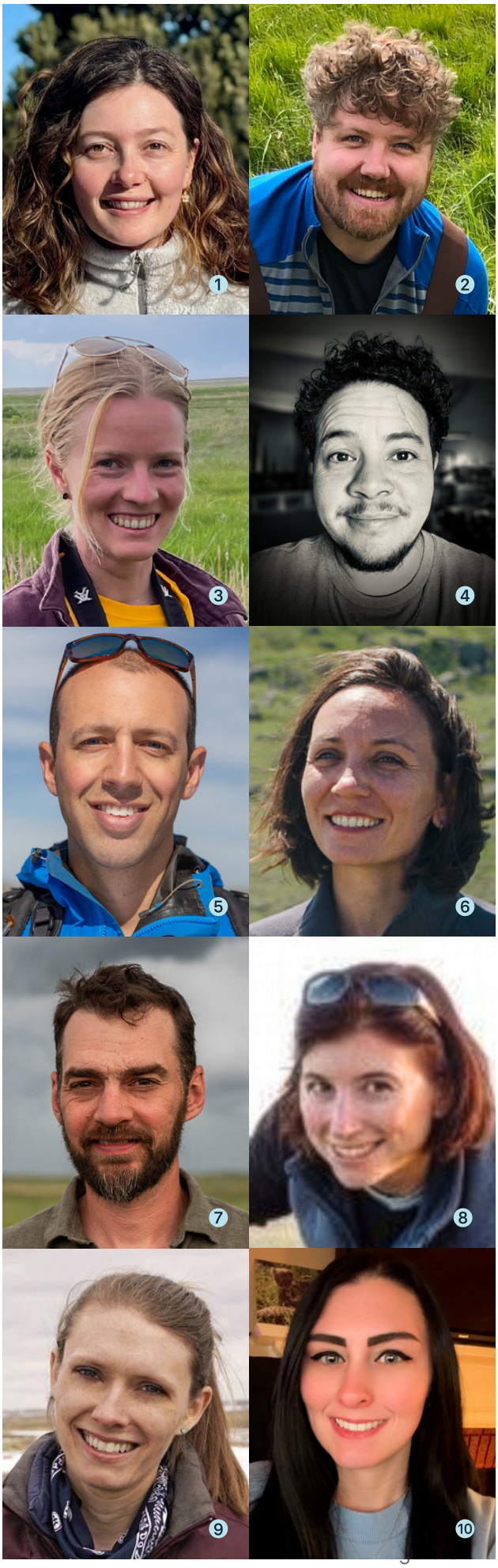
Jessica Alexander, Biologist[8]

Colleen Matzke, Advancement Program Specialist[9]

Patience McNulty, Management Support Specialist[10]

Acknowledgement

In 2025 program director Hila Shamon, ecologist Mitchell Sertoa and ecologist Ellen Welti moved on to new adventures. We are grateful for the time, talent and leadership they shared with the GPSP.



Climbing Toward Discovery

Intern Reveals How Grasshoppers Beat the Heat

On the prairies of eastern Montana, where summer temperatures can exceed 100°F, survival requires remarkable adaptation. Thanks to your support of Smithsonian's Great Plains Science Program, interns are helping uncover how even small creatures respond to extreme heat—and what that means for ecosystems facing climate change.

In the summer of 2025, intern Nadia Alhassani, working alongside Smithsonian researchers, observed grasshoppers clustering high on plant stems and fence posts during the hottest parts of the day. This simple observation quickly became a research opportunity. With guidance from program scientist Ellen Welti, Nadia helped investigate whether this behavior was a deliberate strategy to cope with heat.

Using temperature sensors and field measurements, Nadia found that conditions near the ground were significantly hotter than just a few inches above it. By climbing, grasshoppers were able to access cooler microclimates and regulate their body temperature. This behavior allows them to stay within a survivable range, even as surface temperatures soared, sometimes reaching 140°F.

These findings highlight a surprisingly effective survival strategy—and one with broader ecological importance. Grasshoppers play a key role in grassland ecosystems, influencing plant communities and nutrient cycling. Understanding how they respond to rising temperatures provides valuable insight into how entire ecosystems may adapt to a warming world.

Just as important as the discovery itself is how it happened. Donor support made it possible for interns like Nadia to engage directly in hands-on research, from observation to data collection and analysis. Through this experience, interns contribute to meaningful scientific findings while building the skills needed for careers in conservation and ecology.

In 2025 our team published 27 new articles about the Great Plains in peer-reviewed journals and 31 new articles in total. Under the mentorship of our scientists, two papers were published by interns from our program.

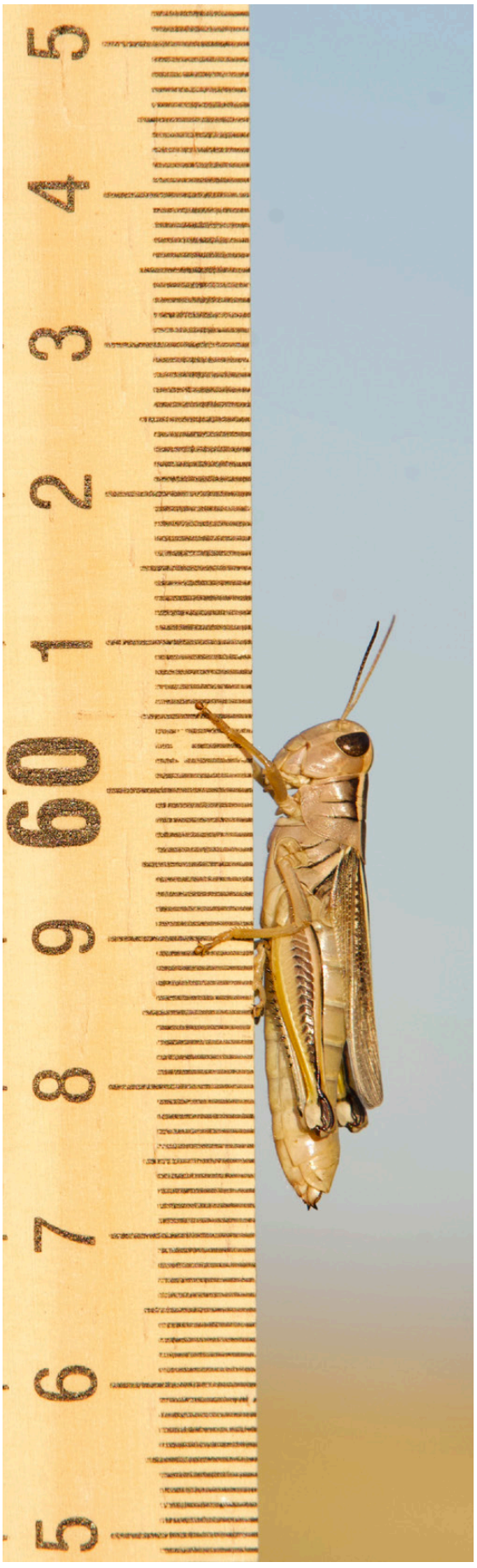


Photo by Nadia Alhassani

Interns prepare camera traps. Photo by Olivia Cosby.

Expanding Community Leadership

Overview

The Intertribal Grassland Network unites tribal communities, conservation organizations, and academic institutions to address socio-ecological challenges and ensure the resilience of Native American communities. Anchored in bison restoration, the Network combines cultural renewal with ecological stewardship to foster healthy grasslands and vibrant communities. 2025 marked the third year of research and education activities for the network. We are at an exciting inflection point, where we are now analyzing what we have learned so far and looking to ensure the future of the network.

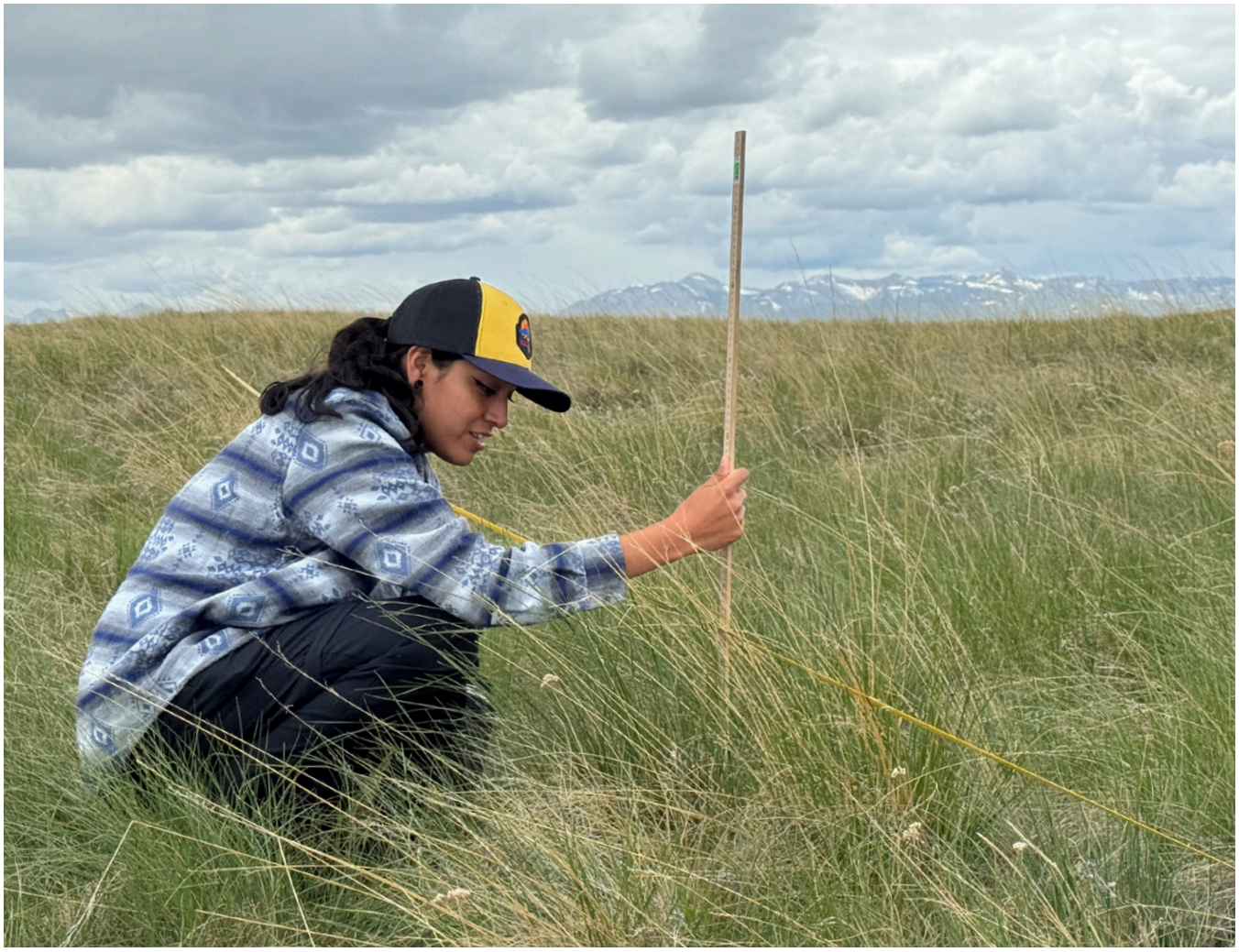
Spotlight: Kai Baker / Maka Tehan Waste Wiya

Kai, our new community coordinator lives in Poplar, Montana, on the Fort Peck Reservation. In their new contractor role with Great Plains Science, Kai will be focused on increasing our engagement and outreach with Native American communities and Tribal Nation stakeholders. They are also leading a new effort to incorporate cultural perspectives into our ecological education modules, and crucially, they are working with us to envision and design the future of the Network. Kai is always working to strengthen their kinship with land, water and non-human relatives in an effort to be a better relative. Kai understands that the disruption of multiples ways of knowing and being in relationships was, and still is, intentional, and that re-establishing these relationships will strengthen and heal Indigenous peoples, lands, waters, and kinship roles.

Expanding Community Leadership, Cont.

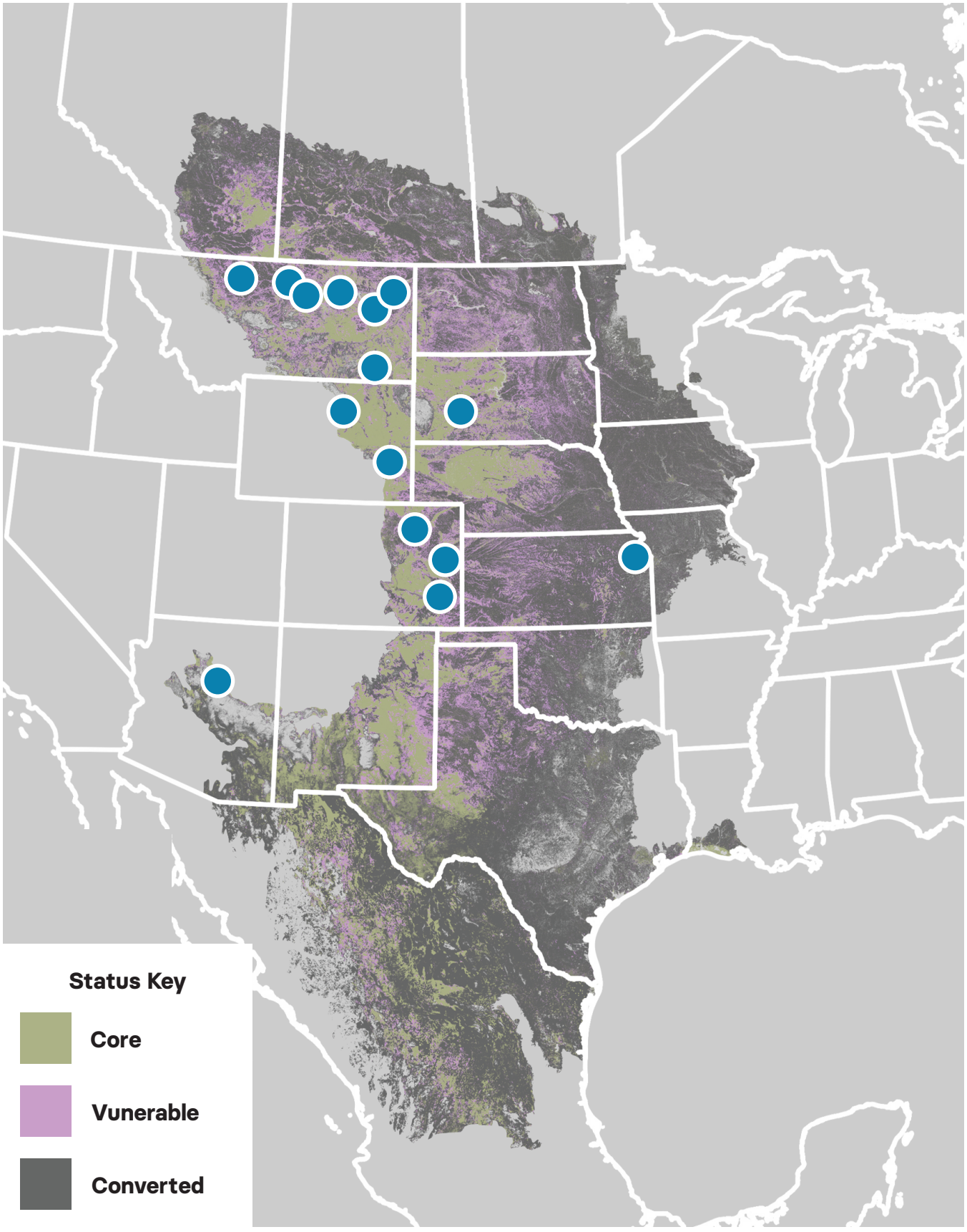
Additional Updates

- **Expanded Internship Program:** During our 3rd field season, we had our largest crew of interns to date, with 5 Tribal College interns recruited! All interns shared a week of training and camaraderie while camping at Blackfeet Nation. Each intern conducted an independent research project, collecting land-use history information from local elders and buffalo program directors, information that will inform our shared research.
- **New research:** Following the guidance of ideas for new research directions from the Inter-Tribal Community Advisory Board, we were successful in securing funding for a new study investigating how bison selectively graze when migration is restricted. All bison in Montana are managed in fenced pastures, but there is little information as to how this impacts both their health and the health of grasslands at reintroduction sites. The study will be based at the National Bison Range managed by the Confederated Salish Kootenai Tribes.



Intern measures vegetation height. Photo by Olivia Cosby.

Grasslands Map



Swift fox kits at the Fort Belknap Indian Reservation in Montana. Photo by Roshan Patel.

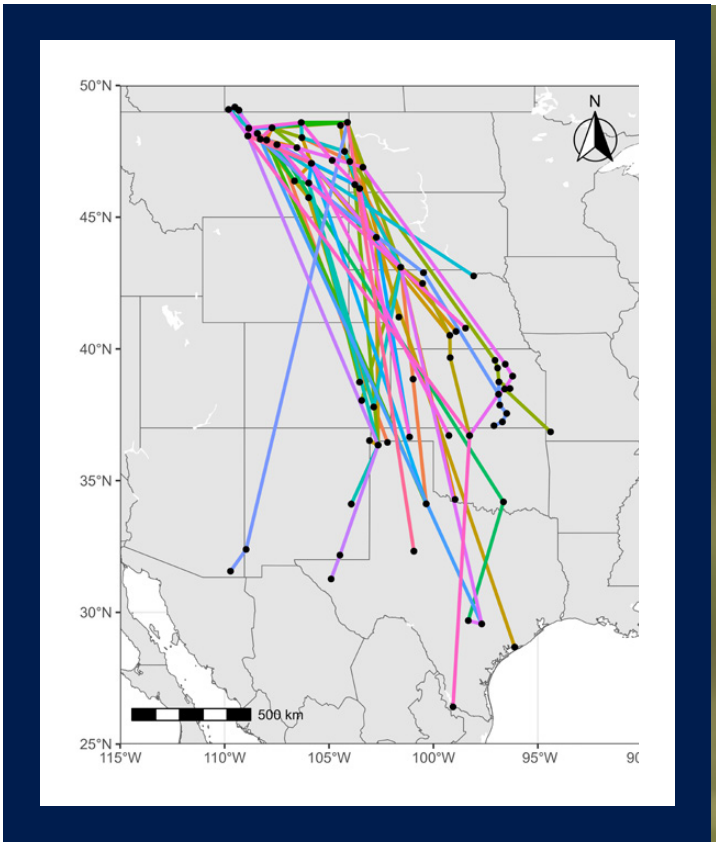
Monitoring Restored Swift Fox Populations

Overview

In 2025, we entered Phase 2 of the swift fox restoration project with our partners at the Aaniiih Nakoda College and Fort Belknap Fish and Wildlife Department. We secured funding to support a graduate student, Owen Kanter, at Montana State University and tribal college interns from ANC to collaborate on the project. They will assess the status of the reintroduced swift fox population to inform future conservation efforts for the population. Research will focus on analysis of genetic samples as well as movement data from collared animals to evaluate the genetic diversity of the population and to understand how wild born individuals are utilizing the landscape.

Updates

- **Live-Trapping:** Across the 2025 fall trapping season, seven swift foxes were captured and genetic samples were collected for analysis. The genetic samples will allow for comparisons of relatedness between individuals and to the original swift foxes that were translocated to the reservation.
- **Distributional Monitoring:** Camera trap stations were placed across the Fort Belknap Indian Reservation to monitor current distribution of swift foxes and highlighted two areas of continued population persistence. Camera trapping will continue next summer to ensure the current distribution is fully documented.
- **Collaboration:** The initial field season allowed the graduate student opportunity to engage ANC interns in the research process, assisting with camera trap surveys and taking part in the live-trapping process. Interns will continue to have opportunities to contribute to this research across the field season.



Left: Migratory paths of 23 Sprague's Pipits tagged by the Great Plains Science team in 2025. Map by Nancy Raginski.
Right: Sprague's pipit tagged with Motus tag for tracking in the Great Plains. Photo by Andrew Motte.

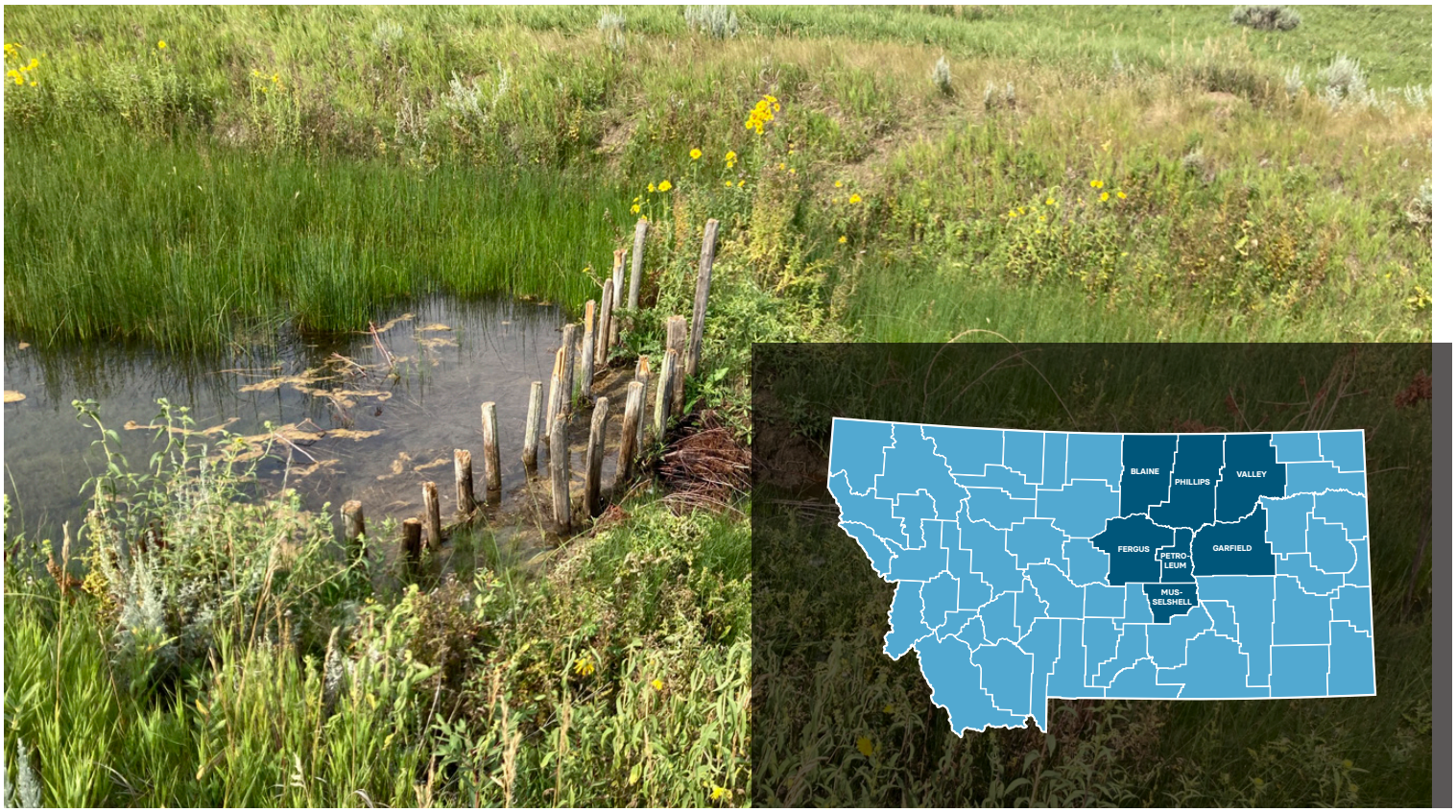
Mapping the Hidden Migration of a Rare Songbird

Overview

In 2025 we completed the 4th and final season of tagging and tracking of Sprague's Pipits on their breeding grounds in the Northern Great Plains of the US. Specifically, we captured and tagged 116 birds in northcentral Montana on Fort Belknap Indian Reservation and American Prairie land, and 15 birds on private lands in western North Dakota in collaboration with North Dakota Game and Fish Department. Fieldwork was led by Smithsonian Research Fellow and PhD student, Nancy Raginski, and Research Ecologist, Andy Boyce.

All of the data received from these tagged birds will provide our first look into the migratory ecology of this highly imperiled and little-known songbird. Because we, with collaborators, are tagging birds across the breeding range, we will also gain an understanding of the migratory connectivity of this species. Finally, over the next 12 months, we will use the complete 4-year tracking dataset to complete demographic models that will tell us when and where during the travels of Sprague's Pipits is survival highest and lowest. This will inform where conservation efforts can have maximum effect on overall population trends.

Initial results from North Dakota indicate that these birds spend the winter across the entire wintering range of the species, from southeastern Arizona to the coastal Texas prairies. Individuals tagged in Montana show a similar pattern. This suggests that Sprague's Pipits have weak to no migratory connectivity. That is, breeding location is not predictive of the wintering location.



Beaver dam analogue. Photo by Maya Rayle.

Convening Communities Around Stream Restoration

Temperate grasslands are the most threatened ecosystem in the world. Within grasslands, the vegetation around wetlands and streams (called riparian areas) are critical habitat for many local and migratory species, however, many of these systems are highly degraded. This negatively impacts wildlife, and reduces forage for cattle and other livestock, which make up a key part of the Northern Great Plains economy.

Beavers used to play a key role in slowing down water on the prairies, but since their numbers were vastly reduced in previous centuries, this ecosystem service has all but disappeared. Today, ranchers and other land stewards are installing structures that mimic the role of beaver dams to create wider and more complex riparian areas, supporting more varied plants, which then create a cooler and wetter habitat for wildlife.

We compare restored and unrestored stream sites using a variety of sensors to measure soil moisture, vegetation growth, and bird biodiversity, assessing climate resilience and productivity. To date, our team has deployed 156 sensors at 13 paired sites across 6 counties. Our data collection is ongoing.

While the scientific outcome of this research will take years to mature, this project has already made tremendous social strides. Healthy, productive landscapes that provide habitat for wildlife and support livestock are a shared goal of many in the West. Our work on this project has brought together 8 non-profits and a diverse array of private landowners who are united in their vision for a resilient and productive prairie.

A herd of cows on American Prairie. Photo by Andrew Motte.

Does Grazing Increase Soil Carbon Storage?

Overview

Nearly one-third of the global terrestrial carbon stock is stored in grasslands, with approximately 90 percent of that carbon found below ground. Understanding how to manage grasslands for sustainable livestock production while simultaneously promoting carbon storage and protecting wildlife habitat is critical for safeguarding the value of grasslands to the planet. Our research will provide new insights into the role grasslands will play in addressing climate challenges of the future.

Updates

- In 2025, we hired a soil scientist, Dr. Jaron Adkins, to answer this question. Jaron is managing a global network of collaborators who have collected more than 300 soil samples from fifteen grassland sites distributed across four continents. In addition to the newly collected samples, Jaron is resynthesizing decades-worth of previously published data from 97 sites to identify long-term trends of grazing effects on soil.

Black-footed ferret collaring and release in Montana Photo by Roshan Patel.

High-Tech Hope for Black-Footed Ferrets

Overview

For more than 40 years, conservationists have worked to restore black-footed ferrets to the wild at a meaningful scale. While captive breeding, genetic rescue, and reintroduction have prevented extinction, a key challenge remains: many released ferrets do not survive. The Great Plains Science Program team is advancing innovative technologies to identify causes of post-release mortality, improve tracking, and deliver critical vaccinations to support population recovery.

Updates

- In 2025, our team, led by Research Ecologist Jesse Boulerice, developed a novel approach to studying black-footed ferrets by integrating high-frequency accelerometers with wildlife trackers. This method delivers unprecedented insight into ferret movement and behavior and will help assess survival of reintroduced populations to inform conservation and management decisions.
- We also advanced monitoring techniques using drones equipped with thermal cameras and radio-telemetry payloads to track these elusive, nocturnal animals. This approach reduces hundreds of person-hours, minimizes ecological disturbance, and has driven new partnerships with conservation groups in Wyoming, Colorado, South Dakota, and Montana.
- Our team, including Ecologist Jessica Alexander, supported monitoring efforts at Fort Belknap Indian Reservation in northern Montana—one of the few sites where reintroduced ferrets have successfully established. In collaboration with tribal partners, we administered critical vaccinations to 38 ferrets.

By the Numbers

In 2025

4
New Grants Awarded

71
Species Detected on Wildlife Cameras

15
New Publications by Program Scientists

330
Soil Samples Collected

Since 2018

22
Graduate Fellows Trained

60
Scientific Publications

108
Internships Completed

>150
Community Members Engaged

Program Support

Grant Funding

The Great Plains Science Program began in 2018 with support from the Mars family who have continued to generously support our program. This funding has been crucial to sustaining program operations and core scientist positions.

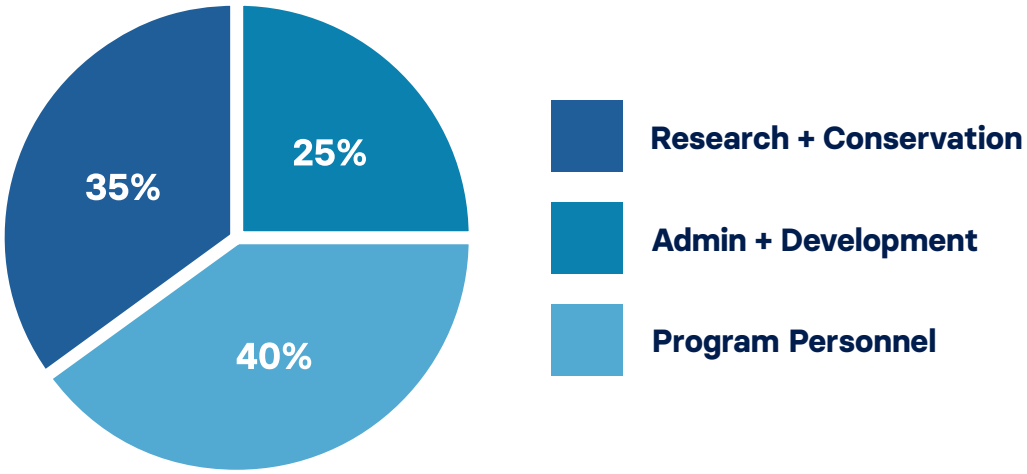
$10.5M
Additional Grants and Gifts Leveraged

With their support, we have raised over $10.5 million in additional funds from competitive grants and new donors since 2018. Additionally, Great Plains Science Program research has helped secure more than $10 million in total grants to science partners and collaborators.

Income

Gifts	$	1,069,195
Competitive Grants	$	156,642
FY25 Operating Budget	**$**	**1,225,837**

Budget Allocation



100% of GPSP funds come from philanthropic gifts, grants, and community support.

Scientific Publications

In 2025 our team published 15 new articles in peer-reviewed scientific journals.

1. Aagaard Kristensen, Jeppe, Katerina Georgiou, and Ellen Welti. 2025. "Effects of Bioturbation on Soil Carbon and Nutrient Stocks: Insights from the American Prairie." April 1, EGU25-8977. https://doi.org/10.5194/egusphere-egu25-8977.

2. Alhassani, Nadia, and Ellen Welti. 2025. "High Rises and Optimal Temperatures: Grasshopper Microclimate Selection." *Ecology* 106 (October). https://doi.org/10.1002/ecy.70232.

3. Baker, Nathan J., Francesca Pilotto, Ellen A. R. Welti, Diana Osadčaja, and Vaidas Palinauskas. 2025. "Recovery or Reorganisation? Long-Term Increases in Riverine Taxonomic and Functional Diversity Are Confounded by Compositional Dynamics." *Hydrobiologia* 852: 1693–715. https://doi.org/10.1007/s10750-024-05665-5.

4. Bennett, Shelley K., Kathryn J. Bloodworth, Sarah J. M. Alley, et al. 2025. "Characterizing the Drivers of Northern Mixed-Grass Prairie Plant Community Composition." *Natural Areas Journal* 45 (3): 159–68. https://doi.org/10.3375/2162-4399-45.3.4.

5. Boulerice, Jesse, Kristy Bly, Shawn Jepson, et al. 2025. "Detection of the Endangered Black-Footed Ferret Mustela Nigripes Using Thermal-Infrared Cameras." *Endangered Species Research* 56 (March): 135–44. https://doi.org/10.3354/esr01387.

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8. Dreelin, Richard A., Andy J. Boyce, and Holly P. Jones. 2025. "Keystone Effects of Prairie Dogs (Cynomys Spp.) on Grassland Birds: Current Knowledge and Future Directions." *Conservation Science and Practice* 7 (4): e70004. https://doi.org/10.1111/csp2.70004.

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10. Duchardt, Courtney J., Jacob D. Hennig, Lauren M. Porensky, et al. 2025. "A Disturbance Triangle: The Interactive Role of Prairie Dogs with Fire and Ungulate Grazing in the Great Plains." *BioScience*, August 25, biaf125. https://doi.org/10.1093/biosci/biaf125.

11. Haase, Peter, Daniela Cortés-Guzmán, Fengzhi He, et al. 2025. "Successes and Failures of Conservation Actions to Halt Global River Biodiversity Loss." *Nature Reviews Biodiversity*, January 20, 1–15. https://doi.org/10.1038/s44358-024-00012-x.

12. Hiller, Tim L., Julia Nawrocki, Tina Jackson, et al. 2025. "Evaluating Conservation Detection Dogs during Surveys of Black-Footed Ferrets in Colorado." *Northwest Science* 98 (3): 190–205.

13. Kaspari, Michael, and Ellen A. R. Welti. 2025a. "Building Plant Diversity into Mechanisms of Nutrient Dilution." *Trends in Ecology & Evolution* 40 (4): 329–30. https://doi.org/10.1016/j.tree.2025.02.011.

14. Kaspari, Michael, and Ellen A. R. Welti. 2025b. "Drivers of 30 Years of Ionomic Change on a North American Tallgrass Prairie." *Ecology* 106 (11): e70266. https://doi.org/10.1002/ecy.70266.

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19. Nelson, Dana L., Hila Shamon, William J. McShea, et al. 2025. "Post-Release Settlement and Resource Selection by Reintroduced Swift Fox." *Restoration Ecology* 33 (7): e70120. https://doi.org/10.1111/rec.70120.

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Selected 2025 Media Coverage

Sierra Magazine

Swift Foxes Go West

North America's smallest fox has started to show up in places no one expected

High Country News

The invisible 'giant nets' that catch the smallest songbirds

Collaboration and tiny technology are revolutionizing the study of migration.

NPR

Why eavesdropping on prairie dogs pays off for this bird

Popular Science

Tiny prairie dogs' poop play a mighty role in grasslands

These environmental engineers and grasshoppers turn over more nutrients in the soil than bigger species do

The Denver Gazette

Researchers in Colorado using cutting-edge tech to track the continent's most endangered mammal

USA Today

Scientists track 'the secret underground lives' of an elusive animal

If only black-footed ferrets had a brand ambassador like groundhogs have in Punxsutawney Phil.

To learn more or support this program, contact

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