Biennial Report

August 2022 - August 2024

Kansas Cooperative
Fish and Wildlife Research Unit

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Unit Cooperators

U.S. Geological Survey
Kansas Department of Wildlife and Parks
Kansas State University
Wildlife Management Institute
U.S. Fish and Wildlife Service

TABLE OF CONTENTS

Preface

The Kansas Cooperative Fish and Wildlife Research Unit is jointly sponsored and financed by the U.S. Geological Survey-Biological Resources Division, Kansas Department of Wildlife, Parks, and Tourism, Kansas State University, U.S. Fish and Wildlife Service, and the Wildlife Management Institute.

In 1960, Congress gave statutory recognition to the Cooperative Research Unit program by enactment of Public Law 86-686. The act reads:

> "To facilitate cooperation between the Federal Government, colleges and universities, the States, and private organizations for cooperative unit programs of research and education relating to fish and wildlife, and for other purposes. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources, the Secretary of the Interior is authorized to continue to enter into cooperative agreements with colleges and universities, with game and fish departments of the several States, and with nonprofit organizations relating to cooperative research units: Provided, That Federal participation in the conduct of such cooperative unit programs shall be limited to the assignment of the Department of the Interior technical personnel by the Secretary to serve at the respective units, to supply for the use of the particular unit's operations such equipment as may be available to the Secretary for such purposes, and the payment of incidental expenses of Federal personnel and employees of cooperating agencies assigned to the units. There is authorized to be appropriated such sums as may be necessary to carry out the purposes of this Act."

The Kansas Unit opened in October 1991 at Kansas State University in Manhattan. Dr. Timothy R. Modde was appointed as the first Unit Leader. Ms. Joyce Brite was hired as office manager. In May 1992, Dr. Modde left the Unit to take a position with the Colorado River Fisheries Project, U.S. Fish and Wildlife Service, in Vernal, Utah. Dr. Michael R. Vaughan of the Virginia Cooperative Fish and Wildlife Research Unit was assigned to the Kansas Unit as Acting Unit Leader for a six-week period.

Dr. Philip S. Gipson was selected as the Unit Leader in May 1993. In 1994, Dr. Christopher S. Guy was hired as Assistant Leader-Fisheries and Dr. Jack F. Cully, Jr. was hired as Assistant Leader-Wildlife.

Dr. Guy left in August 2002 to become Assistant Leader-Fisheries at the Montana Cooperative Fishery Research Unit in Bozeman. In November 2003, Dr. Craig P. Paukert joined the Kansas Unit as Assistant Leader-Fisheries.

In May 2008, Dr. Philip S. Gipson retired from the Kansas Unit. He accepted a position as department head at Texas Tech University in Lubbock. Dr. Craig P. Paukert was appointed as Acting Unit Leader.

In May 2010, Dr. Paukert assumed the Unit Leader position at the Missouri Cooperative Fish and Wildlife Research Unit. Dr. Jack Cully was appointed Acting Unit Leader. Dr. Martha Mather joined the Kansas Unit in October 2010 as Assistant Unit Leader-Fisheries. Dr. David Haukos was hired as Unit Leader in February 2011. In September 2012, Dr. Jack Cully retired from the Kansas Unit. Joyce Brite retired in December 2017. Maiah Diel was hired as Unit office manager and administrative assistant in January 2018 and resigned in February 2019. Tara Dreher was hired as Unit office manager and administrative assistant in June 2019. Dr. Dan Sullins joined the Kansas Unit in November 2023 as Assistant Unit Leader – Wildlife.

The Unit Leader and the Assistant Unit Leaders are faculty members in the Division of Biology at Kansas State University. Graduate students are typically associated with the Unit are part of the Division of Biology and graduate degrees are awarded through the Division; however, graduate students have been associated with the Departments of Geography and Geospatial Sciences; Horticulture and Natural Resources; Statistics; and Animal Science. Unit staff and students often work on partnership projects that involve specialists from Kansas State University, other universities, state and federal agencies, and other cooperating groups.

During the reporting period, 12 projects were initiated and ongoing, and 2 projects were completed. Four students finished M.S. degrees and 1 finished Ph.D. degrees.

<u>New/On-going Projects:</u>

Wild Turkey Population Demography and Ecology in Kansas

Status of Native Bumble Bees (*Bombus* spp.) at Fort Riley Military Reservation, Kansas

Designing Optimal Landscapes for Lesser Prairie-Chicken Conservation

Identification of Landscape Thresholds and Patch Dynamics for Lesser Prairie-Chickens

Movements, Space Use, and Vital Rates of Mourning Doves

Multi-scale Response of Lesser Prairie-Chickens to Future Changes in Land Use and Land Cover

Strategic Conservation of Grassland Habitat for Greater Prairie-Chickens and Pronghorn in Kansas

Distributions and Habitat Associations of Four Bat Species in Kansas

Wild Turkey Poult Foraging Ecology and Nutrient Availability in Kansas

Evaluation of CRP Vegetation Relative to Provision of Lesser Prairie-Chicken Habitat

Quantifying Loss of Stocked Fish to Avian Predators

Effects of Land Cover and Precipitation Gradient on the Relative Risk of Predation of Wild Turkeys in Kansas, USA

Guiding Present and Future Native Fish Restoration Using a Strategic Planning Process, Literature Synthesis, Database Analysis, Field Protocol Development/Testing

Completed Projects:

Reconstruction of Landscape Composition and Vegetation Characteristics in the Sand Sagebrush Prairie Ecoregion

Patterns of Greenness (NDVI) in the Southern Great Plains and Their Influence on the Habitat Quality and Reproduction of a Declining Prairie Grouse

Master's Theses Completed:

Rachel Rusten (M.S., 2023, Sullins). An assessment of grassland loss, woody encroachment, and pesticide use on North American grassland bird populations. (PhD Student, University of Nebraska- Lincoln)

Ashley Messier (M.S., 2023, Sullins/Haukos). Patterns of greenness (NDVI) in the Southern Great Plains and their influence on the habitat quality and reproduction of a declining prairie grouse. (Biologist NRDA Program, USFWS, Atlanta, Georgia)

Victoria Reed (M.S. 2023, Mather). Using state-wide, long-term databases to establish an approach to suggest useful future data related activities. (Water Resources Design Engineer, Professional Engineering Consultants, Wichita, Kansas).

Camille Rieber. (M.S., 2023, Hefley/Haukos). Treed Gaussian processes for animal movement modelling. (Co-advised with T. Hefley, Statistics; USGS Contractor, NABAT project, Bozeman, Montana).

Olivia Rode (M.S., 2023, Mather). How a monitoring dataset, an adaptive management framework, and ecological comparisons of selected fish groups can guide conservation.

Megan Vhay (M.S., 2022, Haukos). Reconstruction of landscape composition and vegetation characteristics in the Sand Sagebrush Prairie Ecoregion. (Natural Resource Specialist, NRCS, New Hampshire)

Ph.D. Dissertations Completed:

Talesha Karish (Ph.D, 2022, Haukos). Survival, activity patterns, movements, home ranges and resource selection of female mule deer and white-tailed deer in western Kansas. (Assistant Area Manager, Baudette Area Wildlife, MN DNR)

KANSAS COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

Mission Statement

The agreement establishing the Kansas Cooperative Fish and Wildlife Research Unit in 1991 stated that the purpose was to... "provide for active cooperation in the advancement, organization, and conduct of fish and wildlife research, graduate education, in- service training, technical assistance, public relations, and demonstration programs" (Cooperative Agreement, Section II, Purpose). Unit research contributes to understanding ecological systems within the Great Plains. Unit staff, collaborators, and graduate students conduct research with both natural and altered systems, particularly those impacted by agriculture. Unit projects investigate ways to maintain a rich diversity of endemic wild animals and habitats while meeting the needs of people.

The Unit focuses on projects that involve graduate students, and the research needs of cooperators are given priority. Unit professionals function as faculty in the Division of Biology at Kansas State University. Unit professionals work with state and federal agencies, private industry, nongovernmental organizations, and interest groups to develop and conduct projects. Partnership projects are common where graduate and undergraduate students, and Unit staff work with multidisciplinary teams, often including other university faculty members and specialists from collaborating groups.

Personnel and Cooperators

Coordinating Committee Members

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Dr. Elisabeth Webb
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John Carlson
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Cooperative Unit Staff

David A. Haukos, Ph.D, Unit Leader, Wildlife; Adjunct Associate Professor, Division of Biology
Martha Mather, Ph.D, Assistant Unit Leader, Fisheries; Adjunct Professor, Division of Biology
Dan Sullins, Ph.D, Assistant Unit Leader, Wildlife; Adjunct Assistant Professor, Division of Biology
Tara Dreher, Office Manager and Administrative Assistant
Liam Berigan, Ph.D, Research Associate – Wildlife, Division of Biology
Andrew Whetton, Ph.D, Research Associate – Wildlife, Division of Biology

Faculty Cooperators at Kansas State University

Division of Biology
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Dr. Andrew Hope
Dr. Keith Gido

Department of Geography
Dr. Doug Goodin
Dr. Shawn Hutchinson

Department of Horticulture and Natural Resources
Dr. Adam Ahlers
Dr. Joseph Gerken
Dr. Andrew Ricketts

Department of Animal Science
Dr. K.C. Olson

Department of Entomology
Dr. Tania Kim

Department of Statistics
Dr. Trevor Hefley

Additional Universities

Oklahoma State University
Dr. Craig Davis
Dr. Sam Fuhlendorf

Emporia State University
Dr. William Jensen

Texas Tech University
Dr. Warren Conway
Dr. Blake Grisham

State of Kansas

Kansas Department of Wildlife and Parks

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Jake George
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Matt Peek
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Ely Sprenkle
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Federal Government

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Jude Smith

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Dr. Lacrecia Johnson
Dr. Steve Sesnie

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U.S. Army, Fort Riley
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Stephanie Manes

Other State Agencies

Colorado Wildlife and Parks
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Dr. David Klute
Liza Rossi
Jonathan Reitz

Private Organizations and NGOs

Stroud Water Research Center
Dr. Melinda Daniels

Ducks Unlimited
Joe Kramer
Matt Hough

Grasslans Charitable Trust
Willard Heck
Jim Weaver

The Nature Conservancy
Matt Bain
Rob Manes

Playa Lakes Joint Venture
Dr. Anne Bartuszevige
Dr. Ashley Gramza

Graduate Students Supported by Unit Projects, 2022-present
Kansas State University

Student and Degree Sought	Thesis Project	Previous Education	Advisor
Caleb Durbin, M.S.	Influence of woody cover and other landscape variables on northern raccoon occupancy	B.S., Pittsburg State University	Dr. Sullins
Sara Hansen, Ph.D.	Landscape ecology of wild turkeys in Kansas.	B.S., California State University – San Bernardino M.S., State University of New York, Syracuse	Dr. Haukos
*Talesha Karish, Ph.D	Survival, activity patterns, movements, home ranges and resource selection of female mule deer and white-tailed deer in western Kansas	B.S., Delaware Valley College M.S., New Mexico State University	Dr. Haukos
Shelby Kuck, M.S.	Extracting actionable insights from biodiversity monitoring data: conserving uncommon fish in Kansas	B.S., Samford University	Dr. Mather
Cassidy Lathrom, M.S.	Density, diversity, and relative abundance of bees on Fort Riley Military Installation	B.S., Kansas State University	Dr. Haukos
Kaitlin Lospinoso, M.S.	Influence of predator communities on wild turkeys in Kansas	B.S., North Carolina State University	Dr. Haukos
Cy Marchese, M.S.	Nutrient dynamics of foods used by wild turkeys in Kansas	B.S., Ohio State University	Dr. Sullins
*Ashley Messier, M.S.	Patterns of greenness (NDVI) in the Southern Great Plains and their influence on the habitat quality and reproduction of a declining prairie grouse	B.S., Unity College	Dr. Sullins Dr. Haukos
Natalie Pegg, Ph.D	Movements, space use, and vital rates of mourning doves	B.S., Butler University M.S., University of Florida	Dr. Haukos
*Victoria Reed, M.S.	Using state-wide, long-term databases to establish an approach to suggest useful data related activities	B.S. Kansas State University	Dr. Mather
*Camille Rieber, M.S.	Treed Gaussian processes for animal movement modelling	B.S., Washington University, St. Louis	Dr. Haukos Dr. Hefley

*Olivia Rode, M.S.	How a monitoring dataset, an adaptive management framework, and ecological comparisons of selected fish groups can guide conservation.	B.S., Rockhurst University	Dr. Mather
*Rachel Rusten, M.S.	An assessment of grassland loss, woody encroachment, and pesticide use on North American grassland bird populations	B.S., Minnesota State University Moorhead	Dr. Sullins
Caroline Skidmore, Ph.D	Population demography of wild turkeys in Kansas	B.S. Kansas State University M.S. Texas Tech University	Dr. Haukos
Katryn Stafford, M.S.	Landscape composition and configuration of lesser prairie-chicken core areas and connectivity zones	B.S. Missouri Western State University	Dr. Haukos
Elisabeth Teige, Ph.D	Assessing effects of vegetation characteristics and management of the Conservation Reserve Program on lesser prairie-chicken habitat quality, resource selection, and demographics throughout the species' northern range	B.S., Minnesota State University – Moorhead M.S., Kansas State University	Dr. Haukos
*Megan Vhay, M.S.	Reconstruction of landscape composition and vegetation characteristics in the Sand Sagebrush Prairie Ecoregion	B.S., University of Maine	Dr. Haukos
Mary Ware, M.S.	Assessing roost site selection and impacts of land management on wild turkeys in Kansas	B.S., Hastings College	Dr. Haukos
Randall Wilson, M.S.	Diets and ecology of piscivorous birds in relation to Colorado pikeminnow conservation efforts	B.S., University of Montana	Dr. Sullins

*Graduated

Fisheries and Aquatics Projects

Active Fisheries and Aquatics Projects

Developing a Strategic Planning Process for Native Fish Restoration

Student Investigators
Olivia Rode, MS;
Victoria Reed, MS;
Jean Ribert Francois, PhD;
Michael Madin, PhD
Shelby Kuck, MS

Professional Colleagues
Jordan Hofmeier, KDWP;
Dr. Trisha Moore, KSU Biological & Agricultural Engineering;
Dr. Kate Nelson, KSU Geography & Geospatial Sciences
Dr. Devon Oliver, Minnesota Department of Natural Resources

Project Supervisor
Dr. Martha Mather

Funding
Kansas Department of Wildlife and Parks

Cooperators
Kansas Department of Wildlife and Parks

Kansas State University

Project Objectives.
1. Identify and implement a strategic planning process,
2. Select a subset of common and uncommon fish on which to focus

Status
Ongoing

Progress

Background. A common mission of many fisheries agency professionals is to be good stewards of natural ecosystems, often with a special emphasis on protecting declining and rare native fish. Conserving and restoring threatened and endangered fish at state, regional, and national scales is challenging because of complexities associated with planning, data collection, analysis, interpretation, and synthesis. As one example, data on rare or uncommon fish are difficult to collect because their rarity makes these at-risk fish hard to sample. Without data on where rare and declining fish are located and what habitat and impact variables reduce their distribution, researchers and managers have difficulty constructing a justifiable plan for conservation and restoration.

At least three categories of information gaps exist related to using monitoring data. The first is the absence of practical guidelines for choosing, using, and interpreting quantitative tools that are effective with "messy" real-world monitoring data that do not meet statistical assumptions. The second is a lack of guidance on how to convert a general adaptive management strategy into an actionable plan for a specific conservation problem (e.g., biodiversity monitoring).The third is the limited availability of planning tools that set realistic expectations for monitoring data (>5-10 years). *Our project seeks to address these information gaps by illustrating an operational, science-based adaptive management framework for the specific conservation problem of biodiversity monitoring for native Kansas fish.*

Kansas has a diverse native stream fish community that is vulnerable to anthropogenic and climate threats. In 2005, experts suggested that almost half (47%) of Kansas *native* fish species merit special conservation status because of declines or small current population sizes. In 2022, experts in the state of Kansas identified and prioritized native fish that were of greatest conservation need (SGCN; n=70) in their detailed Kansas State Wildlife Action Plan (SWAP). Our adaptive management framework seeks to develop a process to use existing monitoring data to understand patterns of these at-risk native fish and guide future actions.

Overview: In this project, we combine the efforts of university personnel, graduate students, and agency partners to provide guidance for present and future native fish restoration. We seek to provide long-term guidance on conservation approaches rather than

3. Synthesize existing literature on habitat needed by Kansas fish and impacts that adversely affect Kansas fish,
4. Analyze monitoring databases related to habitat and native fish distribution,
5. Implement a program of adaptive management.

Location
Data associated with Kansas streams

Started
November 2021

Completion
September 30, 2027

one-time, one-place remedies. Below, we review two foci that integrate multiple project objectives.

Across-Objective Focus 1 - Implementing an Adaptive Management Framework for Extracting Innovative Ecological Insights from Biodiversity Monitoring Data: Improving Outcomes for an Established Environmental Challenge

Background. The overarching issue that we address in this across-objective focus is how to extract clearer and more actionable ecological insights from "messy" biodiversity monitoring data. At present, only partial solutions exist for the well-established challenge of translating real-world data into science-based conservation actions. Here, we developed an iterative 10+6 step adaptive management framework to address this challenge for native species that are threatened by adverse human impacts.

General Adaptive Management Framework. Our adaptive management framework is an iterative, structured process with 10 steps within which six additional steps are embedded in a quantitative sub-loop. In brief, manager-researcher teams prioritize a focused question of interest, isolate a specific taxon and scale, review relevant literature to *a priori* predict target taxon data trends, incorporate cleaning and vetting procedures for data, choose appropriate habitat and impact variables, then wrangle regressor data for each taxon sampling location. Next the original question of interest is refined into specialized, sub-questions which are each addressed with a specific visualization or analysis tool in the quantitative loop (i.e., fish maps, proportional resource maps, ridgeline plots, box plots, histograms, pie diagrams, multiple logistic regression, related probability plots, accuracy assessments). Finally, the framework uses a weight of evidence (WOE) approach to integrate results from all quantitative sub-steps. The 10+6 framework is repeated until teams are satisfied that the accumulated knowledge is adequate for management-restoration actions.

The unique novelty that transforms our framework into an implementable adaptive management plan is the link between the gaps/predictions identified in an initial framework iteration (iteration 1, step 10) and the actions taken in the next iteration to address these needs/gaps/predictions (iteration 2 - step 1). Professionals presently use some, but not all, of our framework steps. At least four improved outcomes can emerge from systematically and repeatedly using our framework in its entirety: (1) Systematically following all framework steps can create a concrete and justifiable work plan. (2) Weight-of-evidence (WOE) synthesis leads to new ecological understanding and the identification of relevant and testable new questions. (3) The systematic and iterative use of our framework connects diverse datasets across years, systems, and taxa. (4) Using

our framework can guide relevant future actions (e.g., analyses, data collections, restoration plans).

Take Home Message 1: Utility of the WOE Approach. New directions would not have emerged from our examination of existing monitoring data if we had not integrated the results from all quantitative sub-steps. When professionals adhere to specific statistical significance thresholds from a single favored quantitative approach, inconsistent approach-specific interpretations can lead to unproductive disagreements. In contrast, the philosophy underlying the WOE concept is that for complex issues (e.g., decision-making, risk assessment), integration of multiple pieces of evidence is required. Using our integrated WOE interpretation of multiple visualizations and analyses for our target taxon and scale applied to our overarching and specific questions, we were able to (a) amass a suite of consistent insights, (b) use meaningful inconsistencies to propose relevant new questions to test in future sampling/analyses, and (c) provide best practices for future sampling and analyses. This approach provided more utility for future planning than simply presenting a simple model as is often done in empirical monitoring.

Take Home Message 2: Implementation Guidance Emerged. Our framework is an example of an adaptive management plan for biodiversity monitoring that can be used immediately. The accuracy of our first-iteration, all-ecological-categories multiple logistic regression model for Emerald Shiner was high (74% correct predictions) and produced consistently interpretable information about regressors that were (substrate, sinuosity, system size, land use) and were not (dams) influential. If we had followed a more narrowly defined and traditional methodology, we might have adopted this single analysis as a final product. However, our iterative 10+6 step framework illustrated that a *single* result is not especially useful for complex conservation questions. Instead, an *implementable and connected iterative step-by step process* that systematically accumulates knowledge is more likely to assist practitioners.

Take Home Message 3: Importance of the Iterative Process. A realistic expectation is that for every major conservation question of interest, a team of fisheries professionals will go around our framework multiple times. For example, we identified questions about the specific role of dams (iteration 1, step 10) that can be addressed in future iterations of the 10+6 framework. These emergent, testable priorities included: "*What are the differential effects of related metrics (dam proximity, number, density, inter-dam distance)? Does the direction of dam location matter relative to the fish sample site (upstream or downstream)? Which scales of dam effects are consistently more influential (local or watershed)? How do different fish respond to these dam metrics? Are there accumulated and interactive dam effects?* Thus, our framework

provides a systematic process for using existing data to direct next steps.

ACROSS-OBJECTIVE FOCUS 2

A Tale of Three Fish: How a Monitoring Dataset, An Adaptive Management Framework, and the Comparison of Thoughtfully-Selected Fish Groups Can Guide Stream Fish Conservation Planning, Future Data Collections, and Management Actions For Uncommon Fish

Objectives. Here we illustrate how our adaptive management framework and existing monitoring dataset can assist conservation and guide restoration planning for thoughtfully chosen groups of common and uncommon fish. To compare two common fish (Emerald Shiner, Central Stoneroller) and one uncommon fish (Plains Minnow, Kansas Threatened), we combined visualization tools (i.e., fish maps, proportional resource maps, ridgeline plots, box plots, histograms, pies diagrams) with multiple logistic regression, related probability plots, and accuracy assessments.

Specifically, we examined:

1. What ecological insights are gained by comparing and contrasting the results across taxa within the chosen group compared to single taxon analysis?
2. What guidance can this approach provide for restoration planning and future data collection for an uncommon fish?

Take Home Message 4: Value of Comparing Groups of Taxa. Data analysis of groups of fish can enhance and expand conservation insights compared to the analysis of a single taxon. Specifically, we were able to compare empirical patterns of those three fish in a standardized way that showed generalities, recognized differences, provided sidebars to bound interpretation, and identified data needs. Although assignment of mechanisms for uncommonness (e.g., reproductive mode) would be premature, our fish taxa comparisons provided a larger context for interpretation of data for individual taxa. With these insights, we were able to focus place-based recommendations for restoration of a Kansas threatened fish. Thus, using the common but heterogeneous Emerald Shiner distribution to guide restoration of the uncommon but regionally distributed Plains Minnow is a potential direction that would not have been obvious without our three fish comparison.

Take Home Message 5: Advantages for Restoration. Our three-taxa analysis of monitoring data, paired with our framework approach, provided specific tractable tools for restoration planning. Common fish restoration strategies include: the establishment of nongame fish hatcheries (rearing and stocking native fish), trap and transfer efforts, identifying locations for further collection and targeting locations for release of restoration taxa. A difficulty associated with

these activities is often not knowing where to stock, where to transplant, where to release hatchery fish, and where to collect further samples and habitat data. Thus, many of our fish conservation strategy needs are location-based. Our approach provides a way to prioritize future locations.

Take Home Message 6: Utility in Coordination and Planning Results. Our framework provided new ways that teams of fisheries professionals can interact to coordinate and plan future data collection and restoration-conservation activities. A future plug and play version of our framework with a dashboard of appropriate data layers could provide opportunities for teams of researchers and managers to regularly discuss data interpretation and future directions.

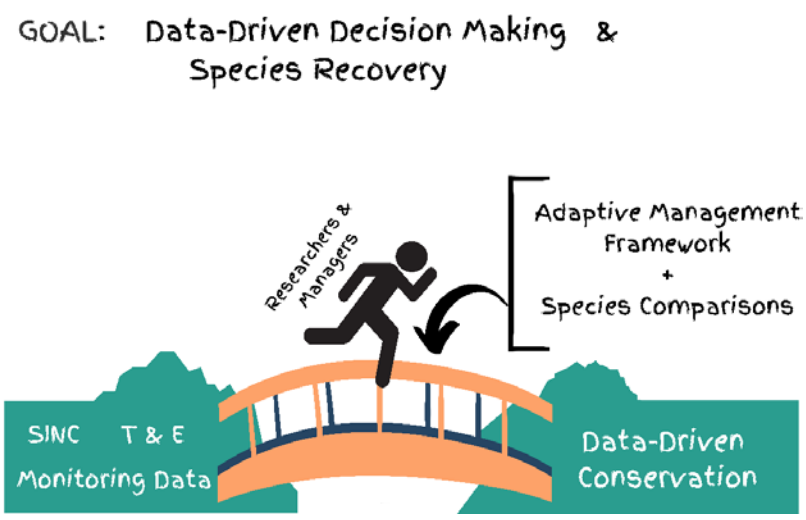
Summary Thus Far: Our framework is an example of an implementable adaptive management that directs the analysis of existing data and can help plan, identify gaps, and effectively connect datasets to make efficient use of existing resources.

Next Steps.

As we move into the next stage of the project (Kuck, MS), we will pursue the following activities that will enhance the usability of the above-described framework

(1) Replicate, refine, and generalize adaptive management framework described above.
(2) Synthesize criteria for successful use of adaptive management framework for uncommon fish monitoring data,
(3) Develop new ecological insights from the framework by focusing on the analysis of select SINC and T&E species,
4. Enhance accessibility of adaptive management framework for researcher-manager team use.

The ultimate goal (see figure below) is for our researcher-manager teams to continually learn from and add to the extensive and powerful biodiversity monitoring data that are available, which should in turn guide decisions for allocating resources in further monitoring and management practice.



Products

Publications

Mather, M. E., and J. M. Dettmers. 2022. Adaptive problem maps (APM): Connecting data dots to build increasingly informed and defensible environmental conservation decisions. Journal of Environmental Management 312:114826. https://doi.org/10.1016/j.jenvman.2022.114826

Mather, M. E., G. Granco, J. Bergtold, M. Caldas, J. Heier-Stamm, M. Sanderson, A. Sheshukov, and M. Daniels. 2023. RISE to interdisciplinary success: a widely-implementable, iterative, multi-step structured process for mastering team skills. BioScience 73:891–905 https://doi.org/10.1093/biosci/biad097

Thesis

Rode, Olivia. 2023 How a monitoring dataset, an adaptive management framework, and ecological comparisons of selected fish groups can guide conservation. M.S. Thesis, Kansas State University. https://krex.k-state.edu/items/cab438b9-43ff-4de6-919d-562bccf09cfa

Reed, Victoria. 2023. Using state-wide, long-term databases to establish an approach to suggest useful future data related activities. M.S. Thesis, Kansas State University. https://krex.k-state.edu/items/eeadb74f-c20a-4a28-88e1-eaa285914533

Presentations

Mather, M. E., P. Angermeier, K. Pope, Chuck Hopkinson, and M. Vanni. 2022. Framing questions differently can catalyze innovative solutions to complex aquatic science problems. Joint Aquatic Science Meeting (JASM). Grand Rapids, MI.

Finn, J. T., M. E. Mather, S. Hitchman, M. P Carey, R. Tingley, O. Rode,* C. Aymami,* D. Oliver, and J. Dettmers. 2022. Monitoring that inspires research: linking monitoring and research data. Joint Aquatic Science Meeting (JASM). Grand Rapids, MI.

Suileman, G., J. Luginbill, and M. E. Mather. 2022. Planning and implementing pathways for proactive biodiversity conservation. Joint Aquatic Science Meeting (JASM). Grand Rapids, MI.

Rode, O., M. E. Mather, V. Reed, K. Nelson. M. Madin,* J. Francois.* T. Moore. L. Krueger. 2023. Squeezing additional insights from fish survey data to aid conservation. Midwest Fish & Wildlife Conference, Overland Park, KS.

Mather, M. E., D. Oliver, and J. Smith. 2023. Will we know "success" when we see it?: defining appropriate expectations for biodiversity monitoring surveys. Midwest Fish & Wildlife Conference. Overland Park, KS.

Mather, M. E., Q. Phelps. D. Shoup, K. Chestnut-Faull, and C. Aymami. 2023. Syntheses are an underused opportunity to advance fisheries research and management: a framework to move fisheries "synthesis science" forward. Midwest Fish & Wildlife Conference. Overland Park, KS.

Rode, O., V. Reed, M. Mather, T. Moore, K. Nelson, M. Madin, J. Francois,* L. Krueger.* 2023. Hybrid digital-empirical approaches can aid conservation: merging GIS & local fish habitat data. Kansas Natural Resource Conference Poster.

Rode, O., M. E. Mather, D. Oliver. K. Nelson, T. Moore, V. Reed, S. Pratrap, and S. Kuck. 2024. How a monitoring dataset, an adaptive management framework, and ecological comparisons of selected fish groups can guide restoration. Kansas Natural Resource Conference. Manhattan, KS.

Developing Communities of Expert Practice (COEP) to Apply Intergenerational Expertise to Challenging Aquatic Conservation Problems

Investigators
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Professional Colleagues
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Dr. Dan Shoup, Oklahoma State University;
Dr. Quinton Phelps, Missouri State University;
Dr. John Dettmers, Great Lakes Fisheries Commission

Project Supervisor
Dr. Martha Mather

Cooperators
Kansas State University

Kansas Department of Wildlife, Parks

US Fish and Wildlife Service

US Geological Service

Wildlife Management Institute

Location
Kansas and Nationwide

Completion:
2027

Status
Ongoing

Progress
The fisheries profession can benefit from increased opportunities for relevant innovation that merge the experience and judgement of seasoned professionals with the skills and energy of younger professionals. Analysis skills and grasp of new tools (fluid intelligence) can peak early in one's career and can decrease through time. However, skills that seek to understand/interpret complex ideas (crystalized intelligence) peak later in one's career and can stay high indefinitely. Young professionals can solve problems with which they are familiar quickly. Seasoned professionals can identify which problems are worth solving. Fisheries can benefit from integration of both types of intelligence for addressing complex natural resource problems. Existing professional advancement criteria include little guidance and few rewards for intergenerational teams to pursue innovative solutions to challenging problems.

A community of expert practice (COEP) is a network of expert professionals who have an interest in a common set of problems and who seek to share information on best practices in a focused, connected way for an extended time period (i.e., not just a one-time collaboration). Yet, existing communities of expert practice frequently do not prioritize the strategic planning that creates new and better "best practices." This project seeks to develop guidelines for forming COEP to develop better "best" practices using the combined skills of intergenerational teams of professionals who continuously interact in a focused way over a prolonged period.

Examples of ongoing COEPs follow.

<u>*Scale*</u>
At the 2021 AFS meeting in Baltimore, 15 teams of researchers working across diverse ecosystems, geographic regions, and taxa, participated in a symposium entitled "*Scale 2021: choosing and matching scales for aquatic field data: status, options, and knowledge gaps*." In this COEP, participants presented their perspectives on status and challenges related to the choice of spatial and temporal scale in the collection and analysis of aquatic field data. By asking each collaborator to address the same set of questions, we were able to identify six future directions related to scale. Of these, four spatial scale themes were further developed in presentations at the 2022 Joint Aquatic Sciences Meeting (JASM). This COEP has worked together through two national professional

meetings and continues to collaborate on multiple publications. By structuring synthesis activities to match rewardable criteria (talks, papers, grants), we hope to integrate new ways of thinking about spatial scale into better "best practices." This COEP is presently revising a synthesis publication.

A New Model For Prairie Stream Collaboration

Over 60 American Fisheries Society members from the North Central, Southern, Northeastern, and Western Divisions have expressed interest in joining a new collaboration to address problems related to prairie stream fish research and conservation. This collaboration includes remote meetings, a symposium at the 2021 national AFS meeting in Baltimore entitled "*Creating and Implementing an Ecosystem-wide Integrated Research Agenda and Conservation Plan for Prairie Streams: A Shared Vision, Next Generation Synthesis, and Future Action Plan,"* as well as a 2022 multi-day workshop.

Increasing threats to aquatic resources demand new collaborative approaches. For large ecosystems, such as prairie streams, one state, one agency, or one research lab cannot be effective alone. Collaborative synthesis in ideas, data, and action is needed for restoration and preservation of prairie fish assemblages. However, this new type of collaboration requires creative and innovative ideas, a common vision, good coordination among participants, and a clear plan for future action. In this COEP, nine organizers repeatedly interact with over 50 professionals from multiple universities, multiple state agencies, three federal agencies, and one non-governmental organization. This COEP is currently submitting proposals to the NE CASC.

Questions We Should Be Asking

As experts in our respective areas, we become very competent at collecting and analyzing data in a certain way. As specialists, we may ask the same kinds of questions that may lead to the collection of the same kinds of data throughout our careers. This accumulation of skills and knowledge is laudable in many respects (e.g., promotions). Yet, this specialization can also have disadvantages in that a singular disciplinary focus can limit innovation, especially the ability to see connections across scientific disciplines. In this COEP, we hypothesize that *"Asking questions differently can identify novel directions for solving complex environmental problems through synthesis and integration*."

This COEP seeks to motivate individual professionals (biological researchers, social science researchers, managers, policy-makers) to think about how their ideas fit into a larger conservation picture, how their skills and interests connect to other sectors and disciplines, what gaps exist, and how we, as a profession, can move

forward together to create a new synthetic interdisciplinary vision that better addresses complex natural resource problems.

Future Reservoir Fisheries Planning
Martha Mather, Steve Miranda, Greg Sass, and Kevin Pope attended the 2023 Midwest Fish and Wildlife Conference at which Steve Miranda provided a keynote talk on future reservoir threats. Following this plenary, we had a strategy discussion with attendees who work with reservoir fisheries from KS, NE, IA, and WI. Following this in-person discussion, we initiated an email conversation with reservoir biologists from the above states as well as those from OK, FL, and OH about the collaborative COEP that we propose here. This group is currently submitting proposals.

Products

Presentations
Mather P. Angermeier, K. Pope, Chuck Hopkinson, M. Vanni 2022. *Framing questions differently can catalyze innovative solutions to complex aquatic science problems.* Joint Aquatic Science Meeting (JASM), May 2022.

Finn, J. T., M. E. Mather, S. Hitchman, M. P Carey, R. Tingley, O. Rode, C. Aymami, D. Oliver, J. Dettmers. 2022. *Monitoring that inspires research: linking monitoring and research data*. Joint Aquatic Science Meeting (JASM), May 2022.

Hitchman, S. M., M. E. Mather, J. M. Smith, K. Pope, D. DeVries, J. Garvey, R. Tingley, M. Carey. *Scale: direction and progress for impactful science-based conservation*. Joint Aquatic Science Meeting (JASM), May 2022.

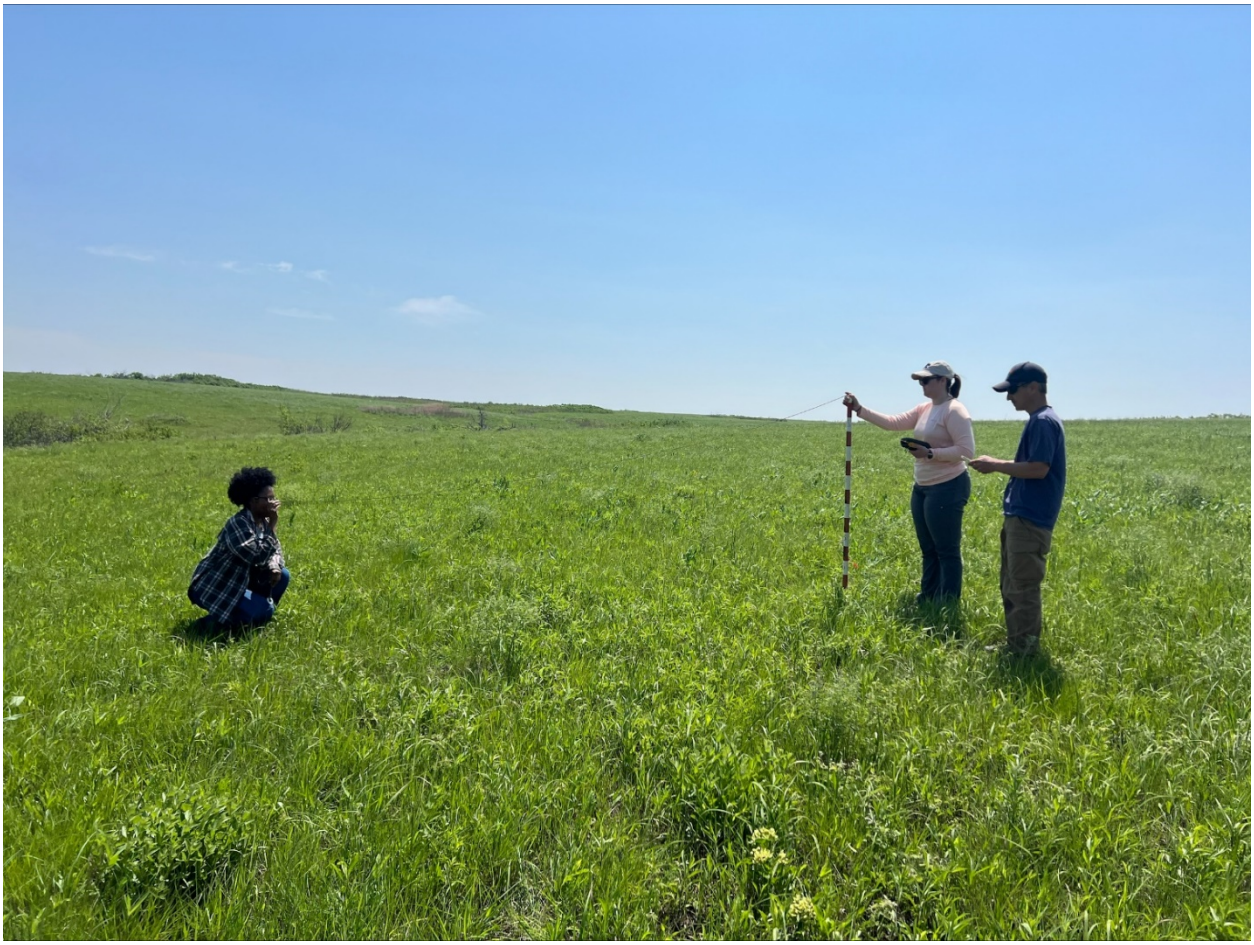
DeVries, D., J. Garvey, M. Mather, K. Pope, S. Hitchman, J. Smith 2022. *Connecting biology to policy: linking scales for data collection to scales needed for the decision-making process*. Joint Aquatic Science Meeting (JASM), May 2022.

Granco, G., and M. Mather 2022. *New questions to understand how culture can affect sustainability policies: linking scales in a multi-use freshwater ecosystem*. Joint Aquatic Science Meeting (JASM), May 2022.

Suileman, G., J. Luginbill. And M. Mather 2022. *Planning and implementing pathways for proactive biodiversity conservation.* Joint Aquatic Science Meeting (JASM), May 2022.

Nepal, V., M. Fabrizio, B. Knuth, M. Mather, D. Parrish. 2022. *Asking different questions can overcome obstacles and identify new solutions to achieving human diversity in the aquatic sciences.* Joint Aquatic Science Meeting (JASM), May 2022.

Wildlife Projects



Completed Wildlife Projects

Patterns of Greenness (NDVI) in the Southern Great Plains and Their Influence on the Habitat Quality and Reproduction of a Declining Prairie Grouse

Investigators
Ashley Messier

Project Supervisors
Dr. Daniel Sullins
Dr. David Haukos

Funding
U.S. Fish and Wildlife Service

Cooperators
Kansas Department of Wildlife and Parks (Kent Fricke)

U.S. Fish and Wildlife Service (Chris O'Meilia)

Objectives

Relate snapshot NDVI to nest site-selection

Relate NDVI-based vegetation phenology metrics to nest and brood site-selection

Predict reproductive habitat abundance

Relate snapshot NDVI to nest survival

Location:
Kansas

Completion
March 2023

Status
Completed

Abstract
Patterns of vegetative greenness and timing of greenness events have been a strong predictor of habitat availability and space use for several species of wildlife and may be a particularly useful tool for imperiled grassland species such as the lesser prairie-chicken (*Tympanuchus pallidicinctus*). I evaluated the utility of Normalized Difference Vegetation Index (NDVI) and NDVI-based vegetation phenology metrics in estimating lesser prairie-chicken habitat availability, habitat quality, and space use during the reproductive season.

I captured, marked with GPS and VHF transmitters, and monitored lesser prairie-chicken nest and brood locations during the reproductive season in Kansas during 2013-2015. I acquired Landsat 8 and vegetation phenology metric data from eMODIS Remote Sensing Phenology (RSP) satellite imagery during 2013-2015. Using NDVI and vegetation phenology data at nest and brood locations, I first examined the use of these remotely sensed tools to model habitat selection and predicted habitat availability. I then tested relationships among phenology metrics and reproductive success (e.g., nest and brood success) and assessed timing of nest initiation and hatch relative to patterns of greenness. Last, I investigated correlations between phenology metrics and in-situ vegetation measurements and stocking density.

Nest site-selection was best predicted by Time Integrated NDVI (TIN), with probability of use increasing as values of TIN increased ($\beta = 2.897$, SE = 1.049). The TIN metric is a proxy for the density of overhead vegetation cover. Brood site-selection was best predicted by an Amplitude (AMP) * Year model ($\beta_{AMPscale1} = 7.76$, SE = 4.81, $\beta_{2014} = 0.99$, SE = 2.065, $\beta_{2015} = -1.78$, SE = 2.17, $\beta_{AMPscale1:2014} = -1.79$, SE = 5.12, $\beta_{AMPscale1:2015} = 6.32$, SE = 5.47), with probability of use varying among years but increasing as values of AMP increased. The AMP metric describes the total increase in productivity from the start of the growing season to the peak of the growing season. Areas experiencing greater increases in productivity were more likely to be used by brood-rearing females.

To predict nesting and brood-rearing habitat abundance in Kansas, I used a random forest approach. Ultimately, I was unable to predict nesting habitat availability using phenology metrics due to high out-of-bag error (30.48%) and high class error rates, with non-habitat predicted as habitat ~63% of the time. Fortunately, I was able to predict brood-rearing habitat abundance. Informative brood habitat variables selected by the random forest model included the End of Growing Season Time (EOST) at the 1-km scale, TIN at the 1-km scale, AMP at the 370-m scale, percent grassland within 5-km, End of Season NDVI (EOSN) at the 1-km scale, density of county roads within 2-km, density of oil wells within 2-km, Time of Maximum NDVI (MAXT) at the 1-km scale, Start of Growing Season Time (SOST) at the 250-m scale, and the density of transmission lines within 2-km. Using the selected variables, I identified priority habitat using the Kappa threshold and high priority habitat using the Sensitivity Specificity Sum Maximizer threshold. Habitat availability was variable between years, with a 71% and 51% decrease in priority and high priority habitat, respectively, from 2014 to 2015. I identified 2,154,137.5 ha of priority habitat and 8,225 ha of high priority

habitat for 2014. I identified 636,493.75 ha of priority habitat and 3,993.75 ha of high priority habitat for 2015.

Nest survival was best predicted by MAXT at the 500-m scale, with nest survival maximized when MAXT was Day-of-Year (DOY) 160 (June 9) and decreasing linearly as MAXT increased (β = -0.009, SE = 0.004). Similarly, I identified phenological differences at successful and unsuccessful nest and brood sites. At successful nest sites, TIN was greater than at unsuccessful nests ($p = 0.05$), and MAXT occurred earlier than at unsuccessful nests ($p = 0.04$). At successful brood sites, MAXT occurred later and EOSN was greater than at unsuccessful brood sites ($p = 0.003$). The EOSN metric was also significantly different, with EOSN greater at successful brood sites than at unsuccessful brood sites ($p = 0.01$). Timing of nest initiation and hatch relative to patterns of greenness indicated that first nests were initiated within ~20 days of SOST. All hatch dates occurred before the peak of the growing season date (MAXT). Ultimately, lesser prairie-chickens time nest initiation and hatch between the start of the growing season and peak of the growing season.

I also tested correlations among vegetation phenology metrics to in-situ vegetation measurements and stocking densities. Correlations with phenology metrics and in-situ vegetation measurements varied among years, but TIN and AMP were often positively correlated with measures of visual obstruction at multiple scales and cover of forbs and grasses ($r = 0.02 – 0.51$). The TIN, AMP, and Maximum NDVI (MAXN) metrics were often negatively correlated ($r = -0.02 – -0.15$) with cover of bare ground, litter depth, litter cover, and shrub cover. Last, I evaluated linkages between vegetation phenology metrics and cattle stocking density. Correlations varied among years (2014 and 2015). The TIN and AMP metrics were positively correlated with stocking density in 2014 ($r = 0.13$, $r = 0.07$, respectively); yet TIN was negatively correlated with stocking density in 2015 ($r = -0.17$) and AMP was not correlated with stocking density in 2015.

Ultimately, I provide evidence that NDVI-based vegetation phenology metrics can be used to model habitat use and predict habitat availability for lesser prairie-chickens in Kansas. My predictions from phenology-based metrics indicated that the availability of high priority habitat may be limited. I also provided evidence that phenology metrics correlate to in-situ vegetation measurements and stocking densities, making phenology metrics a promising tool for monitoring lesser prairie-chicken habitat remotely.

Products

Presentations:

Messier, A., D. Sullins, D. Haukos, and C. O'Meilia. 2021. Evaluating the role of NDVI-Based phenology metrics in lesser prairie-chicken nest-site selection. Annual Conference of The Wildlife Society (virtual).

Messier, A., D. Sullins, D. Haukos, and C. O'Meilia. 2021. Lesser prairie-chicken resource selection following megafire in the mixed-grass prairie. Kansas Natural Resource Conference, Virtual poster.

Messier, A., D. Sullins, D. Haukos, and C. O'Meilia. 2022. Evaluating the role of vegetation phenology metrics in lesser prairie-chicken nest and brood-site selection. Kansas Natural Resource Conference, Manhattan.

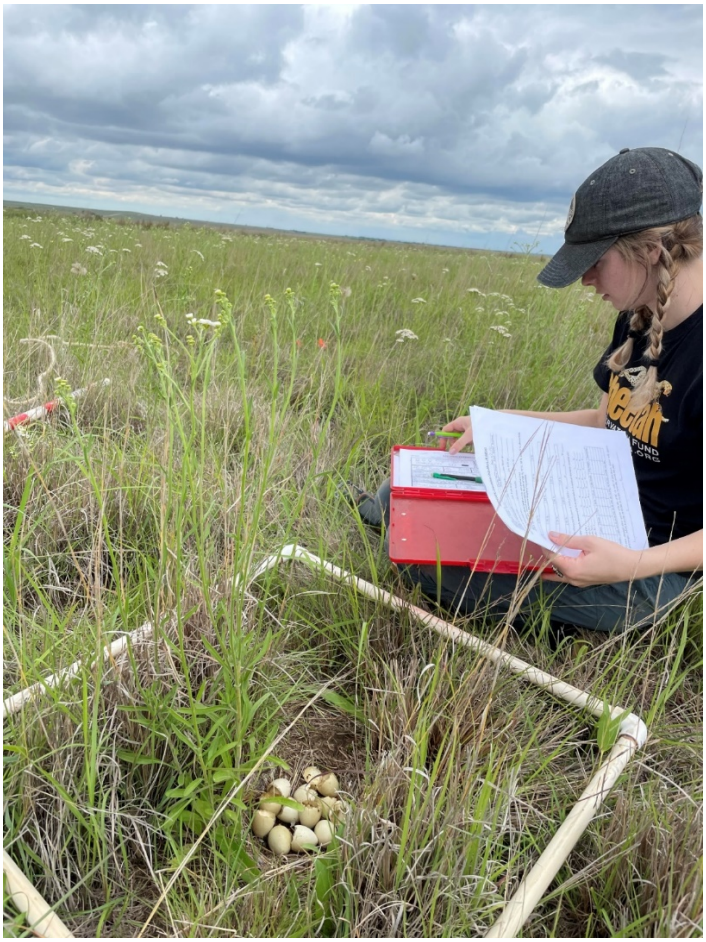
Messier, A., D. Sullins, D. Haukos, and C. O'Meilia. 2022. Predicting within grassland habitat abundance for lesser prairie-chickens using gradient landscape and vegetation phenology metrics Annual Conference of The Wildlife Society, Spokane, Washington.

Messier, A., D. Sullins, D. Haukos, and C. O'Meilia. 2022. Linking greenness (NDVI) to lesser prairie-chicken reproductive habitat availability and quality. Prairie Grouse Technical Council, Lewiston, Montana.

Messier, A., D. Sullins, D. Haukos, and C. O'Meilia. 2023. Identifying priority grasslands for lesser prairie-chicken reproduction using phenology and gradient landscape metrics. Kansas Natural Resource Conference, Manhattan, Kansas.

Thesis

Messier, A. 2023. Patterns of greenness (NDVI) in the Southern Great Plains and their influence on the habitat quality and reproduction of a declining prairie grouse. M.S. Thesis, Kansas State University, Manhattan. https://krex.k-state.edu/items/a2332259-2f99-40b9-97e1-5a135d659b4a



Assessing Long-Term Changes in Lesser Prairie-Chicken Habitat Quality across the Sand Sagebrush Prairie Ecoregion

Investigators:
Megan Vhay
Dr. David Haukos
Dr. Daniel Sullins
Dr. Mindy Rice

Project Supervisor:
Dr. David Haukos

Funding:
Kansas Department of Wildlife and Parks

U.S. Geological Survey

Cooperators:
Kansas Department of Wildlife and Parks

USDA Forest Service

Objectives:
Reconstruct landscape-scale landcover changes in the Sand Sagebrush Prairie Ecoregion from the mid-1980s through 2020

Assess changes in vegetation composition and structure in the Sand Sagebrush

Status
Completed

Abstract

Populations of lesser prairie-chickens (*Tympanuchus pallidicinctus*) in the Sand Sagebrush Prairie Ecoregion of southwest Kansas and southeast Colorado, USA, have declined sharply since the mid-1980s. Decreased habitat quality and availability are believed to be the main drivers of declines; however, no broad-scale assessment of habitat change has been conducted for the ecoregion. My objectives were to reconstruct landscape-scale change in the ecoregion since 1985, assess changes in vegetation structure and composition relative to management goals, and compare features of Conservation Reserve Program (CRP) grasslands used and apparently unused by lesser prairie-chickens. I assessed change in landcover types and calculated landscape metrics using Land Change Monitoring, Assessment, and Projection (LCMAP) layers, and documented presence of anthropogenic structures including oil wells and transmission lines. I compared historical and contemporary fine-scale vegetation composition and structure survey data from public lands. I also tested for differences in landscape-scale and field-scale characteristics between CRP with tagged bird locations and those without. Landcover type composition and tree occurrence changed little since 1990 across the Sand Sagebrush Prairie Ecoregion. However, anthropogenic structures (i.e., oil/gas wells, cell towers, wind farms, and transmission lines) increased, potentially causing functional habitat loss as a result of avoidance by lesser prairie-chickens. Quality vegetation structure has declined on Comanche National Grassland since 1985. Used CRP fields were closer to release sites of translocated lesser prairie-chickens than apparently unused CRP, with a greater proportion of used fields associated with ≥60% grassland. Increased anthropogenic structures and decrease in vegetation vertical structure appears to have decreased habitat as well as the quality of existing habitat for lesser prairie-chickens, likely contributing to recent population declines throughout the Sand Sagebrush Prairie Ecoregion. Tracts of CRP associated with ≥60% grassland within 5km may continue to provide habitat for lesser prairie-chickens, but is a precarious option for habitat conservation in a trend of declining CRP enrollment. If lesser prairie-chickens are still considered a management priority by the U.S. Forest Service, the Cimarron and Comanche National Grasslands will need to adjust management practices to promote habitat conditions that support lesser prairie-chicken populations.

Products

Publication
Vhay, M.P., D.A. Haukos, D.S. Sullins, and M.B. Rice. 2024. Landscape-scale changes in lesser prairie-chicken habitat. PLoS ONE 19(5): e0304452.

Prairie Ecoregion

Determine the potential influence of CRP on space use by lesser prairie-chickens in the Sand Sagebrush Prairie Ecoregion

Location: Southwest Kansas and southeast Colorado

Completion: August 2023

Professional Presentations

Vhay, M., D. Sullins, and D. Haukos. 2021. Assessing long-term changes in lesser prairie-chicken habitat quality across the Sand Sagebrush Prairie Ecoregion. Annual Conference of The Wildlife Society (virtual).

Vhay, M., D. A. Haukos, D. S. Sullins, and M. B. Rice. 2022. Changing habitat quality for lesser prairie-chickens in the Sand Sagebrush Prairie Ecoregion. Kansas Natural Resource Conference, Manhattan.

Vhay, M., D. A. Haukos, D. S. Sullins, and M. B. Rice. 2022. A retrospective assessment of lesser prairie- chicken habitat quality in the Sand Sagebrush Prairie. Midwest Fish and Wildlife Conference, Des Moines, Iowa.

Vhay, M., D. Haukos, D. S. Sullins, and M. B. Rice. 2022. Declining habitat quality and quantity for lesser prairie-chickens of the Sand Sagebrush Prairie. Annual Conference of The Wildlife Society, Spokane, Washington.

Vhay, M., D. Haukos, D. S. Sullins, and M. B. Rice. 2022. Assessment of lesser prairie-chicken habitat quality in the Sand Sagebrush Prairie. North American Congress for Conservation Biology, Reno, Nevada.

Vhay, M., D. Haukos, D. S. Sullins, and M. B. Rice. 2022. Assessment of lesser prairie-chickens habitat in the Sand Sagebrush Prairie. Prairie Grouse Technical Council, Lewiston, Montana.

Vhay, M., D. Haukos, D. S. Sullins, and M. B. Rice. 2023. Retrospective assessment of lesser prairie-chicken habitat quality in the Sand Sagebrush Prairie. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Thesis

Vhay, M. 2023. Reconstruction of landscape composition and vegetation characteristics in the Sand Sagebrush Prairie Ecoregion. M.S. Thesis, Kansas State University. https://krex.k-state.edu/items/8f18eb84-ebb0-4151-b1cc-04736c742dd8

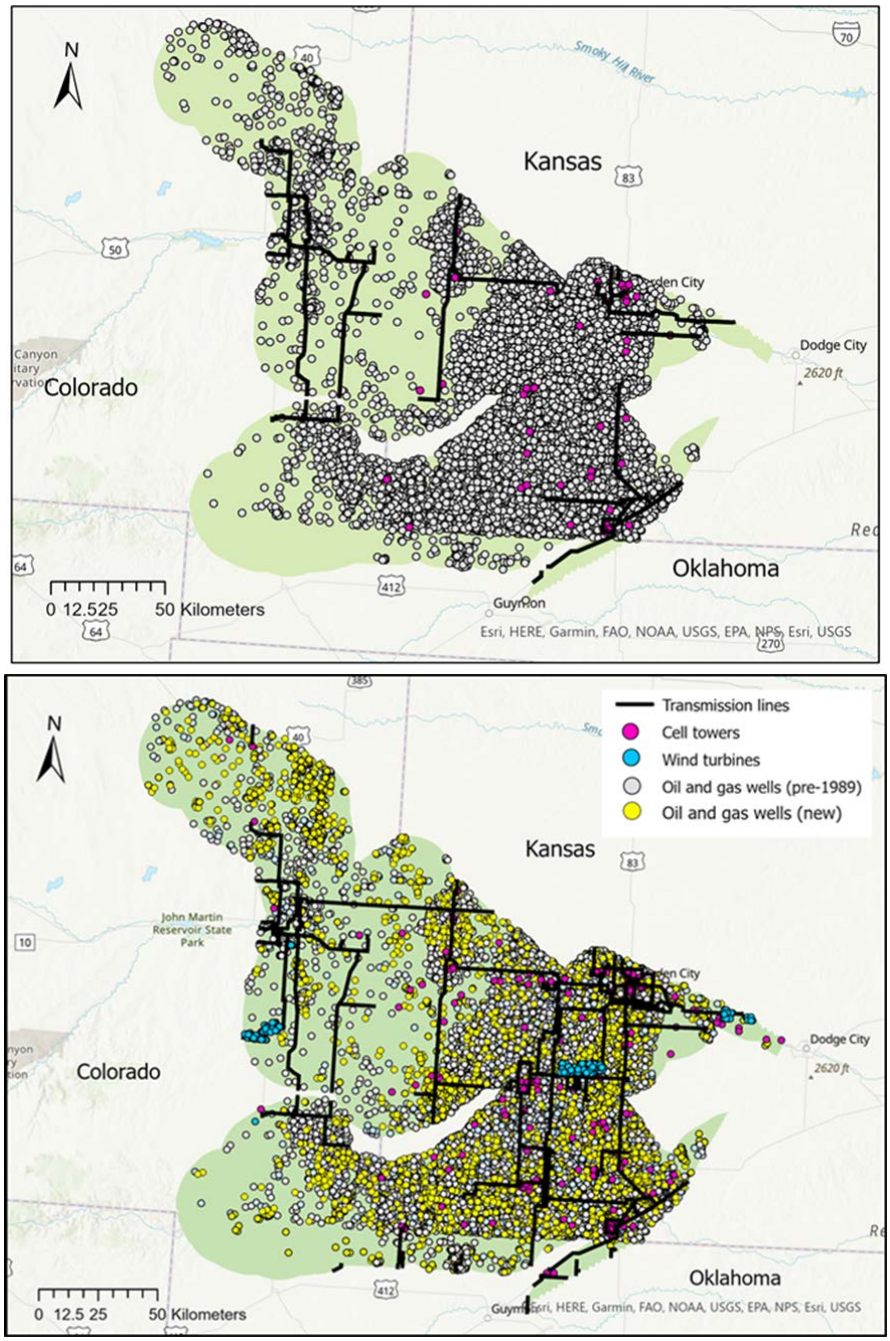


Figure 1. Number of anthropogenic structures (transmission lines, cell/radio towers, wind turbines, and oil/gas wells) present in the Sand Sagebrush Prairie Ecoregion of Kansas, Colorado, and Oklahoma, USA, in 1989 (top), around the time of the lesser prairie-chicken population peak, and by the end of 2014 (bottom).

Treed Gaussian Process for Animal Movement Modeling

Investigators
Camille Rieber
Dr. Trevor Hefley

Project Supervisor
Dr. David Haukos

Funding
U.S. Geological Survey

Cooperators
Kansas Department of Wildlife and Parks

Objectives
Compare lesser prairie-chicken movements on adjacent patch-burn and rotationally grazed ranches

Use derived daily displacement estimates to make inference about habitat quality on these ranches

Develop and demonstrate a novel animal movement modeling technique with wide applications

Location:
Kiowa, Comanche, Pratt, and Barber counties, Kansas

Completion
August 2023

Status
Completed

Abstract

Wildlife telemetry data are widely collected and can be used to answer a diverse range of questions relevant to wildlife ecology and management. While multiple animal movement models exist, current methods face challenges in modeling the nonstationarity of animal movement. Additionally, model implementation often poses barriers to practitioner use. To address these issues, I demonstrated a Bayesian machine learning modeling framework for telemetry data. This framework incorporates Bayesian statistics' ability to quantify uncertainty and estimate comparable movement descriptors, while machine learning enables near automation of modeling. Specifically, my developed framework utilizes treed Gaussian processes (TGPs), a recently developed machine learning model that is well suited to the intrinsic nonstationarity of telemetry data. To ensure accessibility to practitioners, I utilized an existing R package to implement TGP modeling and outlined in detail the nearly automated use of the package within the movement modeling framework. I used telemetry data from a declining grassland bird, the lesser prairie-chicken (*Tympanuchus pallidicinctus*), as a case study to demonstrate the ease and applicability of this framework. I obtained model-based estimates of trajectories to compare individual and population estimates for movement descriptors such as distance traveled and residence time and compared these estimates across grazing management treatments. To maintain broad useability, I outlined all steps necessary for practitioners to specify relevant movement descriptors and apply TGP modeling and trajectory comparison to their own telemetry datasets. As well as modeling the nonstationarity present in animal telemetry data, the combined benefits of this framework increase accessibility and applicability of animal movement modeling, allowing practitioners to model trajectories and estimate comparable movement descriptors to answer applied management questions.

Products

Publications
Rieber, C.J., T.J. Hefley, and D.A. Haukos. 2024. Treed Gaussian processes for animal movement modelling. Ecology and Evolution 14:e11447

Presentations

Rieber, C. T. Hefley, and D. Haukos. 2022. Bayesian machine learning for movement modeling of lesser prairie-chickens. Annual Conference of The Wildlife Society, Spokane, Washington.

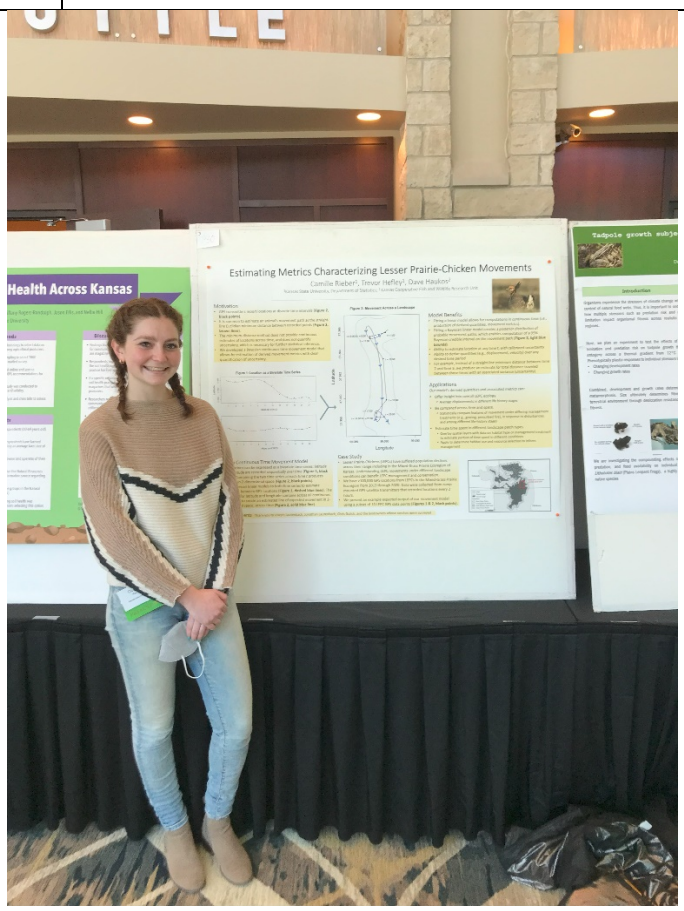
Rieber, C. T. Hefley, and D. Haukos. 2022. Estimating metrics characterizing lesser prairie-chicken movements. Kansas Natural Resource Conference, Manhattan (poster).

Rieber, C., T. Hefley, and D. Haukos. 2023. Lesser prairie-chicken movement models in patch-burn and rotational grazing systems. Kansas Natural Resource Conference, Manhattan, Kansas.

Rieber, C., T. Hefley, and D. Haukos. 2023. Bayesian machine learning for movement modeling of lesser prairie-chickens. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Thesis

Rieber, C. 2023. Treed Gaussian processes for animal movement modelling. M.S. Thesis, Kansas State University, Manhattan. https://krex.k-state.edu/items/26b74104-1416-4917-aee8-8cb219693c27



Survival, Activity Patterns, Movements, Home Ranges, and Resource Selection of Female Mule Deer and White-tailed Deer in Western Kansas

Investigators
Talesha Karish

Project Supervisors
Dr. David Haukos
Dr. Andrew Ricketts

Cooperators
Levi Jaster, KDWP

Funding
Kansas Department of Wildlife and Parks

Kansas State University

Objectives
Evaluate differences in seasonal multi-scale resource selection by female mule deer and white-tailed deer in western Kansas

Measure differences in home range area, composition, and overlap; movements; and activity patterns between adult female mule deer and white-tailed deer at seasonal and fine temporal scales in western Kansas

Estimate annual and seasonal survival rates and cause-specific mortality of female mule deer and white-tailed deer in western Kansas

Location
Lenora, Kansas
Scott City, Kansas

Completion
April 2022

Status

Completed

Abstract:
White-tailed deer (*Odocoileus virginianus*) and mule deer (*O. hemionus*) occur in sympatric populations across the Great Plains in North America. Mule deer abundance and occupied range has been declining during the past three decades while white-tailed deer abundance and occupied range has been increasing. Factors contributing to the dichotomous population growth and distribution patterns across their sympatric range are unknown, but potentially include differential survival, space use, and resource selection, all of which may be contributing to indirect competition that may be negatively affecting mule deer populations. Overlap in resource use or space use between mule deer and white-tailed deer could be evidence of competition or competitive exclusion. Activity patterns could provide insights for temporal segregation or competition. Differential space use could allow these species to spatially segregate and co-occur without competing for the same resources. My objectives were to 1) estimate annual and seasonal survival rates, 2) identify cause-specific mortality of adult female mule deer and white-tailed deer, 3) compare behavior patterns between adult mule deer and white-tailed deer of both sexes at seasonal and fine temporal period scales, 4) evaluate the difference in movements between adult female mule deer and white-tailed deer at seasonal and fine temporal scales, 5) test for differences in home range area and composition of adult female mule deer and white-tailed deer at seasonal and fine temporal scales, and 6) evaluate differences in seasonal multi-scale resource selection by female mule deer and white-tailed deer in western Kansas. I deployed collars on 184 pregnant females (94 mule deer and 90 white-tailed deer) at two different study sites in western Kansas (North, South) over three years, 2018, 2019 and 2020. Each deer received a high-resolution GPS/VHF collar that recorded hourly locations, activity accelerometer data along 3 axes, and used an activity sensor to identify mortality events. I used a Kaplan-Meier model to estimate cumulative weekly and annual survival and fit a hazard function to each survival model. I tested for relative influence of factors on estimated survival. I categorized activity points into three behavioral states (feeding, resting, and running). I converted activity points into a proportion of total behavior for each deer and tested for differences in the proportion of behavior categories between species and among seasons. I calculated individual hourly and daily movements seasonally and compared them between species and among seasons. I calculated annual and seasonal 95% home ranges and 50% core areas for each individual deer using a

Biased Brownian Bridge movement model. Using logistic regression, I modeled resource selection by mule deer and white-tailed deer at the landscape scale, within home range scale, and within the core home range to identify selection for potential habitat variables and cover types. There was no difference in annual survival of adult female deer between species (mule deer [0.78 ± 0.04] and white-tailed deer [0.77 ± 0.05]). Harvest was the leading known cause of female mortality at 14% of the total mortality, but it was low compared to other studies in the Great Plains. Behavior of both species was similar in all seasons except for rut for males. In rut, males doubled their running behavior. Firearm season produced no changes in behavior for either species or sex. However, the greatest movements and home ranges were in the firearm season. There were greater movements and home ranges in the cold seasons than in the warm seasons. Mule deer were found to use steeper slopes than white-tailed deer, and white-tailed deer used riparian and woodland areas more than mule deer. Habitat patches enrolled in the U.S. Department of Agriculture Conservation Reserve Program were strongly selected by both species in every season and scale. Managers should focus on preserving CRP to stabilize the mule deer population. Given harvest rates of females are low, survival of adult females of both species of deer appears to be little affected by harvest, so there is no need to alter harvest rates of either species.

Products

Professional Presentations

Karish, T., D. Haukos, A. Ricketts, and L. Jasper. 2018. Resource selection and movements of female mule deer and white-tailed deer during parturition and lactation in western Kansas. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Karish, T., D. Haukos, A. Ricketts, L. Jaster, M. Kinlan, and M. Kern. 2019. Seasonal activity patterns of female white-tailed deer and mule deer in western Kansas. Annual Meeting of The Wildlife Society, Reno, Nevada.

Karish, T., D. Haukos, A. Ricketts, Levi Jaster, M. Kinlan, and M. Kern. 2019. Resource selection and movements of female mule deer and white-tailed deer in western Kansas. Kansas Natural Resource Conference, Manhattan, Kansas.

Karish, T., D. Haukos, A.M. Ricketts, and L. Jaster. 2020. Resource selection in multiple spatial scales by female mule deer and white-tailed deer in western Kansas. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Dissertation

Karish, T. 2022. Survival, activity patterns, movements, home ranges and resource selection of female mule deer and white-tailed deer in western Kansas. Dissertation, Kansas State University, Manhattan.

Active Wildlife Projects

Survival of Wild Turkey Hens, Nests, and Poults Across a Precipitation Gradient in Kansas

Investigators
Caroline Skidmore

Project Supervisors
Dr. David Haukos
Dr. Dan Sullins

Funding
Kansas Department of Wildlife and Parks
Kansas Chapter of the National Wild Turkey Foundation

Cooperators
KDWP
Kent Fricke
Jeff Prendergast
Rich Schultheis

KSU
Dr. Trent Schrader

Objectives
Determine effects of landscape composition, habitat selection, and weather on the survival and recruitment of wild turkey hens.

Location:
Ellsworth, Riley, Marion, Lyon, Trego, McPherson, Russell, Morris, and Greenwood Counties, KS.

Status
In progress, initiated August 2023

Progress and Results
The Kansas State University wild turkey research team captured 383 wild turkeys (*Meleagris gallopavo*) between January 20 and March 14, 2024 (Figure 1). Of that total, 325 turkeys were female and 58 were male. We exceeded our original goal of fitting 270 hens with backpack transmitters, and report that 297 hens were fitted with ATS iridium transmitters (Figure 2).

Based on GPS locations and field observations, 185 hens initiated at least one nest by June 2024, with 304 nests identified. Of these, 106 are renests, and 15 are second renests. For initial nests, there were 105 nests initiated in April and 93 nests initiated in May (Figure 3). There are105 nests in the western region, 103 in the central region, and 96 in the eastern region. Apparent nest success in 2024 is 23% in the west region, 15% in both the central and east regions. We have completed nest vegetation surveys for 205 nests.

Additionally, 30 nests reached their 28-day estimated hatch date resulting in attempts for poult survival surveys. This includes one hen that attempted a renest after initial failure, and currently still has a live brood. Brood survival to 28 days was 67% (6/9) in the east region, 44% (4/9) in the central region, and 36% (4/11). On-going monitoring of active broods continues.

Lastly, 19 hen mortalities that occurred in May compared to 32 hen mortalities in April. Of the 97 hen mortalities that have occurred since the trapping efforts this winter, we have recovered 68 of the transmitters (seven of which were redeployed during the trapping season). This results in 200 hens remaining alive from our original 297 captured and tagged individuals.

Products

Presentations

Skidmore, C., D. Haukos, and D. Sullins. 2024. Nesting ecology and survival of wild turkey hens across three grassland ecoregions in Kansas. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Completion
Spring 2027

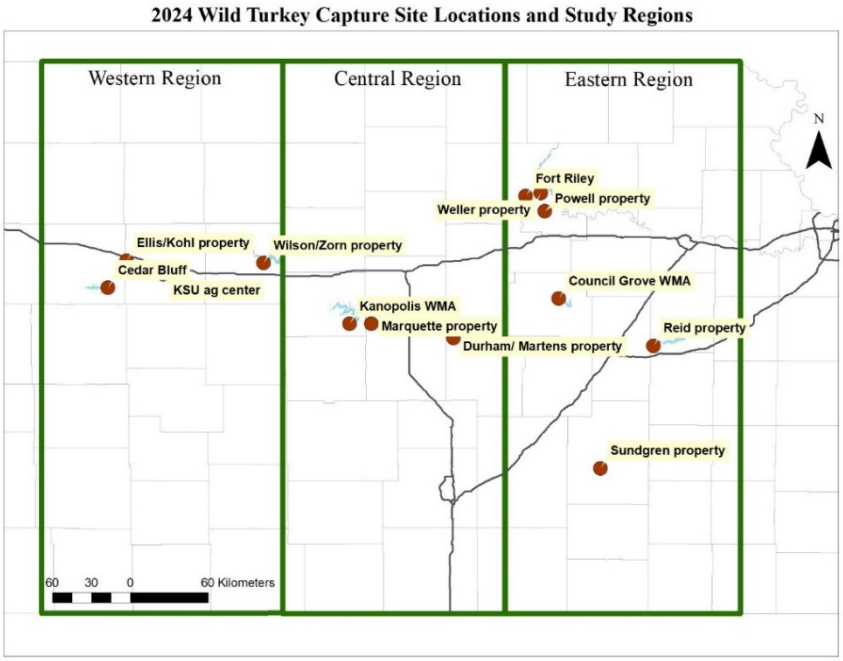


Figure 1. Trapping locations of wild turkeys across three study regions (western, central, and eastern) in Kansas, during January-March 2024.

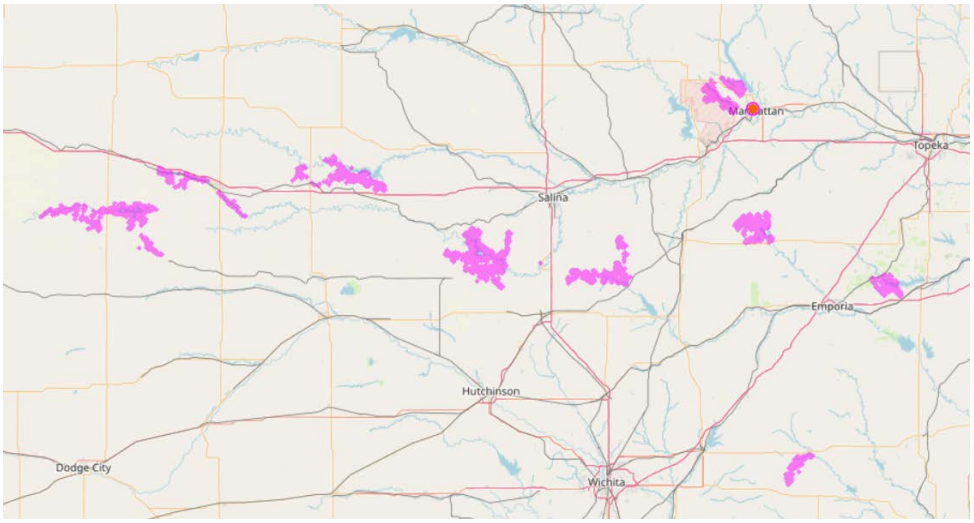


Figure 2. Distribution of the locations of 297 wild turkey hens across Kansas, from January-June 2024.

Figure 3. Example of a failed wild turkey nest, likely depredated, placed within poison hemlock. Morris County, Kansas. May 2024.

Assessing Roost Site Selection and Impacts of Land Management on Wild Turkeys in Kansas

Investigators
Mary Ware

Project Supervisors
Dr. David Haukos
Dr. Dan Sullins

Funding
Kansas Department of Wildlife and Parks
Kansas Chapter of the National Wild Turkey Foundation

Cooperators
KDWP
Kent Fricke
Jeff Prendergast
Rich Schultheis

KSU
Dr. Trent Schrader
Dr. Nellie Hill-Sullins

Objectives
Measure wild turkey response to habitat management practices

Compare use and availability of roost trees in Kansas

Assess female wild turkey movements in response to

Status
In progress, initiated August 2023

Progress and Results

Although not typically considered a strong influence on habitat use by wild turkey (*Meleagris gallopavo*) populations, roost tree availability can greatly limit resource selection, space use, and movements by turkeys in historically grassland-dominant or savanna landscapes. In those landscapes, turkeys are restricted to riparian areas with limited availability of trees for roosting. Our objective is to characterize roost tree use, selection, and availability across a longitudinal precipitation gradient in Kansas representing variation in abundance and distribution of forest cover types. Female turkeys were captured and fitted with Iridium GPS backpack-mounted units along the precipitation gradient. We are identifying nocturnal roost locations based on GPS locations and evidence of droppings and feathers. Marked females incubating nests or attending broods are excluded from the data set. We are measuring tree characteristics (species, total height, DBH, height to lowest limb, surrounding understory composition, stand area) of trees used three or more times per month. Preliminary analyses indicates that Kansas turkeys use the tallest and largest diameter deciduous trees in a stand. Turkeys in the east region typically spent fewer nights on average in the same roost tree as compared to turkeys in the west region where presumably fewer roost trees are available. Roost trees in the western sites were more likely to be used by multiple transmittered birds. Preliminary results indicated that roost trees are a factor in determining habitat availability for turkeys and management strategies would benefit by considering availability and distribution of roost trees in grassland-dominated landscapes.

Wild turkey response to habitat management will be conducted in multiple ways. Using spatial layers of different habitat management such as prescribed burning, discing, mowing, food plots, timber stand improvements, and invasive species selection and distance to management area will be conducted. These areas need be identified on both private and public land in the study regions. Resource selection of management areas will also be examined at different life stages and needs.

I will also be assessing female turkey response to hunting pressure by classifying public land, walk-in hunting areas, and private land as high, medium, and low hunting pressure, respectively. Once these areas are classified, I will assess derived quantities of associated movement patterns related to biological needs and time of hunting events. In addition to the movements of these turkeys, I will compare home range area before, during, and after hunting season. Lastly, I will assess how harvest pressure affects reproductive effort by examining if there is a disproportionate increase of

hunting pressure

Location:
Kansas

Completion
December 2026

nest failing in high harvest areas or if nesting attempts are delayed due to hunting pressure.

Products

Presentations

Ware, M., D. Sullins, and D. Haukos. 2024. Roost tree selection by wild turkeys in Kansas. Annual Conference of The Wildlife Society, Baltimore, Maryland. (Poster)

Wild Turkey Poult Foraging Ecology and Nutrient Availability in Kansas

Investigators
Cy Marchese

Project Supervisors
Dr. Dan Sullins
Dr. David Haukos

Funding
National Wild Turkey Federation
Kansas Department of Wildlife and Parks

Cooperators
KDWP
Kent Fricke
Jeff Prendergast
Rich Schultheis

Objectives
Measure food selection, availability, and quality for breeding hens and poults to inform management to promote nest and poult survival

Location:
Trego, Russel, Ellis, Lincoln, and Osage counties, Kansas

Completion
August 2026

Status
In progress, initiated May 2024

Progress and Results

Interactions among starvation, predation, and thermoregulation critically influence wild turkey (*Meleagris gallopavo*) populations, with the relative impact of these factors varying across landscapes. Among these population controls, our understanding of wild turkey food resources and their accessibility during critical life stages remains limited. This research employs advanced DNA metabarcoding techniques to analyze diets of wild turkey hens and poults, establishing correlations between habitat use, reproductive success, and available forage.

Recent declines in wild turkey populations may be attributed to changes in the availability of these food-rich habitats. Early successional patches are rich in herbaceous vegetation, particularly forbs, which have lower lignin concentrations and attract invertebrates. These patches, when composed of native forbs and grasses, support abundant invertebrate communities essential for poults and significant for nesting hens. However, information on food availability and utilization within these critical habitats during nesting and brood-rearing stages is lacking, especially in the Great Plains of Kansas, where native warm-season grasses, croplands, and woodlands are threatened by land use conversion and woody encroachment/maturation.

Forage availability for nesting hens and broods will be assessed through monthly surveys documenting plant and invertebrate occurrences in land cover patches occupied by nesting hens and broods over the study's first two years. Vegetation surveys will be conducted at successful nest sites and known brood locations using GPS data. Vegetation clippings will be collected at central survey points and at 10 meters north and south using a 0.1 m^2 clipping frame. This methodology will also be applied at two paired random locations based on the central survey point. Arthropod sampling will be conducted concurrently using a modified leaf vacuum blower. Each sample will be sorted, and the occurrence of plant and invertebrate species will be recorded.

Hen and poult fecal samples will be collected at nest sites, ground roosts, and GPS locations, aiming to gather 25 hen and 35 brood fecal samples per study area per year, totaling 360 samples. These samples will be sent to Jonah Ventures (Boulder, CO) for quantification of plant and invertebrate species using eDNA.

Based on the results of diet composition analyses, we will assess the nutritional quality of plant and invertebrate forage. At least three replicate samples of foods occurring in more than 20% of fecal samples for each study area will be sent to a forage analysis laboratory (either SDK Labs, Hutchinson, KS, or Oklahoma State University) for proximate analysis to measure dry matter, crude protein, ADF, NDF, and ash, evaluating forage quality.

Movements, Space Use, and Vital Rates of Mourning Doves

Investigators
Natalie Pegg

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife and Parks

Cooperators
KDWP
Rich Schultheis
Tom Bidrowski

Objectives
Estimate breeding vital rates among intensively managed public lands, other rural public and private lands, and urban landscapes

Assess relationships among breeding season production, movements, habitat use, and timing of harvest

Determine the relative levels of co-occurrence of mourning doves, white-winged doves, and Eurasian collared-

Status
In Progress, initiated in 2022

Progress and Results

The mourning dove (*Zenaida macroura*) is an iconic, migratory gamebird that breeds throughout the contiguous United States and cooperatively managed by the United States Fish and Wildlife Service and state wildlife agencies in three management units. While there have been population declines in all three, the Central Management Unit, including Kansas, contains a disproportionately large percent of the breeding mourning dove population in the United States and has experienced declines >40% since 2004. Potential reasons for these declines include changes in land use and habitat quality, agricultural intensification, competition with non-native doves such as white-winged dove (*Zenaida asiatica*) and Eurasian collared-dove (*Streptopelia decaocto*), disease, lead poisoning due to spent lead shot, and climate change. This project aims to address most of these factors and establish a thorough baseline of demographic rates for future comparison.

In the initial field season of this study during 2023, 104 patches, each measuring 750 m^2, were established and utilized for step-point vegetation surveys, nest searching transects, and avian point-count surveys. Our surveys resulted in the identification of 230 mourning dove nests, 78 Eurasian collared-dove nests, and 13 white-winged dove nests. Notably, all nests of non-native doves were located within urban treatment areas. Analysis revealed variability in apparent nest success across different locations and treatments. Apparent nest success rates were comparable between the western (Garden City) and central (McPherson) locations, 50% and 50.48%, respectively, whereas the eastern (Topeka) location exhibited a lower success rate of 22%. Urban treatment areas consistently demonstrated greater apparent nest success relative to intensively managed public lands and other public/private rural lands. Nest density estimates varied, ranging from 0 to 156.39 nests per km^2, with the largest densities of mourning dove nests observed in urban treatment areas across all locations. Additionally, a total of 322 doves were banded, and Very High Frequency (VHF) transmitters were attached to 99 adults. Approximately 30% of the tagged birds were successfully relocated at least once during the study period. The second field season of this study is currently underway with nine full-time research technicians employed on this project. As of June 8, 2024, we have found more than 50 mourning dove nests, banded 117 doves, and deployed 97 VHF transmitters.

In addition to fieldwork, I conducted several dead recovery analyses that determined annual survival and recovery rates among the three dominant bird conservation regions (BCRs) in Kansas and between birds banded in urban vs rural locations. I found that while there were significant differences in rates across the state (stratified by BCR), there were not significant differences in estimated annual survival between birds banded in urban vs rural locations. I included a final analysis determining rates among doves banded at managed dove fields and outside of managed dove fields. Additionally, I plan to address potential competition between mourning doves and non-native doves using data from the North American Breeding Bird Survey (BBS). The BBS provides counts dating back to the 1960s of each species seen or heard at 0.5-mile stops along 25-mile survey routes. I have fit several generalized additive

doves throughout Kansas

Determine trends for annual survival and harvest rates using recovery data for mourning doves banded in Kansas

Determine prevalence of avian pox in mourning doves throughout Kansas

General Locations: Topeka, McPherson, and Garden City

Expected Completion: December 2025

models to these count data to generate predictions of abundance for mourning doves, white-winged doves, and Eurasian collared-doves across Kansas.

Products

Presentations

Pegg, N., D.A. Haukos, and R. Schulthesis. 2023. Band recovery analyses of mourning doves banded in Kansas. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Pegg, N., D.A. Haukos, and R. Schulthesis. 2023. Harvest pressure on an iconic household species, the mourning dove. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Pegg, N., D.A. Haukos, and R. Schulthesis. 2024. Vital rates of mourning doves in Kansas. Kansas Natural Resources Conference, Manhattan, Kansas.

Pegg, N., D.A. Haukos, and R. Schulthesis. 2024. Harvest pressure on an iconic household species, the mourning dove. Annual Meeting of the Midwest Fish and Wildlife Agencies, Sioux Falls, South Dakota.

Pegg, N., D. Haukos, and R. Schultheis. 2024. Novel co-occurrence of mourning doves, Eurasian collared-doves, and white-winged doves in Kansas. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Composition and Diversity Assessment of *Bombus* spp. on Fort Riley Military Reservation, Kansas

Investigators
Cassidy Lathrom

Project Supervisor
Dr. David Haukos

Funding
Department of Defense

Cooperators
Fort Riley Military Reservation, Environmental Division

Caroline Skidmore

Derek Moon

Objectives
Measure bumblebee species composition present relative to land cover types and management regimes

Determine environmental factors with the greatest effect on abundance and density of native bee populations

Status
In Progress, initiated 2022

Progress and Results

Bumblebees (*Bombus* spp.) are essential pollinators for a variety of native grassland forbs and agricultural crops across the globe but have been steadily declining in abundance and occupied range during the past several decades. I measured the variation of native *Bombus* communities across space and time relative to land cover types, floral types and stage, and tallgrass prairie management regimes (e.g., prescribed fire, haying, mechanical and herbicide control of invading trees and herbaceous plants) Fort Riley Military Reservation (FRMR), Kansas, with a focus on American bumblebee (*B. pensylvanicus*) and Southern Plains bumblebee (*B. fraternus*), both species of conservation concern.

Bombus movement ecology and habitat use varies over space and time with diversity and composition dependent on factors at several spatial scales. To identify which environmental conditions are required for the maintenance of populations, I measured species diversity and composition of bee species in grasslands at multi-scale levels. At a landscape scale, distance sampling site locations were selected using randomized survey location resulting in 151, 500-m transects total on Fort Riley (Figure 1). Surveys were used to determine the relative influence of environmental factors (e.g., tree removal, fire; time since burned, haying) on the abundance and density of *Bombus* species. Vegetation sampling consists of a 500-m step-point transect with a random start point to determine species compositions in the floral colony or associated with distance-sampling transects. The location of all bumblebees observed along the transect were recorded using a GPS unit.

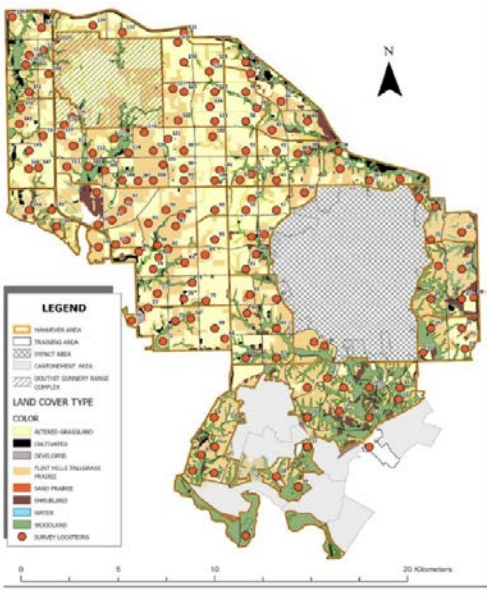


Figure 1. Randomized distance survey locations of 151 transects on Fort Riley.

Establish a causal link between floral resource availability and pollinator density at local habitat scales.

Location
Fort Riley Military Reservation, Kansas

Completion
Spring 2025

At the local scale, Mark-Recapture (MR) trials were used to determine native bee species occurrence, richness, and estimate abundance among different types of floral colonies at habitat scales. Bumblebee site locations were selected based on dominant blooming floral colonies using surveys during early summer (May and June) and late summer (July and August; Figure 2). Plant-pollinator richness and density were measured at local habitat scales using MR efforts and vegetation surveys. Abundance of total *Bombus* spp. and individual bee species are estimated using either closed population models in Program MARK, or the Schnabel estimator for the Lincoln-Peterson estimator. Abundance was estimated for each floral colony during each capture-mark-recapture bout and scaled to larger spatial and temporal scales as appropriate given available data and model assumptions. Bee density was derived based on the estimated area of the respective floral colony and used in conjunction with linear models to evaluate potential relationships with vegetation and landscape characteristics.

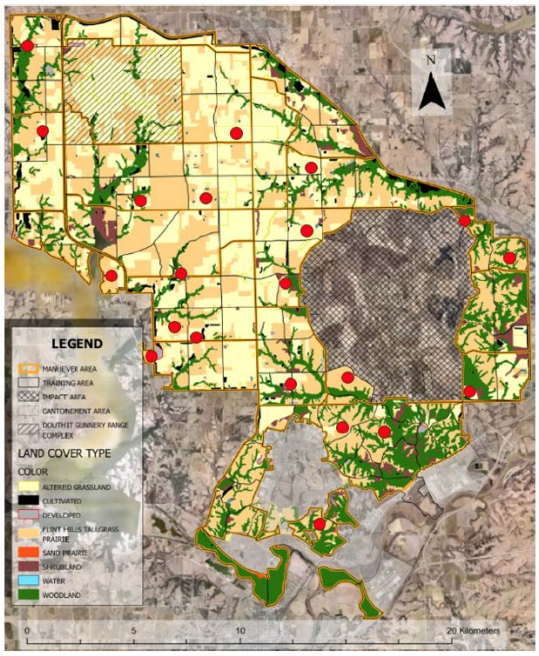


Figure 2. The 22 floral colony sites for mark-recapture sampling during 2023 on Fort Riley.

During the 2023 field season, we captured 8,620 bees across 22 MR sites representing 12 dominant plant colonies. Data were comprised of six species including American, Southern Plains, Black and Gold (*B. auricomus*), Common Eastern (*B. impatiens*), Brown-Belted (*B. griseocollis*), and Two Spotted (*B. bimaculatus*) bumblebees. We estimated *Bombus* occurrence of 1.40 *Bombus*/ha (CV = 0.122) and abundance of 40,047.1 ± 4924.003 bees on FRMR in 2023, respectively. These results yield a lower density rate per/ha on Fort Riley compared to similar studies in the midwest region. Overall, Fort Riley supports a diverse native bumblebee community. These data are the first known estimates of *Bombus* density in tallgrass prairie and serve as a baseline for future assessments.

Products

Presentations

Lathrom, C., Skidmore, C., D. Haukos, and D. Moon. 2023. Tallgrass prairie management regime and plant diversity effects on native bumblebee density. Annual Meeting of The Wildlife Society, Louisville, Kentucky. (poster)

Lathrom, C., Skidmore, C., D. Haukos, and D. Moon. 2024. Assessing the Composition and Diversity of Native Bumblebee Species in the Great Plains. Annual Meeting of the Midwest Fish and Wildlife Agencies, Sioux Falls, South Dakota.

Lathrom, C., Skidmore, C., D. Haukos, and D. Moon. 2024. Assessing the composition and diversity of native bumblebee species in the Great Plains. Kansas Natural Resources Conference, Manhattan, Kansas.

Lathrom, C., Skidmore, C., D. Haukos, and D. Moon. 2024. Assessing the composition and diversity of native bumblebee species in the Great Plains. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Landscape Composition and Configuration of Lesser Prairie-Chicken Core Areas and Connectivity Zones

Investigators
Katryn Stafford

Project Supervisor
Dr. David Haukos

Funding
CEAP, USDA Natural Resources Conservation Service

Cooperators
Kansas Department of Wildlife and Parks

Objectives
Compare composition of surrounding landscapes between leks with counts above and below survival threshold

Characterize the landscape surrounding lesser prairie-chicken leks, identified core areas, and potential movement corridors in Kansas

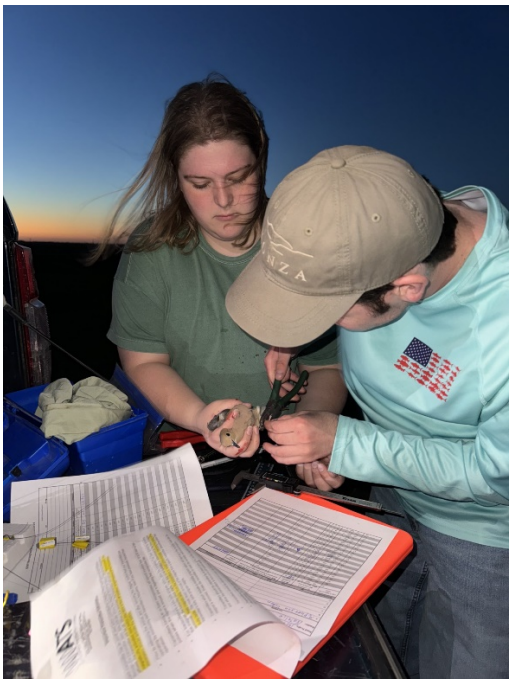
Location:
Lesser prairie-chicken range in Kansas

Status

In progress, initiated January 2024

Progress and Results

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is a prairie grouse that has suffered significant declines in abundance and occupied range since the mid-1980s due to habitat loss and degradation, anthropogenic disturbance, and expanding invasion by trees. Currently listed as threatened in Kansas under the 1973 Endangered Species Act, the lesser prairie-chicken is considered an indicator species of grassland ecological quality. Populations of lesser prairie-chickens are sensitive to landscape thresholds based on percent grassland, density of anthropogenic structures, percent tree cover, and other features within 5 km of leks. Recent investigations have indicated an apparent threshold of 10 birds for long-term persistence for leks. Leks with <10 attending individual birds have a significantly lower probability of persistence than leks with >10 birds. I am comparing characteristics of surrounding landscapes between leks with attendance counts above and below the survival threshold. In addition, I will use spatial analyses to categorize landscape metrics (e.g., patch size, number of patches, contagion) and known landscape thresholds (e.g., percent grassland, tree cover) to determine if landscape-scale characteristics are influencing lek attendance across the lesser-prairie chicken range in Kansas. Finally, I will characterize landscapes for identified core areas and movement corridors relative to identified population thresholds to assist in prioritization of conservation efforts. Results from this work will be used as part of a larger effort to evaluate the relative persistence of lesser prairie-chicken populations in Kansas.



Assessing Effects of Vegetation Characteristics and Management of the Conservation Reserve Program on Lesser Prairie-Chicken Habitat Quality, Resource Selection, and Demographics throughout the Species' Northern Range

Investigators
Elisabeth Teige

Project Supervisor
Dr. David Haukos

Funding
USDA-Natural Resources Conservation Service

USDA - Farm Service Agency

USGS – Fort Collins Science Center

Cooperators
USDA-Natural Resources Conservation Service

USDA - Farm Service Agency

USGS – Fort Collins Science Center

Objectives
Review the effects of CRP on prairie grouse

Understanding the selection of CRP by

Status
On going, initiated August 2023

Progress and Results
Since 1985, the Conservation Reserve Program (CRP) has been one of the most successfully implemented conservation efforts in the United States and valuable for increasing grasslands across the central and intermountain plains. The CRP is a federal conservation tool where landowners voluntarily plant former row-crop land with grassland species for 10-15 years, receiving monetary compensation with some flexibility on management practices allowed after planting, including grazing. The CRP has recently expanded to allow enrollment of working rangelands. Additionally, CRP grasslands are used by various wildlife including grassland birds, providing nesting and reproductive habitat, a critical stage in grassland birds' annual lifecycle. With the severe decline of grassland bird species, grasslands provided by CRP could help mitigate population declines.

One species that relies on CRP for several aspects of their annual life cycle is the lesser prairie-chicken (*Tympanuchus pallidicinctus*). Lesser prairie-chickens are dependent on the CRP in the western portion of their range, notably during extreme events such as intensive drought, wildfire, or after translocation. However, with the various vegetation plantings and flexibility available for management of CRP grasslands, there is considerable variation in vegetation composition and structure as well as juxtaposition of CRP fields within and among landscapes. While previous research indicates a pattern of use of CRP by lesser prairie-chickens, specific characteristics of CRP fields selected by lesser prairie-chickens are unknown. Understanding and investigating the intricate interaction of CRP and lesser prairie-chicken populations will provide insight into management opportunities for the threatened and endangered species at multiple scales.

The project objectives are to 1) review our current understanding of the effects of CRP on prairie grouse, 2) use 10 years of existing research of lesser prairie-chickens to establish characteristics of selected CRP fields relative to availability of CRP on the landscape, 3) determine the area and quality of lesser prairie-chicken habitat provided by CRP throughout the species range using demographic metrics, and 4) evaluate current CRP practices and management effects on the availability of lesser prairie-chicken nesting habitat.

Results
The CRP is generally thought to broadly benefit prairie grouse species but literature on the direct effects of CRP on prairie grouse demography, resource selection, and space use is scattered throughout time and across the United States. I conducted a literature review of the direct effects of CRP on *Tympanuchus* and *Centrocercus* spp. and found 19 studies, of which 84% of the effects were positive on species dynamics, 16% indicated no direct effects, and 0% of studies indicated negative effects of CRP on species dynamics. Greater than half (52%)

LEPC across multiple scales.

Evaluate the demographic effects of the CRP on LEPC

Conducting vegetation assessment of available LEPC nesting habitat on variously managed CRP

Location: Western Kansas and Eastern Colorado

Expected Completion: May 2026

of studies included CRP as binary present/absence variable, 31% included CRP field vegetation measurements, and 10% included a grazing variable. Literature on response to emergency grazing and haying, initial seed planting, and current composition of CRP fields on prairie grouse species dynamics are lacking and could be useful for implementing CRP to support imperiled prairie grouse.

Fields established by the CRP can vary in length since establishment, seed planting, and management. Understanding how these factors interact with climatic conditions can provide insight into management practices that would be beneficial for the lesser prairie-chicken. Currently, vegetation sampling is being conducted in western Kansas where the largest current population of lesser prairie-chickens occurs. Identical sampling techniques are being used to directly compare results from past studies that concluded optimal nest site selection for lesser prairie chickens (Table 1). Sampling is taking place on the five most common conservation practices by frequency and by size within this region. These practices are CP2 - establishment of permanent native grasses, CP25 - rare and declining habitat such as tallgrass prairie, CP38E-2 - state acres for wildlife enhancement (SAFE) on previous CP2 fields, CP4D - permanent wildlife habitat, and CP88 – working land opportunities for land with native grasses and legumes (Figure 1). Information from this study can provide insight into the effect that management, seed planting and precipitation can have on available nesting and brood rearing habitat.

Finished collecting vegetation measurements with Robel poles on CRP in Gove County, KS. From left to right: Elisabeth Teige, Caitlyn Klemm, Leena Rossel, and Ethan Mitchell.

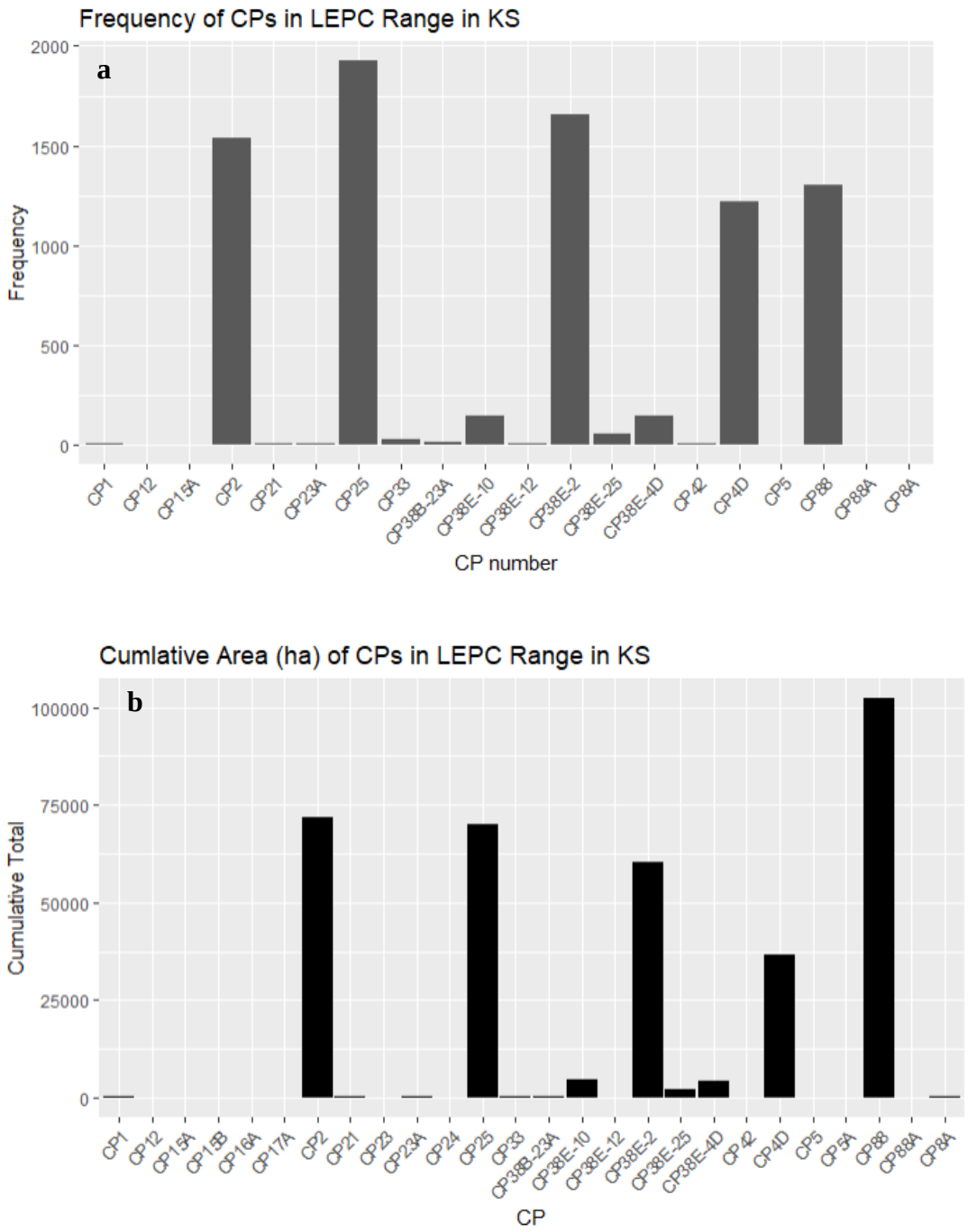


Figure 1. Frequency (a) and cumulative area (b) of the conservation practices (CP) within the LEPC range in Kansas.

Table 1. Current management guidelines for LEPC nesting and brood rearing habitat.

Sources	Location[a]	Nesting Habitat	Brood Rearing Habitat
WAFWA Range wide Conservation Plan 2013	SGP/CRP	Native grass canopy cover: >50%	Native grass canopy cover: 30-50%
		Native forbs canopy cover: >10%	Native forb canopy cover: >20%
		Average grass height between 38-56 cm	Average grass height between 38-56 cm
	MGP	Native grass canopy cover: >50%	Native grass canopy cover: 30-50%
		Native forbs canopy cover: >10%	Native forb canopy cover: >20%
		Average grass height between 38-56 cm	Average grass height between 38-56 cm
	SSB	Native grass canopy cover: >30%	Native grass canopy cover: >20%
		Native forb canopy cover: >10%	Native forb canopy cover: >20%
		Average grass height: >38 cm	Average grass height: >38 cm
		Sand sagebrush canopy cover: 15-30%	
Lautenbach et al. 2019	Northern DPS	Average 75% VOR[b]: 15 cm – 35 cm	-
		Bare ground cover: ≤ 10%	
Lautenbach 2015	Northern DPS	-	Average 50% VOR[b]: 20 - 50cm
			Forbs Canopy Cover: 7 - 37%

[a]SGP, Short-Grass Prairie/Conservation Reserve Program Mosaic; MGP, Mixed-Grass Prairie; SSB, Sand Sagebrush Prairie; Northern DPS, Across a majority of the Northern Distinct Population Segment

[b] VOR, Visual Obstruction Reading

Products

Grants:

Teige, E. Influence of emergency haying and grazing on lesser prairie-chicken habitat in Conservation Reserve Program fields. USDA-FSA, Co-PI, $92,500

Publications:

Berigan, L. A., C. S. H. Aulicky, E. C. Teige, D. S. Sullins, K. A. Fricke, J. H. Reitz, L. G. Rossi, K. A. Schultz, M. B. Rice, E. Tanner, S. D. Fuhlendorf, and D. A. Haukos. 2024. Lesser prairie-chicken dispersal after translocation: implications for restoration and population connectivity. Ecology and Evolution 14.

Teige, E. C., L. A. Berigan, C. S. H. Aulicky, J. H. Reitz, D. A. Haukos, D. S. Sullins, K. A. Fricke, K. A. Schultz, and L. G. Rossi. 2023. Assessment of lesser prairie-chicken translocation through survival and lek surveys. Wildlife Society Bulletin 2022:e1379

Teige, E. C., L. M. Maxwell, S. E. Jordan, T. K. Rutherford, E. I. Dietrich, E. M. Samuel, A. L. Stoneburner, N. J. Kleist, J. K. Meineke, L. B. Selby, A. C. Foster, and S. K. Carter. 2023. Annotated bibliography of scientific research on greater sage-grouse published from October 2019 to July 2022. USGS Open-File Report.

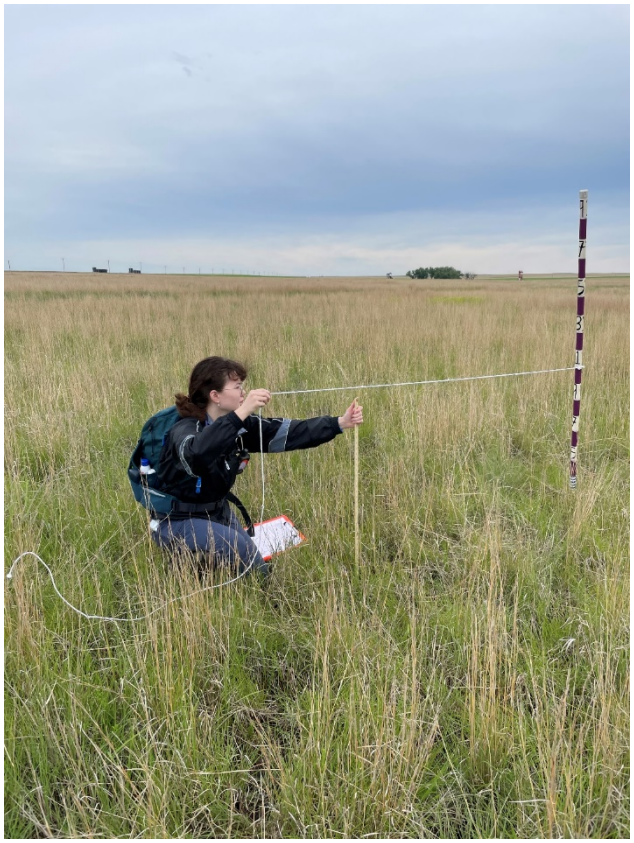
Maxwell, L. M., E. C. Teige, S. E. Jordan, T. K. Rutherford, E. M. Samuel, L. B. Selby, A. C. Foster, N. J. Kleist, and S. K. Carter. 2023. Annotated Bibliography of Scientific Research on Gunnison Sage-Grouse Published from January 2005 to September 2022. USGS Open-File Report.

Presentations

Teige, E.C., D. Sullins, and D. Haukos. 2024. The Conservation Reserve Program and prairie grouse: a review of what we know and where we can go. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Teige, E., L. Berigan, N. Parker, C. Aulicky, D. Haukos, D. Sullins, J. Reitz, L. Rossie, K. Fricke, and K. Schultz. 2024. How does translocated lesser prairie-chicken's nest site selection affect nest survival? Annual Conference of American Ornithological Society, Estes Park, Colorado.

Teige, E.C., D. Sullins, and D. Haukos. 2024. The Conservation Reserve Program and prairie grouse: what do we know and where can we go? Kansas Natural Resources Conference, Manhattan, Kansas.



List of Scientific, Peer-Reviewed Publications: 2022-present

Book Chapters

Vest, J.L., D.A. Haukos, N.D. Niemuth, C.M. Setash, J.H. Gammonley, J.H. Devries, and D.K. Dahlgren. 2023. Waterfowl and wetland birds. Chapter 13 in L.B. McNew, D.K. Dahlgren, and J.L. Beck, editors. Rangeland Wildlife Ecology and Conservation. Springer Publishing, New York, New York, USA.

Haukos, D.A. 2022. Applying key concepts: management of harvested species. Chapter 12 in E. Gomez, C. Bishop, and J. Organ, editors. Wildlife Management and Conservation in North America: An Overview. Cognella, San Diego, California, USA.

Peer-Reviewed Journal Articles

Andersson, K., C.A. Davis, G. Harris, and D.A. Haukos. 2022. Changes in waterfowl migration phenologies in central North America: implications for future waterfowl conservation. PLoS ONE 17(5): e0266785.

Bergtold, J. S., M. M. Caldas, S. R. Ramsey, M. R. Sanderson, G. Granco, and M. E. Mather. 2022. The gap between experts, farmers and non-farmers on perceived environmental vulnerability and the influence of values and beliefs. Journal of Environmental Management 316, 115186.

Berigan, L.A., C.S.H. Aulicky, E.C. Teige, D.S. Sullins, D.A. Haukos, K.A. Fricke, J.H. Reitz, L.G. Rossi, K.A. Schultz, and A.M. Ricketts. 2022. Lack of lesser prairie-chicken nesting habitat impairs translocation success. Wildlife Society Bulletin 2022:e1379.

Berigan, L.A. C.S.H. Aulicky, E.C. Teige, D.S. Sullins, D.A. Haukos, K.A. Fricke, J.H. Reitz, L.G. Rossi, K.A. Schultz, M.B. Rice, E. Tanner, and S.D. Fuhlendorf. 2023. Lesser prairie-chicken dispersal after translocation: implications for restoration and population connectivity. Ecology and Evolution 14:e10871.

Black, A.N., K.J. Bondo, A. Mularo, A. Hernandez, Y. Yu, C.M. Stein, A. Gregory, K.A. Fricke, J. Prendergast, D. Sullins, D. Haukos, M. Whitson, B. Grisham, Z. Lowe, and J.A. DeWoody. 2023. A highly-contiguous and annotated genome assembly of the lesser prairie-chicken (*Tympanuchus pallidicinctus*). Genome Biology and Evolution 2023: evad043.

Chestnut, K., M. E. Mather, Q. Phelps, and D. Shoup. 2022. A review of empirical evidence related to the effectiveness of harvest regulation evaluations: a professional call to action for a more systematic, standardized collaborative approach to data collection. Fisheries 47(10):423-434.

Combe, F. J., L. Jaster, A. Ricketts, D. Haukos, and A. G. Hope. 2022. Population genomics of free ranging Great Plains white-tailed and mule deer reflects a long history of inter-specific hybridization. Evolutionary Applications 15:111-131.

Dodds, W., S. Bonjour, M. Fisher, L. Krueger, P. Pfaff, M. A. Raihan, and O. Rode. 2024. A novel index reveals disconnects between recreational harmful algal bloom exposure risks and responses among U.S. states. Journal of the American Water Resources Association 60:273-286.

Gehrt, J.M., D.A. Moon, S.C. Stratton, and D.A. Haukos. 2022. Role of landscape features in resource selection by female Greater Prairie-chickens within a constrained environment. Global Ecology and Conservation 38 (2022):e02267.

Gehrt, J.M, D.S. Sullins, B.H.F. Verheijen, and D.A. Haukos. 2023. Lesser prairie-chicken incubation behavior and nest success most influenced by nest vegetation structure. Ecology and Evolution 13(9):e10509.

Godar, A. A. Piernicky, D. Haukos, and J. Prendergast. 2023. Ring-necked pheasant brood habitat selection and movements in an intensive agricultural landscape. Prairie Naturalist 56:107-123.

Granco, G., M. Caldas, J. Bergtold, J. L. Heier-Stamm, M. Mather, M. Sanderson, M. Daniels, A. Sheshukov, D. Haukos, and S. Ramsey. 2022. The role of cultural behavior and natural environment in shaping public support for sustainability policy. Journal of Environmental Management 301 (2022) 113776.

Kuck, S., C. Grant, M. de Barros, A., Rodriguez, and R. Baker. 2024. Nekton community responses to living shoreline restorations in Alabama. Gulf and Caribbean Research, 35(1): SC1-SC6.

Londe, D.W., C.A. Davis, S.R. Loss, E.P. Robertson, D.A. Haukos, and T.J. Hovick. 2024. Climate change causes declines and greater extremes in wetland inundation in a region important for wetland birds. Ecological Applications 34:e2930.

Mather, M. E., and J. M. Dettmers. 2022. Adaptive problem maps (APM): Connecting data dots to build increasingly informed and defensible environmental conservation decisions. Journal of Environmental Management 312 (2022) 114826.

Mather, M. E., C. Moffitt, M. Fabrizio, D. Parrish, B. Penaluna, B. Brown, S. Nesbit. 2022. Diversity and inclusion: a strategy to implement change for 2021 and beyond: symposium summary. Fisheries 47(1):28-34.

Maxwell, L. M., E. C. Teige, S. E. Jordan, T. K. Rutherford, E. M. Samuel, L. B. Selby, A. C. Foster, N. J. Kleist, and S. K. Carter. 2023. Annotated Bibliography of Scientific Research on Gunnison Sage-Grouse Published from January 2005 to September 2022. USGS Open-File Report.

Parker, N.J., D.S. Sullins, D.A. Haukos, K.A. Fricke, and C.A. Hagen. 2022. Recovery of working grasslands following a megafire in the southern mixed-grass prairie Global Ecology and Conservation 36 (2022) e02142.

Parker, N.J., D.S. Sullins, D.A. Haukos, K.A. Fricke, and C.A. Hagen. 2022. Demographic effects of a megafire on a declining prairie grouse in the mixed-grass prairie. Ecology and Evolution 12:e9544.

Portillo-Quintero, C., B. Grisham, D. Haukos, C. Boal, C. Hagen, Z. Wan, and N. Menkiti. 2022. Trends of lesser prairie-chicken habitat extent and distribution on the Southern High Plains. Remote Sensing (Special Issue Wildlife Ecology for a Dynamic Future) Remote Sensing 14:3780.

Rieber, C.J., T.J. Hefley, and D.A. Haukos. 2024. Treed Gaussian processes for animal movement modelling. Ecology and Evolution 14:e11447.

Rutherford, T. K., L. M. Maxwell, N. J. Kleist, E. C. Teige, R. J. Lehrter, M. A. Gilbert, D. J. A. Wood, A. N. Johnston, C. Mengelt, J. C. Tull, T. S. Haby, and S. K. Carter. 2023. Effects of noise from oil and gas development on ungulates and small mammals—a science synthesis to inform National Environmental Policy Act analyses. USGS Scientific Investigations Report 2023.

Sirch, M.W., D.S. Sullins, N.J. Parker, D.A. Haukos, J.D. Kraft, C.A. Hagen, and K.A. Fricke. 2022. Woody species mortality due to a megafire within the mixed-grass prairie. Prairie Naturalist 54:11-23.

Teige, E.C., N.J. Parker, M.P. Vhay, and D.A. Haukos. 2022. Durability and longevity of *Tympanuchus pallidicinctus* (Lesser Prairie-Chicken) fence tags in Kansas and Colorado. Ecological Restoration 40:83-87.

Teige, E.C., L.A. Berigan, C.S.H. Aulicky, J.H. Reitz, D.A. Haukos, D.S. Sullins, K.A. Fricke, K.A. Schultz, and L.G. Rossi. 2023. Assessment of lesser prairie-chicken translocation through survival and lek surveys. Wildlife Society Bulletin 2023:e1493.

Teige, E. C., L. M. Maxwell, S. E. Jordan, T. K. Rutherford, E. I. Dietrich, E. M. Samuel, A. L. Stoneburner, N. J. Kleist, J. K. Meineke, L. B. Selby, A. C. Foster, and S. K. Carter. 2023. Annotated bibliography of scientific research on greater sage-grouse published from October 2019 to July 2022. USGS Open-File Report.

Van Ee, J.J. C.A. Hagen, D.C. Pavlacky Jr., D.A. Haukos , A.J. Lawrence, A.M. Tanner, B.A. Grisham, K.A. Fricke, L.G. Rossi, G.M. Beauprez, K.E. Kuklinski, R. Martin, M.D. Koslovsky, T.B. Rintz, and M.B. Hooten. 2024. Melded integrated population models. Journal of Agricultural, Biological, and Environmental Statistics doi.org/10.1007/s13253-024-00620-2.

Vhay, M.P., D.A. Haukos, D.S. Sullins, and M.B. Rice. 2024. Landscape-scale changes in lesser prairie-chicken habitat. PLoS ONE 19(5): e0304452.

Werdel, T. J., C. W. Piper, A. M. Ricketts, M. S. Peek, D. S. Sullins, and A. A. Ahlers. 2023. Strategic grassland conservation for swift foxes in multi-use landscapes. Biological Conservation 277:109864.

Whetten, A.B., T.J. Hefley, and D.A. Haukos. 2024. Estimation of contact time among animals from telemetry data. The American Statistician In Press

Theses and Dissertations

Rachel Rusten (M.S., 2023, Sullins). An assessment of grassland loss, woody encroachment, and pesticide use on North American grassland bird populations. (PhD Student, University of Nebraska- Lincoln)

Victoria Reed (M.S. 2023, Mather). Using state-wide, long-term databases to establish an approach to suggest useful future data related activities. (Water Resources Design Engineer, Professional Engineering Consultants, Wichita, Kansas).

Olivia Rode (M.S., 2023, Mather). How a monitoring dataset, an adaptive management framework, and ecological comparisons of selected fish groups can guide conservation. (Assistant Scientist, Olsson Engineering, Overland Park, Kansas).

Ashley Messier (M.S., 2023, Sullins/Haukos). Patterns of greenness (NDVI) in the Southern Great Plains and their influence on the habitat quality and reproduction of a declining prairie grouse. (Biologist NRDA Program, USFWS, Atlanta, Georgia).

Camille Rieber. (M.S., 2023, Hefley/Haukos). Treed Gaussian processes for animal movement modelling. (Co-advised with T. Hefley, Statistics; USGS Contractor, NABAT project, Bozeman, Montana).

Megan Vhay (M.S., 2023, Haukos). Reconstruction of landscape composition and vegetation characteristics in the Sand Sagebrush Prairie Ecoregion. (Natural Resource Specialist, NRCS, New Hampshire)

Talesha Kalish (Ph.D, 2022, Haukos). Survival, activity patterns, movements, home ranges and resource selection of female mule deer and white-tailed deer in western Kansas. (Assistant Area Manager, Baudette Area Wildlife, Minnesota DNR)

Undergraduate Student Research Mentorships

Madison White and Makayla Oeding. 2022. Kansas State University. Project: Survey of pollinators on Fort Riley. (Haukos)

List of Presentations 2022-present

Berigan, L., C. Aulicky, E. Teige, D. Sullins, K. Fricke, J. Reitz, L. Rossi, K. Schultz, M. Rice, E. Tanner, S. Fuhlendorf, and D. Haukos. 2024. Lesser prairie-chicken dispersal after translocation: implications for restoration and population connectivity. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Bleitz, M., C. Davis, B. Ballard, D. Haukos, T. Hovick, D. Londe, E. Robertson, and S. Loss. 2024. Migratory shorebirds and landscape-level characteristics of stopover sites used in the U.S. Great Plains. IALE-North America Annual Meeting, Oklahoma City, Oklahoma.

Byrd, D., A. A. Ahlers, D. A. Moon, C. K., Skidmore, C. J. Durbin, and D. S. Sullins. 2024. Winter habitat use by a restored elk (Cervus canadensis) population in the Tallgrass prairie. Kansas Natural Resources Conference. Manhattan, Kansas.

DeVries, D., J. Garvey, M. Mather, K. Pope, S. Hitchman, and J. Smith. 2022. Connecting biology to policy: linking scales for data collection to scales needed for the decision-making process. Joint Aquatic Science Meeting (JASM), Grand Rapids, Michigan.

Durbin, C., D. S. Sullins, and A. A. Ahlers. 2023. Predicting northern raccoon abundance and occupancy in relation to woody cover. Kansas Natural Resources Conference. Manhattan, Kansas.

Durbin, C., D. S. Sullins, N. Byrd, and A. A. Ahlers. 2023. An examination of proximity to water and minimum woody cover requirements for northern raccoon occupancy in Kansas. The Wildlife Society's 30th Annual Conference. Louisville, Kentucky.

Durbin, C. J., R. H. Rusten, G. Brunette, T. Kim, and D. S. Sullins. 2024. Landscape-scale drivers of wildlife communities in an altered working landscape. Kansas Natural Resources Conference. Manhattan, Kansas.

Godar, A., A. Piernicky, D. Haukos, and J. Prendergast. 2022. Ring-necked pheasant use of spring cover crops. Kansas Natural Resource Conference, Manhattan (poster).

Granco, G., and M. Mather. 2022. New questions to understand how culture can affect sustainability policies: linking scales in a multi-use freshwater ecosystem. Joint Aquatic Science Meeting (JASM), Grand Rapids, Michigan.

Haukos, D.A. 2022. Science informs managing working lands for lesser prairie-chickens. Invited seminar, NRCS, USDA.

Haukos, D. 2022. Prioritization strategy for conservation of Greater Plains isolated wetland systems. Invited Seminar, Department of Natural Resource Management, Texas Tech University (Virtual).

Haukos, D. 2022. Essentials for certification by The Wildlife Society. Invited Workshop, Central Mountains and Plains Section, Kansas Natural Resources Conference, Manhattan, KS.

Haukos, D., A. Arsenault, C. DuBrock, J. Schneider, S. Fritts, F. C. Coe, K. Holland, and B. Dunlap. 2023. Wildlife undergraduate curriculum from the perspective of the TWS Certification Review Board members. Annual Conference of The Wildlife Society, Louisville, Kentucky. (Invited).

Haukos, D. 2023. Basics for certification by The Wildlife Society. Invited Workshop, Central Mountains and Plains Section, Joint Meeting of the Colorado/Utah chapters of The Wildlife Society, Grand Junction, Colorado (Virtual).

Haukos, D. 2023. Collaborative research of lesser prairie-chickens. All-Hands-Meeting, Cooperative Research Units, Tampa, Florida.

Haukos, D., and C. Lathrom. 2024. Status of native bumblebees at Fort Riley Military Reservation, Kansas. Friday's Findings, EMA Webinar Series, U.S. Geological Survey (Invited).

Haukos, D. 2024. Basics for certification by The Wildlife Society. Invited Workshop, Central Mountains and Plains Section, Joint Meeting of the South Dakota chapters of The Wildlife Society, Rapid City, South Dakota (Virtual).

Haukos, D. 2024. Playas: keystone ecosysems of the High Plains. Invited Presentation, Ogallala Commons Stewarding Our Water Future Conference, Amarillo, Texas (Virtual).

Hitchman, S. M., M. E. Mather, J. M. Smith, K. Pope, D. DeVries, J. Garvey, R. Tingley, and M. Carey. 2022. Scale: direction and progress for impactful science-based conservation. Joint Aquatic Science Meeting (JASM), Grand Rapids, Michigan.

Hitchman, S., M. Mather, J. Smith. 2022. Status quo vs innovation when creating best practices. Invited presentation, 152nd Annual Meeting of the American Fisheries Society American Fisheries Society Annual Meeting, Spokane, Washington.

Lathrom, C., Skidmore, C., D. Haukos, and D. Moon. 2023. Tallgrass prairie management regime and plant diversity effects on native bumblebee density. Annual Meeting of The Wildlife Society, Louisville, Kentucky. (poster)

Lathrom, C., Skidmore, C., D. Haukos, and D. Moon. 2024. Assessing the Composition and Diversity of Native Bumblebee Species in the Great Plains. Annual Meeting of the Midwest Fish and Wildlife Agencies, Sioux Falls, South Dakota.

Lathrom, C., Skidmore, C., D. Haukos, and D. Moon. 2024. Assessing the composition and diversity of native bumblebee species in the Great Plains. Kansas Natural Resources Conference, Manhattan, Kansas.

Lathrom, C., Skidmore, C., D. Haukos, and D. Moon. 2024. Assessing the composition and diversity of native bumblebee species in the Great Plains. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Lehnen, S.L., J.A. Moon, M.J. Osland, N.M. Enwright, K.L. Metzger, B.C. Wilson, M.G. Brasher, B.C. Chivoiu, W.C. Conway, B.E. Davis, L.C. Feher, D.A. Haukos, D.M. Head, D.J. Johnson, T.C. Lane, N.M. Rankin, F.C. Rohwer, C.R. Sanspree, C.L. Stagg, D.R. Stewart, M.A. Squires, and W.C. Vervaeke. 2023. Implementation of climate change adaption using the resist-accept-direct framework: a case study for managing coastal Texas wetlands in response to rising seas. Society of Wetland Scientists, Spokane, Washington.

Lloyd, J.D, C. Aldridge, T. Allison, D. Haukos, C. LeBeau, L. McNew, and V. Winder. 2022. Prairie grouse and wind energy: the state of the science. Annual Conference of The Wildlife Society, Spokane, Washington. (Invited)

Mather, M., P. Angermeier, K. Pope, Chuck Hopkinson, and M. Vanni 2022. Framing questions differently can catalyze innovative solutions to complex aquatic science problems. Joint Aquatic Science Meeting (JASM), Grand Rapids, Michigan.

Mather, M. E. 2022. Using a holistic approach to connect research and management. Contributed presentation. 152nd Annual Meeting of the American Fisheries Society, Spokane, Washington.

Mather, M. E., Oliver, D., Smith, J., Rode, O., Reed, V., Moore, T., Nelson, K., Hitchman, S., Pratap, S. 2023. Failure only occurs if nothing is learned: incorporating testable predictions into monitoring. Invited presentation for a symposium entitled “Failing Successfully: how unexpected results improve fisheries science.” 153rd American Fisheries Society Annual Meeting, Rapids, Michigan.

Mather, M., D. Oliver, J. Smith. 2023. Will we know success when we see it?: defining appropriate expectations for biodiversity monitoring surveys. 83rd Midwest Fish & Wildlife Conference, Overland Park, Kansas.

Mather, M. E., Q. Phelps. D. Shoup, K. Chestnut-Faull, C. Aymami. 2023. Syntheses are an underused opportunity to advance fisheries research and management: a framework to

move fisheries “synthesis science” forward. 83rd Midwest Fish & Wildlife Conference, Overland Park, Kansas.

Messier, A., D. Sullins, D. Haukos, and C. O’Meilia. 2022. Evaluating the role of vegetation phenology metrics in lesser prairie-chicken nest and brood-site selection. Kansas Natural Resource Conference, Manhattan.

Messier, A., D. Sullins, D. Haukos, and C. O’Meilia. 2022. Predicting within grassland habitat abundance for lesser prairie-chickens using gradient landscape and vegetation phenology metrics Annual Conference of The Wildlife Society, Spokane, Washington.

Messier, A., D. Sullins, D. Haukos, and C. O’Meilia. 2022. Linking greenness (NDVI) to lesser prairie-chicken reproductive habitat availability and quality. Prairie Grouse Technical Council, Lewiston, Montana.

Messier, A., D. Sullins, D. Haukos, and C. O’Meilia. 2023. Identifying priority grasslands for lesser prairie-chicken reproduction using phenology and gradient landscape metrics. Kansas Natural Resource Conference, Manhattan, Kansas.

Nepal, V., M. Fabrizio, B. Knuth, M. Mather, and D. Parrish. 2022. Asking different questions can overcome obstacles and identify new solutions to achieving human diversity in the aquatic sciences. Joint Aquatic Science Meeting (JASM), Grand Rapids, Michigan.

Parker, N.J., D.S. Sullins, A.A. Ahlers, D.A. Haukos, K.A. Fricke, and C.A. Hagen. 2022. Demographic effects of a megafire on lesser prairie-chickens in the mixed- grass prairie. Prairie Grouse Technical Council, Lewiston, Montana.

Pegg, N., D.A. Haukos, and R. Schulthesis. 2023. Band recovery analyses of mourning doves banded in Kansas. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Pegg, N., D.A. Haukos, and R. Schulthesis. 2023. Harvest pressure on an iconic household species, the mourning dove. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Pegg, N., D.A. Haukos, and R. Schulthesis. 2024. Vital rates of mourning doves in Kansas. Kansas Natural Resources Conference, Manhattan, Kansas.

Pegg, N., D.A. Haukos, and R. Schulthesis. 2024. Harvest pressure on an iconic household species, the mourning dove. Annual Meeting of the Midwest Fish and Wildlife Agencies, Sioux Falls, South Dakota.

Pegg, N., D. Haukos, and R. Schultheis. 2024. Novel co-occurrence of mourning doves, Eurasian collared-doves, and white-winged doves in Kansas. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Rieber, C. T. Hefley, and D. Haukos. 2022. Bayesian machine learning for movement modeling of lesser prairie-chickens. Annual Conference of The Wildlife Society, Spokane, Washington

Rieber, C., T. Hefley, and D. Haukos. 2023. Lesser prairie-chicken movement models in patch-burn and rotational grazing systems. Kansas Natural Resource Conference, Manhattan, Kansas.

Rieber, C., T. Hefley, and D. Haukos. 2023. Bayesian machine learning for movement modeling of lesser prairie-chickens. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Rode, O., V. Reed, M. Mather, T. Moore, K. Nelson, M. Madin, J. Francois, and L. Krueger. 2023. Hybrid digital-empirical approaches can aid conservation: merging GIS & local fish habitat data. Poster, Kansas Natural Resources Conference, Manhattan, Kansas.

Rode, O., M. Mather, V. Reed, K. Nelson, M. Madin, J. Francois, T. Moore, and L. Krueger. 2023. Squeezing additional insights from fish survey data to aid conservation. 83rd Midwest Fish & Wildlife Conference, Overland Park, Kansas.

Rode, O., M. E. Mather, D. Oliver. K. Nelson, T. Moore, V. Reed, S. Pratrap, and S. Kuck. 2024. How a monitoring dataset, an adaptive management framework, and ecological

comparisons of selected fish groups can guide restoration. Kansas Natural Resource Conference. Manhattan, Kansas.

Rusten, R. H., D. S. Sullins, C. M. O'Meilia. 2022. A ~30 year evaluation of the effects of woody encroachment, grassland loss, and pesticide use of meadowlark populations. The Wildlife Society's 29th Annual Conference. Spokane, Washington. (Poster presentation)

Rusten, R. H., D. S. Sullins, C. M. O'Meilia. 2022. A ~30 year evaluation of the effects of woody encroachment, grassland loss, and pesticide use of meadowlark populations. Kansas Natural Resources Conference. Manhattan, Kansas,

Rusten, R. H., D. S. Sullins, C. M. O'Meilia. 2023. A ~30 year evaluation of the effects of woody encroachment, grassland loss, and pesticide use of meadowlark populations. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Rusten, R. H., D. S. Sullins, C. M. O'Meilia, D. A. Haukos, K.A. Fricke. 2023. A ~30 year evaluation of the effects of woody encroachment, grassland loss, and pesticide use of meadowlark populations. The Wildlife Society's 30th Annual Conference. Louisville, Kentucky.

Rusten, R. H., D. S. Sullins, C. M. O'Meilia, and K. A. Fricke. 2024. As trees grow, chickens go: examining threats to greater prairie-chicken habitat in Kansas over the past three decades. Kansas Natural Resources Conference. Manhattan, Kansas.

Skidmore, C., D. Haukos, and D. Sullins. 2024. Nesting ecology and survival of wild turkey hens across three grassland ecoregions in Kansas. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Skidmore, C., C. Lathrom, D. Haukos, and D. Moon. 2023. Effects of tallgrass prairie management regimes and land cover types on native bumblebee communities. Annual Meeting of The Wildlife Society, Louisville, Kentucky

Skidmore, C., M. Oeding, M. White, D. Haukos, and D. Moon. 2023. Abundance and diversity assessment of Bombus spp. on Fort Riley Military Reservation in the Flint Hills of Kansas. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Stafford, K., and D. Haukos. 2024. Viability of lesser prairie-chicken populations in Kansas. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Suileman, G., J. Luginbill, and M. Mather 2022. Planning and implementing pathways for proactive biodiversity conservation. Joint Aquatic Science Meeting (JASM), Grand Rapids, Michigan.

Sullins, D.S., D.A. Haukos, K.C. Olson, and K. Harmoney. 2023. Strategic brush removal to increase lesser prairie-chicken habitat and cattle forage availability. Kansas Natural Resource Conference, Manhattan, Kansas.

Sullins, D., and D. Haukos. 2024. Strategic conservation of grassland dependent wildlife in working landscapes: an ideal free distribution perspective. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Teige, E., L. Berigan, C. Aulicky, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K.Schultz. 2022. Assessment of lesser prairie-chicken translocation through demographics, space use, and resource selection. Prairie Grouse Technical Council, Lewiston, Montana.

Teige, E.C., D. Sullins, and D. Haukos. 2024. The Conservation Reserve Program and prairie grouse: a review of what we know and where we can go. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Teige, E., L. Berigan, N. Parker, C. Aulicky, D. Haukos, D. Sullins, J. Reitz, L. Rossie, K. Fricke, and K. Schultz. 2024. How does translocated lesser prairie-chicken's nest site selection affect nest survival? Annual Conference of American Ornithological Society, Estes Park, Colorado.

Teige, E.C., D. Sullins, and D. Haukos. 2024. The Conservation Reserve Program and prairie grouse: what do we know and where can we go? Kansas Natural Resources Conference, Manhattan, Kansas.

Vhay, M., D. A. Haukos, D. S. Sullins, and M. B. Rice. 2022. Changing habitat quality for lesser prairie-chickens in the Sand Sagebrush Prairie Ecoregion. Kansas Natural Resource Conference, Manhattan.

Vhay, M., D. A. Haukos, D. S. Sullins, and M. B. Rice. 2022. A retrospective assessment of lesser prairie- chicken habitat quality in the Sand Sagebrush Prairie. Midwest Fish and Wildlife Conference, Des Moines, Iowa

Vhay, M., D. Haukos, D. S. Sullins, and M. B. Rice. 2022. Declining habitat quality and quantity for lesser prairie-chickens of the Sand Sagebrush Prairie. Annual Conference of The Wildlife Society, Spokane, Washington.

Vhay, M., D. Haukos, D. S. Sullins, and M. B. Rice. 2022. Assessment of lesser prairie-chicken habitat quality in the Sand Sagebrush Prairie. North American Congress for Conservation Biology, Reno, Nevada

Vhay, M., D. Haukos, D. S. Sullins, and M. B. Rice. 2022. Assessment of lesser prairie-chickens habitat in the Sand Sagebrush Prairie. Prairie Grouse Technical Council, Lewiston, Montana.

Vhay, M., D. Haukos, D. S. Sullins, and M. B. Rice. 2023. Retrospective assessment of lesser prairie-chicken habitat quality in the Sand Sagebrush Prairie. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Ware, M., J. Gehrt, and D. Haukos. 2023. Non-breeding space use and survival of a constrained population of Greater Prairie-chickens on Fort Riley Military Reservation in Kansas. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Ware, M., J. Gehrt, D. Haukos, D. Moon, and S. Stratton. 2024. Non-breeding space use and survival of a constrained population of greater prairie-chickens on Fort Riley Military Reservation in Kansas. Kansas Natural Resources Conference, Manhattan, Kansas.

Ware, M., D. Sullins, and D. Haukos. 2024. Roost tree selection by wild turkeys in Kansas. Annual Conference of The Wildlife Society, Baltimore, Maryland.

Werdel, T.J., C.W. Piper, A.M. Ricketts, M.S. Peek, D.S. Sullins, and A.A. Ahlers. 2023. Strategic grassland conservation for swift foxes in multi-use landscapes. Texas Chapter of The Wildlife Society Annual Conference, Houston, Texas.

Werdel, T.J., C.W. Piper, A.M. Ricketts, M.S. Peek, D.S. Sullins, and A.A. Ahlers. 2023. Strategic grassland conservation for swift foxes in multi-use landscapes. Kansas Natural Resources Conference. Manhattan, Kansas. (Poster presentation).

Whetten, A. 2023. RShiny Workshop – interactive data visualization using R. Invited Seminar, Northern Michigan University, Marquette, Michigan.

Whetten, A. 2023. Data science practice and theory in the environmental and biological sciences. Invited Seminar, Northern Michigan University, Marquette, Michigan.

Whetten, A. 2023. Data science practice and theory in the environmental and biological sciences. Invited Seminar, Central Michigan University, Mount Pleasant, Michigan.

Whetten, A. 2023. Data science practice and theory in the environmental and biological sciences. Invited Seminar, Michigan Tech University, Houghton, Michigan.

Whetten, A. T. Hefley, and D. Haukos. 2023. A framework for clustering trajectories of telemetric data. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Whetten, A. T. Hefley, and D. Haukos. 2023. A Bayesian machine learning framework for animal telemetry data. Midwest Fish and Wildlife Conference, Overland Park, Kansas.

Whetten, A. T. Hefley, and D. Haukos. 2023. Estimation of contact time between animals from telemetry data. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Whetten, A. T. Hefley, and D. Haukos. 2024. Automated core area detection for prairie grouse in Kansas. Kansas Natural Resources Conference, Manhattan, Kansas.

Whitson. M.D., B.A. Grisham, C.A. Hagen, W.C. Conway, D.A. Haukos, and C. Villalobos. 2022. Habitat selection and nest success response of lesser prairie-chicken to prescribed burning and grazing. Annual Meeting of the Texas Chapter of The Wildlife Society.

Whitson. M.D., B.A. Grisham, C.A. Hagen, W.C. Conway, D.A. Haukos, and C. Villalobos. 2023. Sand shinnery oak prairie ecoregion plant community composition response to various spring prescribed-fire and post-fire regimes in eastern New Mexico. Annual Meeting of the Texas Chapterof The Wildlife Society, Houston, Texas.

Committees, Service, and Other Professional Assignments
2022-present

Sara Hansen (GRA)

- Immediate Past President and NW Section Rep - WA Chapter – TWS
- Board Member - Inclusion, Diversity, Equity, and Awareness (IDEA) Working Group – TWS
- Member – Diversity Resource Center Committee – TWS
- Mentor – Leadership Institute – TWS

David Haukos

- Member, Playa Lakes Joint Venture Science Advisory Team
- Associate Editor, Wildlife Society Bulletin 2020-current
- Subject/Associate Editor, Journal of Fish and Wildlife Management 2013-current
- Technical Representative, Great Plains Cooperative Ecosystems Study Unit, Kansas State University 2012-current
- Member, KSU Institutional Animal Care and Use Committee 2012-current
- Faculty Advisor, KSU Student Chapter of The Wildlife Society 2012-current
- Member of the KDWPT Threatened and Endangered Task Committee 2013-current
- Adjunct Professor, Texas Tech University
- Abstract Reviewer, The Wildlife Society 2018-2024 Annual Meetings
- The Wildlife Society – Certification Review Board, CMPS Representative 2020-2026 (Co-Chair 2023).
- NRES (Natural Resources and Environmental Sciences Secondary Major), Governing Board, KSU – Natural Sciences Representative 2020-2022.
- Organizing Committee, 2023 Midwest Fish and Wildlife Conference
- Search Committee Chair – KSCFWRU AUL-Wildlife 2023
- Search Committee Member – IACUC Program Manager 2023
- Reviewed USFWS Species State Assessment for the Monarch Butterfly 2023
- Mentoring committee, Dr. Trent Schrader, KSU VMC 2024

Shelby Kuck (GRA)

- Member, Biology Graduate Student Association
- Member, Kansas Chapter, American Fisheries Society
- Member, Beta Beta Beta Biological Honor Society

Cassidy Lathrom (GRA)

- Member, Ducks Unlimited, Friends of Konza, Friends of the Kaw, Backcountry Hunters and Anglers

Martha Mather

- Subject Editor, Wetlands Ecology and Management 2008-current
- Organizing Committee, Plenary Committee, Student Committee Affairs, 83rd Midwest Fish & Wildlife Conference, Overland Park, Kansas, 2023.
- Leadership Team, Kansas State University Chapter, Sigma Xi, 2022-2024.
- Member, USGS Fisheries Leadership Team, 2021-2024.
- Subject Editor, Frontiers in Freshwater Science – Human Impacts 2023

- National Grant Coordinator, American Association of University Women, Manhattan Chapter, 2023-present.
- National Science Foundation proposal review panel, Arlington, VA,2024.

Natalie Pegg (GRA)

- Teaching Assistant, Principles of Biology BIOL 198 (Fall 2022, Spring 2023)
- Biology Graduate Student Association Seminar Representative (2022-2023)
- BGSA Manual Sales Coordinator. (Spring 2024 – Fall 2024)
- BGSA Seminar Chair. (Spring 2023 – Fall 2023)

Camille Rieber (GRA)

- TWS Kansas State University student chapter graduate student liaison 2022-2023

Olivia Rode (GRA)

- Teaching Assistant Organismic Biology (Spring 2021, Fall 2021, Fall 2022), Principals of Biology (Spring 2022, Spring 2023)

Caroline Skidmore (GRA)

- Board member of the Kansas Chapter of TWS

Dan Sullins (Assistant Unit Leader)

- Advisory board member: lesser prairie-chicken Habitat Conservation Partnership 2022-current
- Technical assistance: provided scientific guidance on the spatially strategic enrollment of CRP and brush control to benefit lesser prairie-chickens, greater prairie-chickens, and other grassland wildlife (The Nature Conservancy, NRCS, and KDWP).
- Rangeland Wildlife Working Group, Chair (2022-2024)

Elisabeth Teige (GRA)

- Board Member-at-Large, 2022-2024, Central Mountains and Plains Section of The Wildlife Society (CMPS).
- CMPS Student and Early Career Professionals Committee Chair
- CMPS Elections Committee Acting Chair
- Treasure/Secretary, TWS KS State Chapter, 2024-present
- Graduate Student Liaison, Kansas State Student Chapter of TWS, 2023-present
- Seminar Committee Chair, Biological Graduate Student Association, K-State, 2023-present

Megan Vhay (GRA)

- Teaching Assistant Organismic Biology (Fall 2020, Spring 2021, Fall 2021, Fall 2022)
- Teaching Assistant Wildlife Management and Techniques (Spring 2022, 2023)
- Teaching Assistant Mammalogy (Fall 2022)

Mary Ware (GTA)

- Teaching 2 sections of Principals of Biology (Fall 2023), 1 section of Principals of Biology (Spring 2024), and grader for Environmental Biology (Spring 2024).

Awards and Recognition
2022-present

David Haukos

- Lifetime Member – The Wildlife Society. 2022.
- Snipe Award, Kansas Chapter of The Wildlife Society for Outstanding Contributions to Wildlife Conservation. 2024

Cassidy Lathrom

- The Wildlife Society 2020 Annual Conference Travel Grant $1,000

Martha Mather

- USGS STAR Award – planning and leading a session at 2023 USGS CRU All-Hands Meeting

Ashley Messier

- Awarded the 2022 John Toepfer Prairie Grouse Research Scholarship by the Prairie Grouse Technical Council.
- Graduate Student Council (GSC) travel award, 2022.
- Best Oral Presentation, Kansas Chapter of The Wildlife Society, Kansas Natural Resources Conference – 2022
- Registration Scholarship, KNRC 2022 - $50

Camille Rieber

- Timothy R. Conoghue Graduate Scholarship, KSU Graduate School 2022-2023 - $3,000
- Recipient of the Kansas State University Lolafaye Coyne Statistics Graduate Scholarship for summer research, 2023 - $6,000
- Kansas Natural Resources Conference registration scholarship, 2023 - $350
- TWS Biometrics Working Group travel grant, 2022 - $750

Elisabeth Teige

- Early Career Professional Working Group Certification Scholarship ($500), 2022, TWS
- TWS Associate Wildlife Biologist ®, 2023
- Travel Grant, TWS ($1,000), 2024

Mary Ware

- The Wildlife Society Student Travel Grant, 2023 - $1000

Kansas State University Courses Taught by Unit Faculty 2011-2024

Course	Years Taught	Instructor
Professional Skills and Ethics	2011-2017, 2020, 2022	Martha Mather
Introduction to Fisheries, Wildlife, Conservation, and Environmental Biology	2012-2024	David Haukos
Advanced Spatial Modeling	2012, 2014	Eugene Albanese David Haukos
River Regimes	2012	Martha Mather
Bayesian Methods in Ecology	2014	Beth Ross David Haukos
Introduction to WOEM, Pistols and Rifles, Hunter Education Instructor	2015	Thomas Becker
Habitat Ecology and Management	2016, 2017, 2019, 2022, 2023	David Haukos
Population Biology	2017, 2018	David Haukos
Modeling Distribution and Resource Section of Organisms	2018, 2022, 2024	Dan Sullins
Natural Resources/Environmental Science Capstone Course	2019, 2023	David Haukos
Design and Analyses of Wildlife Population Studies	2019	Bram Verheijen David Haukos
Demographic Methods	2020, 2022, 2024	David Haukos
Biologically-involved Sustainability (BIS): A New Direction for Successful Resource Conservation and Management.	2023	Martha Mather
Fish Ecology	2024	Martha Mather

Kansas State University Degrees Completed 1996 – 2023

2023

Rachel Rusten (M.S., 2023, Sullins). An assessment of grassland loss, woody encroachment, and pesticide use on North American grassland bird populations. (PhD Student, University of Nebraska-Lincoln)

Victoria Reed (M.S. 2023, Mather). Using state-wide, long-term databases to establish an approach to suggest useful future data related activities. (Water Resources Design Engineer, Professional Engineering Consultants, Wichita, Kansas).

Olivia Rode (M.S., 2023, Mather). How a monitoring dataset, an adaptive management framework, and ecological comparisons of selected fish groups can guide conservation. (Assistant Scientist, Olsson Engineering, Overland Park, Kansas).

Ashley Messier (M.S., 2023, Sullins/Haukos). Patterns of greenness (NDVI) in the Southern Great Plains and their influence on the habitat quality and reproduction of a declining prairie grouse. (Biologist NRDA Program, USFWS, Atlanta, Georgia).

Camille Rieber. (M.S., 2023, Hefley/Haukos). Treed Gaussian processes for animal movement modelling. (Co-advised with T. Hefley, Statistics; USGS Contractor, NABAT project, Bozeman, Montana).

Megan Vhay (M.S., 2023, Haukos). Reconstruction of landscape composition and vegetation characteristics in the Sand Sagebrush Prairie Ecoregion. (Natural Resource Specialist, NRCS, New Hampshire)

2022

Talesha Karish (Ph.D, 2022, Haukos). Survival, activity patterns, movements, home ranges and resource selection of female mule deer and white-tailed deer in western Kansas. (Assistant Area Manager, Baudette Area Wildlife, MN DNR)

2021

John Malanchuk (Ph.D, 2021, Haukos). Assessment of resident Canada goose management in Kansas. (Natural Resources Specialist, Center for Environmental Management of Military Lands, Andrews AFB, Maryland)

Maureen Kinlan (M.S., 2021, Haukos). Survival, movement, and resource selection of male mule deer and white-tailed deer in western Kansas. (Deer Project Co-Leader, Wildlife and Heritage Service, Maryland Department of Natural Resources)

Jackie Gehrt (M.S., 2021, Haukos). Response of greater prairie-chickens to natural and anthropogenic disturbance on Fort Riley. (Biologist, Federal Aid, U.S. Fish and Wildlife Service, Twin Cities, MN)

Elisabeth Teige (M.S., 2021, Haukos). Assessment of lesser prairie-chicken translocation through survival, space use, and resource selection. (Ph.D Candidate, Kansas State University).

Nick Parker (M.S., 2021, Sullins/Haukos). Lesser prairie-chicken demography, resource selection, and habitat response following megafire in the mixed-grass prairie. (Ph.D Candidate, Colorado State University).

2020

Alixandra Godar (Ph.D., 2020, Haukos). Ring-necked pheasant population and space use response to landscapes including spring cover crops. (Biometrician, Montana Fish, Wildlife, and Parks).

Carly Aulicky (Ph.D., 2020, Haukos). Lek dynamics and range-wide morphometric patterns of lesser prairie-chickens. (Conservation Program Manager, Minnesota Land Trust)

2019

Liam Berigan (M.S., 2019, Haukos). Dispersal, reproductive success, and habitat use by translocated lesser prairie-chickens. (Post-doctoral Research Associate, Kansas State University)

Chris Gulick (M.S., 2019, Haukos). Spatial ecology and resource selection by female lesser prairie-chickens within their home ranges and during dispersal. (Ph.D Candidate, University of Florida)

Mitchell Kern (M.S., 2019, Ricketts/Haukos). Fawn survival and bed-site selection of mule deer and white-tailed deer in western Kansas. (Biologist, Virginia Department of Wildlife Resources)

Adela Annis (M.S., 2019, Haukos). Ring-necked pheasant survival, nest habitat use, and predator occupancy in Kansas spring cover crops. (Biologist, Pheasants Forever, Nebraska)

2018

Sean Hitchman (Ph.D., 2018, advisor Mather). A mosaic approach can advance the understanding and conservation of native fish biodiversity in natural and fragmented riverscapes. (Faculty, Department of Biology, Saint Mary's College of Maryland)

Richard Lehrter (M.S. 2018; advisor Mather). Links between food web structure, biodiversity, and resilience: effects of anthropogenic disturbance on aquatic communities in the Smoky Hill River, KS (Biologist, NEON Inc., Boulder, CO)

2017

Ryland Taylor (M.S. 2017; advisor Mather). Using geomorphology and animal "individuality" to understand 'scape-scale predator distributions. (Environmental Specialist, Maryland Environmental Service)

Robert Mapes (M.S. 2017; advisor Mather). Young of year largemouth bass (*Micropterus salmoides*) relative abundance and diet: role of habitat type, spatial context, and size. (Grass Carp Fisheries Project Manager, University of Toledo)

Dan Sullins (Ph.D. 2017; advisor Haukos). Regional variation in demography, distribution, foraging, and strategic conservation of lesser prairie-chickens in Kansas and Colorado. (Assistant Unit Leader, Kansas Cooperative Fish and Wildlife Research Unit)

Jonathan Lautenbach (M.S. 2017; advisor Haukos). The role of fire, microclimate, and vegetation in lesser prairie-chicken habitat selection. (Ph.D candidate, University of Wyoming)

2016

John Kraft (M.S. 2016; advisor Haukos). Vegetation characteristics and lesser prairie-chicken responses to land cover types and grazing management in western Kansas.

Willow Malone (M.S. 2016; advisor Haukos). Biodiversity in playa wetlands in relation to watershed disturbance. (NEON field biologist, Colorado)

Kelsey McCullough (M.S. 2016; advisor Haukos). A multi-scale examination of the distribution and habitat use patterns of the regal fritillary. (Spatial Analyst, USDA)

Sarah Ogden (M.S. 2016; advisor Haukos). Responses of grassland birds and butterflies to control of sericea lespedeza with fire and grazing. (Environmental Enforcement Specialist, Montana DEQ)

Thomas Becker (M.S. 2016; advisor Haukos, Horticulture and Natural Resources). Retrospective review of avian diseases in Kansas. (Senior Project Manager, Davey Resource Group, Inc.)

2015

Samantha Robinson (M.S. 2015; advisor Haukos). Landscape conservation design, movements, and survival of lesser prairie-chickens in Kansas and Colorado. (Biologist - Headquarters Recovery Planning Team, U.S. Fish and Wildlife Service)

Zach Peterson (M.S. 2015; advisor Mather). Quantifying patterns and select correlates of the spatially and temporally explicit distribution of a fish predator (blue catfish, *Ictalurus furcatus*) throughout a large reservoir ecosystem. (Fishery Biology, City of Denton, TX)

Kayla Gerber (M.S. 2015; advisor Mather). Tracking blue catfish: quantifying system-wide distribution of a mobile fish predator throughout a large heterogeneous reservoir. (Fishery Biologist, Kentucky Department of Fish & Wildlife Resources)

Jane Fencl (M.S., 2015; advisor Mather). How big of an effect do small dams have? Using ecology and geomorphology to quantify impacts of low-head dams on fish biodiversity. (Assistant Unit Leader, TXCFWRU, Texas Tech University)

Joe Gerken (Ph.D. 2015; advisor Paukert). Fish and invertebrate community response to flow magnitude in the Kansas River. Kansas State University. (Assistant Professor, Wildlife and Outdoor Enterprise Management, KSU)

Brian Kearns (Ph.D. 2015; advisor Haukos). Risk assessment of lead exposure by mottled ducks on the upper Texas Gulf Coast. Kansas State University. (Biologist, WRA Environmental Consultants, CA)

Joseph Lautenbach (M.S. 2015; advisor Haukos). Lesser prairie-chicken reproductive success, habitat selection, and response to trees. Kansas State University. (Chief, Upland Game Research, Ohio Department of Natural Resources)

Reid Plumb (M.S. 2015; advisor Haukos). Lesser prairie-chicken movement, space use, survival, and response to anthropogenic structures in Kansas and Colorado. (Biologist, Wildlife Biologist, Walker Unit, Chippewa NF, USFS)

2014

David Spencer (M.S. 2014; advisor Haukos, Geography). Historical changes in landscapes occupied by lesser prairie-chickens in Kansas. (GIS Cartographer, Eastview Geospatial)

Rachel Pigg (Ph.D. 2014; advisor Cully). A multi-scale investigation of movement patterns among black-tailed prairie dog colonies. (Assistant Professor, Presbyterian College, Clinton, SC)

Andrew Stetter (M.S. 2014; advisor Haukos). Nest site selection, duckling survival, and blood parasite prevalence of Lesser Scaup nesting on Red Rock Lakes National Wildlife Refuge. (Deputy Project Leader, Big Stone NWR)

2012

Jason Fischer (M.S. 2012; advisor Paukert). Fish community response to habitat alteration: impacts of sand dredging in the Kansas River.

2011

Derek Moon (M.S. 2011; advisor Cully). Small mammals in disturbed tallgrass prairie landscapes.

Amanda Goldberg (M.S. 2011; advisor Cully). Apparent survival, dispersal, and abundance of black-tailed prairie dogs.

2010

Andrea Severson (M.S. 2010; advisor Paukert). Effects of zebra mussel (*Dreossena polymorpha*) invasion ion the aquatic community of a Great Plains reservoir.

2009

Jonathan M. Conard (Ph.D, 2009; Advisor: Gipson). Genetic variability, demography, and habitat selection in a reintroduced elk (*Cervus elaphus*) population.

Mackenzie R. Shardlow (M.S., 2009; Advisor: Paukert). Factors affecting the detectability and distribution of the North American river otter.

Ron E. VanNimwegen (Ph.D [Posthumous], 2009; Advisor: Cully). Behavioral ecology of grasshopper mice and deer mice.

2008

Wesley W. Bouska (M.S., 2008; Advisor: Paukert). Road crossing designs and their impact on fish assemblages and geomorphology of Great Plains streams.

Jeffrey L. Eitzmann. (M.S., 2008; Advisor: Paukert). Effects of anthropogenic disturbance on the fish assemblage and food web structure in a Great Plains river.

Kristen Pitts (M.S., 2008; Advisor: Paukert). Assessing threats to native fishes of the Lower Colorado River Basin.

Joshua Schloesser (M.S., 2008; Advisor: Paukert). Large river fish community sampling strategies and fish associations to engineered and natural river channel structures.

2007

Jesse R. Fischer (M.S., 2007; Advisor: Paukert). Structural organization of Great Plains stream fish assemblages: Implications for sampling and conservation.

2006

Jeremy Baumgardt (M.S., 2006; Advisor: Gipson). The effects of trapping methods on estimation of population parameters for small mammals.

Brian E. Flock (Ph.D, 2006; Advisor: Gipson). The effects of landscape configuration on northern bobwhite in southeastern Kansas.

Tracey N. Johnson (M.S., 2006; Advisor: Brett K. Sandercock). Ecological restoration of tallgrass prairie: grazing management benefits plant and bird communities in upland and riparian habitats.

Andrew S. Makinster (M.S., 2006; Advisor: Paukert). Flathead catfish population dynamics in the Kansas River.

Timothy R. Strakosh (Ph.D, 2006; Advisor: Keith Gido). Effects of water willow establishment on littoral assemblages in Kansas reservoirs: Focus on Age-0 largemouth bass.

Bala Thiagarajan (Ph.D, 2006; Advisor: Cully). Community dynamics of rodents, fleas and plague associated with black-tailed prairie dogs.

2005

Tammi L. Johnson (M.S., 2005; Advisor: Cully). Spatial dynamics of a bacterial pathogen: Sylvatic plague in Black-tailed prairie dogs.

Lorri A. Newby (M.S., 2005; Advisor: Cully). Effects of experimental manipulation of coterie size on demography of Black-tailed prairie dogs in South Dakota.

2003

Christopher D. Anderson (M.S.; 2003; Advisor: Gipson). Recreational pressure at Fort Niobrara National Wildlife Refuge: Potential impacts on avian use and seasonal productivity along the Niobrara River.

Jonathan M. Conard (M.S., 2003; Advisor: Gipson). Responses of small mammals and their predators to military disturbance in tallgrass prairie.

William E. Jensen (Ph.D, 2003; Advisor: Cully). Spatial variation in Brown-headed Cowbird (*Molothrus ater*) abundance and brood parasitism in Flint Hills Tallgrass Prairie.

Mayee Wong (M.S., 2003; Advisor: Cully). High spatial homogeneity in a sex-biased mating system: The genetic population structure of greater prairie chickens (*Tympanuchus cupido pinnatus*) in Kansas, Missouri, and Nebraska.

Stanley L. Proboszcz (M.S., 2003; Advisor: Guy). Evaluation of habitat enhancement structure use by spotted bass in natural and experimental streams.

2002

Michael C. Quist (Ph.D, 2002, Advisor: Guy). Abiotic factors and species interactions that influence recruitment of walleyes in Kansas reservoirs.

2001

Troy R. Livingston (M.S., 2001; Advisor: Gipson). Coprophagy: An ecological investigation of the consumption of mammalian carnivore feces.

Amber D. Rucker (M.S., 2001; Advisor: Cully). Conversion of tall fescue pastures to tallgrass prairie in southeastern Kansas: Small mammal responses.

Gerald L. Zuercher (Ph.D, 2001; Advisor: Gipson). The ecological role of the Bush Dog, *Speothos venaticus,* as part of the mammalian predator community in the Interior Atlantic Forest of Paraguay.

2000

Patrick J. Braaten (Ph.D, 2000; Advisor: Guy). Growth of fishes in the Missouri River and Lower Yellowstone River, and factors influencing recruitment of freshwater drum in the lower channelized Missouri River.

Anne C. Cully (Ph.D, 2000; Advisors: Barkley and Knapp). The effects of size and fragmentation on tallgrass prairie plant species diversity.

Travis B. Horton (M.S., 2000; Advisor: Guy). Habitat use and movement of spotted bass in Otter Creek, Kansas.

Sally J. Schrank (M.S., 2000; Advisor: Guy). Population characteristics of bighead carp *Hypophthalmichthys nobilis* larvae and adults in the Missouri River and interspecific dynamics with paddlefish *Polyodon spathula*.

Patricia R. Snyder (M.S., 2000; Advisor: Gipson). Assessment of activity transmitters based on behavioral observations of coyotes, bobcats, and raccoons.

Jeffry A. Tripe (M.S., 2000; Advisor: Guy). Density, growth, mortality, food habits, and lipid content of age-0 largemouth bass in El Dorado Reservoir, Kansas.

1999

Justin E. Kretzer (M.S., 1999; Advisor: Cully). Herpetological and coleopteran communities of black-tailed prairie dog colonies and non-colonized areas in southwest Kansas.

Michael C. Quist (M.S., 1999; Advisor: Guy). Structure and function of fish communities in streams on Fort Riley Military Reservation.

James W. Rivers (M.S., 1999; Advisor: Gipson). Seasonal avian use patterns of farmed wetlands and nest predation dynamics in riparian grasslands dominated by reed canary grass (*Phalaris arundinacea*).

Stephen L. Winter (M.S., 1999; Advisor: Cully). Plant and breeding bird communities of black-tailed prairie dog colonies and non-colonized areas in southwest Kansas and southeast Colorado.

1998

Jan F. Kamler (M.S., 1998; Advisor: Gipson). Ecology and interspecific relationships of mammalian predators on Fort Riley Military Reservation, Kansas.

1997

Matthew N. Burlingame (M.S., 1997; Advisor: Guy). 1995 Kansas licensed angler use and preference survey and attitudes towards angling by secondary education students.

Greg A. Hoch (M.S., 1997; Advisor: Cully). Mapping and monitoring of disturbance from military training at Fort Riley, Kansas and an investigations into the stability of grassland ecotones using satellite remote sensing.

David E. Hoover (M.S., 1997; Advisor: Gipson). Vegetation and breeding bird assemblages in grazed and ungrazed riparian habitats in southeastern Kansas.

Raymond S. Matlack (M.S., 1997; Advisor: Gipson). The swift fox in rangeland and cropland in western Kansas: Relative abundance, mortality, and body size.

Heidi L. Michaels (M.S., 1997; Advisor: Cully). Landscape and fine scale habitat of the Loggerhead Shrike and Henslow's Sparrow on Fort Riley Military Reservation, Kansas.

Jeff S. Tillma (M.S., 1997; Advisor: Guy). Characteristics of spotted bass in southeast Kansas streams.

1996

William K. Smith (M.S., 1996; Advisor: Gipson). Responses of ring-necked pheasants to Conservation Reserve Program fields during courtship and brood rearing in the high plains.

Jennifer R. Wiens (M.S., 1996; Advisor: Guy). Effects of tree revetments on the abiotic and biotic components in two Kansas streams.