Biennial Report

August 2018 - August 2020

Kansas Cooperative
Fish and Wildlife Research Unit

Biennial Report

Kansas Cooperative
Fish and Wildlife Research Unit

August 2018 - August 2020

United States Geological Survey
205 Leasure Hall
Division of Biology
Kansas State University
Manhattan, Kansas 66506-3501
Telephone (785) 532-6070
Fax (785) 532-7159
Email kscfwru@ksu.edu
http://www.k-state.edu/kscfwru/

Unit Cooperators

U.S. Geological Survey
Kansas Department of Wildlife, Parks, and Tourism
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 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 as hired as Unit office manager and administrative assistance in June 2019.

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; Horticulture and Natural Resources; and Animal Science. Unit staff and students often work on partnership projects that involve specialists from the University and other cooperating groups.

During the reporting period, 5 new projects were initiated, 5 projects were ongoing, and 6 projects were completed. Four students finished M.S. degrees and 2 finished Ph.D. degrees.

<u>New Projects:</u>

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

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

The Impact of Future Climate Variability on Shorebirds and Their Wetland Habitats in the South-Central U.S.

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

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

Response of Greater Prairie-Chickens to Military Operations on Fort Riley

Survival Rates, Habitat Selection, and Movement of Sympatric Mule Deer and White-tailed Deer in Kansas

Assessment of Resident Canada Goose Management in Kansas

Assessment of Lesser Prairie-Chicken Response to Translocation

Lesser Prairie-Chicken and Grassland Response to Intensive Wildfire in the Mixed-Grass Prairie

Completed Projects:

Ring-necked Pheasant Use of Cover Crops in Western Kansas

Use of Grazing Management and Prescribed Fire for Conservation of Lesser Prairie-Chickens

Dams and Fish Communities: Developing and Testing a Spatially-Explicit, Science-Based, Decision-Support Tool for Making Riverscape-Scale Management Decisions for Native Stream Fish Communities in the Neosho and Smoky Hill Rivers, KS

Lesser Prairie-Chicken Response to USDA Conservation Practices in Kansas and Colorado

Plum Island Ecosystems LTER

Coupled Climate, Cultivation and Culture in the Great Plains: Understanding Water Supply and Water Quality in a Fragile Landscape

Master's Theses Completed:

Liam Berigan. (M.S., 2019, Haukos) Dispersal, reproductive success, and habitat use by translocated lesser prairie-chickens. (PhD Candidate, University of Maine)

Chris Gulick. (M.S., 2019, Haukos) Spatial ecology and resource selection by female lesser prairie-chickens within their home ranges and during dispersal. (PhD 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. (Game Warden, Wyoming Game and Fish)

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)

Ph.D. Dissertations Completed:

Alixandra Godar. (Ph.D., 2020, Haukos Ring-necked pheasant population and space use response to landscapes including spring cover crops. (Post-Doctoral Research Associate, Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University).

Carly Aulicky. (Ph.D., 2020, Haukos) Lek dynamics and range-wide morphometric patterns of lesser prairie-chickens. (Post-Doctoral Research Associate, Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University)

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

U.S. Geological Survey
Dr. Kevin Whalen
USGS CRU
3259 Fieldstone Dr W
Bozeman MT 59715

Wildlife Management Institute
Dr. Bill Moritz
1608 Packwood Road
Fairfield IA 52556

Kansas Department of Wildlife, Parks, and Tourism
Secretary Brad Loveless
Office of the Secretary
1020 S. Kansas, Rm 200
Topeka, KS 66612-1327

Kansas State University
Dr. Mark Ungerer
Director
Division of Biology, Ackert Hall, KSU
Manhattan, KS 66506

U.S. Fish and Wildlife Service
Greg Watson
Chief, Office of Landscape Conservation
Region 6, U.S. Fish and Wildlife Service
134 Union Blvd
Lakewood, CO 80228

Cooperative Unit Staff

David A. Haukos, Ph.D.
Unit Leader, Wildlife and Adjunct Associate Professor, Division of Biology
Martha Mather, Ph.D.
Assistant Unit Leader, Fisheries and Adjunct Associate Professor, Division of Biology
Tara Dreher, Office Manager and Administrative Assistant
Bram Verheijen, Ph.D, Research Associate – Wildlife, Division of Biology
Alix Godar, Ph.D, Research Associate – Wildlife, Division of Biology
Carly Aulicky, Ph.D, Research Associate – Wildlife, Division of Biology

Faculty Cooperators at Kansas State University

Division of Biology
Dr. Alice Boyle
Dr. Keith Gido
Dr. Walter Dodds
Dr. Andrew Hope

Department of Geography
Dr. Doug Goodin
Dr. Shawn Hutchinson

Department of Horticulture and Natural Resources
Dr. Adam Ahlers
Dr. Andrew Ricketts
Dr. Dan Sullins

Department of Animal Science
Dr. K.C. Olson

Department of Statistics
Dr. Trevor Hefley

Additional Universities

Oklahoma State University
Dr. Craig Davis
Dr. Dwayne Elmore
Dr. Sam Fuhlendorf
Dr. Loren Smith

Emporia State University
Dr. William Jensen

Texas Tech University
Dr. Warren Conway
Dr. Blake Grisham
Dr. Mark Wallace

State of Kansas

Kansas Department of Wildlife, Parks, and Tourism

Chris Berens
Tom Bidrowski
Kent Fricke
Jake George
Shane Hesting
Jordan Hofmeier
Levi Jaster
Jeff Koch
Ron Marteney
Mike Miller
Doug Nygren
Matt Peek
Jeff Prendergast
John Reinke
Richard Schultheis
Kraig Schultz
Mark Van Scoyoc
Ely Sprenkle

Federal Government

U.S. Fish and Wildlife Service, Kansas
Susan Blackford
Mike Disney
Mike Estey
Aron Flanders
Greg Kramos
Rachel Lauban
Jason Lugenbill
Chris O'Meilia

U.S. Fish and Wildlife Service, Texas
Bill Johnson
Duane Lucia
Dr. Jena Moon
Jude Smith

U.S. Fish and Wildlife Service, New Mexico
Dr. Dan Collins
Dr. Grant Harris
Dr. Lacrecia Johnson
Dr. Steve Sesnie

U.S. Fish and Wildlife Service, Colorado
Dr. Mindy Rice

U.S. Fish and Wildlife Service, Nebraska
Andy Bishop
Dana Varner

U.S. Geological Survey
Dr. David Anderson
Dr. Clint Boal
Dr. Donna Parrish
Dr. Kevin Pope
Dr. Elizabeth Webb

U.S. Department of Agriculture,
Natural Resources Conservation Service
Dr. Christian Hagen
David Kraft
Charlie Rewa

U.S. Army, Fort Riley
Kelsey McCullough
Derek Moon
Caroline Skidmore
Shawn Stratton

Other State Agencies

Colorado Wildlife and Parks
Brian Dreher
Dr. Jim Gammonly
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
Kansas Alliance for Wetlands & Streams
Jessica Mounts
Kansas Rangeland Trust
Stephanie Manes
Playa Lakes Joint Venture
Dr. Anne Bartuszevige

Graduate Students Supported by Unit Projects, 2018-present
Kansas State University

Student and Degree Sought	Thesis Project	Previous Education	Advisor
*Adela Annis, MS	Ring-necked pheasant survival, nest habitat use, and predator occupancy in Kansas spring cover crops	B.S., Unity College	Dr. Haukos
*Carly Aulicky, Ph.D	Lek dynamics and range-wide morphometric patterns of lesser prairie-chickens	B.S., Rutgers University M.S., University of Glasgow	Dr. Haukos
*Liam Berigan, M.S.	Dispersal, reproductive success, and habitat use by translocated lesser prairie-chickens	B.S., Cornell University	Dr. Haukos
Jackie Gehrt, M.S.	Greater Prairie-chicken response to natural and anthropogenic factors on Fort Riley Military Reserve	B.S. Kansas State University	Dr. Haukos
*Alixandra Godar, Ph.D	Ring-necked pheasant population and space use response to landscapes including spring cover crops	B.S., University of Wisconsin – Stevens Point M.S., Texas Tech University	Dr. Haukos
. *Chris Gulick, MS	Spatial ecology and resource selection by female lesser prairie-chickens within their home ranges and during dispersal	B.S., Texas Tech University	Dr. Haukos
Talesha Karish, Ph.D	Habitat selection, movements, and activities of sympatric white-tailed deer and mule deer among Kansas landscapes	B.S. Delaware Valley College M.S. New Mexico State University	Dr. Haukos Dr. Ricketts
*Mitchell Kern, M.S.	Factors affecting survival of fawns of sympatric white-tailed deer and mule deer among Kansas landscapes	B.S. Virginia Tech	Dr. Haukos Dr. Ricketts
Maureen Kinlan, M.S.	Survival and mortality factors for sympatric male white-tailed deer and mule deer among Kansas landscapes	B.S. King's College	Dr. Haukos Dr. Ricketts
John Malachuk, Ph.D	Ecology of resident Canada geese in Kansas	B.S., Rhodes College M.S., University of Wisconsin – Stevens Point	Dr. Haukos

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. Haukos Dr. Sullins
Nick Parker, M.S.	Lesser prairie-chicken and grassland response to intensive wildfire in the mixed-grass prairie	B.S. University of California - Berkley	Dr. Haukos Dr. Sullins
Elisabeth Teige, M.S.	Translocation of the lesser prairie-chicken to the Sand Sagebrush Prairie Ecoregion	B.S. Minnesota State University – Moorhead	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

*Graduated

Fisheries Projects

Completed Fisheries Projects

Dams and Fish Communities: Providing a Scientific Basis for Making Riverscape-Scale Management Decisions for Native Stream Fish Communities in the Neosho and Smoky Hill Rivers, KS.

Student Investigators
Jane Fencl, M.S.
Sean Hitchman, Ph.D.

Professional Colleagues
Dr. Joseph Smith, NOAA
Jason Luginbill, USFWS
Dr. Katie Costigan
Jordan Hofmeier, KDWPT
Dr. James Nifong, USACOE

Project Supervisor
Dr. Martha Mather

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

Kansas State University

Objectives
Quantify how dams and habitat affect fish communities

Identify the role of heterogeneity in stream networks

Location
Neosho River, KS
Smoky Hill River, KS

Status
Completed

Progress and Results

Team and Focus
The valued native fish communities that inhabit Kansas streams and rivers are threatened by human impacts, such as dams. Dam impacts on biodiversity can be mediated by natural habitat heterogeneity and implemented through dam-related habitat alterations. In order to help managers make science-based decisions on the impact of dams on native fish communities, the Neosho River research team (Jane Fencl, M.S. student; Sean Hitchman, Ph.D student; Dr. Joseph Smith, post-doctoral fellow; Dr. James Nifong, post-doctoral fellow; Dr. Katie Costigan, post-doctoral fellow; and Dr. Martha Mather, Principal Investigator) sampled fish communities and instream habitat at dammed and undammed sites within the upper Neosho River, KS, and Smoky Hill River, KS.

Methods
In consultation with our project liaisons at Kansas Department of Wildlife, Fisheries, and Parks (KDWPT), our research efforts have focused on the collection of fish and habitat data at sites with dams as well as at paired undammed reference sites. As a team, we identified the best gear to use to sample fish upstream and downstream of dammed and undammed sites. Our gear test showed that the mini-Missouri trawl, the gear we chose to use for all stream sampling, caught as many species as other common stream sampling gears and more individuals than other gears. Once we determined that the mini-Missouri trawl performed as well as other gears, we conducted a trawl length experiment to determine the optimal trawl length (30 m). These results have been incorporated into our standardized sampling protocols.

In 2012, we sampled three dams and one undammed site. Fish and habitat were sampled at 20 transects above and below all dams (or the site centerline of the undammed location) resulting in 90 fish samples at transects around dams. To assess microhabitat (width, depth, velocity, substrate), we sampled 42 habitat transects at four sites (168 microhabitat samples). In addition, we categorized mesohabitat (pool, riffle, run, glide) across 16.1 km of stream for a total of 65, 100-m long mesohabitat samples. Within these mesohabitats, we sampled fish with an additional 44 trawls.

Completion
March, 2019

In 2013, we expanded the number of sample sites from 4 to 11 and extended the distances we sampled at each site to include 22 transects that extended 3 km above and below each dam or undammed site centerline. We sampled habitat and native fish communities using standardized methods at 22 transects (13 transects downstream and 9 transects upstream of each dam or centerline at undammed sites) at 11 sites. At these 11 sites, in 2013, collectively we sampled fish and habitat at 52 upstream transects, 70 downstream transects, 70 transects at undammed sites, 73 additional transects to address temporal variation, for a total of 265 fish and habitat transect samples. At these same 11 sites, in 2013, we also collected samples to identify the relationship between fish communities and specific habitat types. Specifically, at 11 locations, we sampled five replicates of four mesohabitat types (pool, riffle, run, and glide) during 64 days of field sampling. This sampling resulted in 220 habitat-specific fish samples (42 total species), 220 stream width measurements, 1,100 depth, flow velocity, substrate measurements, and mesohabitat data for patch mosaics across 51 km of stream. At the six dam sites, we quantified the geomorphic dam footprint to identify the spatial extent of the dam effect. These dam footprints helped us interpret dam impacts on fish communities.

Results
In contrast to well documented adverse impacts of large dams, little is known about how smaller low-head dams affect fish biodiversity. Over 2,000,000 low-head dams fragment United States streams and rivers and can alter biodiversity. The spatial impacts of these common low-head dams on geomorphology and ecology are largely untested. A select review of how intact low-head dams affect fish species identified four methodological inconsistencies that impede our ability to generalize about the ecological impacts of low-head dams on fish biodiversity. This project tested the effect of low-head dams on fish biodiversity (1) upstream vs. downstream at dams and (2) downstream of dammed vs. undammed sites. Fish assemblages for both approaches were evaluated using three community summary metrics and seven habitat guilds (based on empirically based species occurrence in pools, riffles, and runs). Downstream of dams vs. undammed sites, this project tested if (a) spatial extent of dam disturbance, (b) reference site choice, and (c) site variability altered fish biodiversity at dams. Based on information from geomorphic literature, this research quantified the spatial extent of low-head dam impacts using width, depth, and substrate. Sites up- and downstream of dams had different fish assemblages regardless of the measure of fish biodiversity. Richness, abundance and Shannon's index were significantly lower upstream compared to downstream of dams. In addition, only three of seven habitat guilds were present upstream of dams. Methodological decisions about spatial extent and reference choice affected observed fish assemblage responses between dammed and undammed sites. For

example, species richness was significantly different when comparing transects within the spatial extent of dam impact but not when transects outside the dam footprint were included. Site variability did not significantly influence fish response.

Furthermore, these small but ubiquitous disturbances may have large ecological impacts because of their potential cumulative effects. Therefore, low-head dams need to be examined using a contextual riverscape approach. How low-head dam studies are designed has important ecological insights for scientific generalization and methodological consequences for interpretations about low-head dam effects. This research provides a template on which to build this approach that will benefit both ecology and conservation.

A mosaic-based approach can identify keystone habitats, increase scientific understanding of organismal-habitat relationships, and facilitate conservation of native biodiversity in disturbed freshwater ecosystems. Rivers and streams provide valuable goods and services to society. Freshwater biodiversity is a key attribute of streams and rivers. Organisms that comprise biodiversity are influenced by habitat. A suite of anthropogenic impacts, exacerbated by climate change, threaten aquatic habitats and freshwater biodiversity. Because many ecological processes require spatially-connected data, a mosaic approach offers a scientific foundation for understanding and managing a range of disturbance-related conservation problems. In another component of the larger project, we ask if patterns of aquatic biodiversity differ for habitat mosaics (i.e., connected series of individual juxtaposed habitats) compared to isolated, individual habitats. Traditional approaches to conserving native biodiversity will be inadequate if mosaics create different patterns of biodiversity than isolated mesohabitats. This research yielded four important insights. First, mesohabitats (pool, riffle, run, and glide) formed discrete habitat categories based on three physical characteristics. Together juxtaposed mesohabitats formed diverse mosaics. Second, multivariate, community analysis on three fish biodiversity data sets confirmed guild-based organism-habitat associations identified from type and strength of species-mesohabitat associations. Third, patterns of biodiversity were different in mosaics than for isolated mesohabitats. Fourth, riffles acted as keystone habitats in that mosaics with more riffle mesohabitat (<5% of sampled area) had higher native species diversity. Links among human impacts, water use, land use change, climate change predictions, precipitation, discharge, aquatic habitat, and biodiversity make a suite of diverse and often complex spatial and temporal impacts inevitable in disturbed aquatic ecosystems. Thus, developing a new approach for quantifying connected biodiversity-habitat relationships is essential to construct baselines to which future human impacts and climate disturbances can be compared. A mosaic approach can provide this framework for examining ecological processes in both reference and disturbed ecosystems.

Implications

This research advanced riverscape-scale understanding of the structure and function of aquatic ecosystems in a way that informs aquatic conservation. Ultimately, this research can be used to manage fish and dams in Great Plains stream and river networks.

Major accomplishments under this grant include Jane Fencl's thesis (2015), Sean Hitchman's dissertation (2017), Fencl et al. 2015, Fencl et al. 2017, Hitchman et al 2018 a, b, and a 2016 symposium at the American Fisheries Society national meeting.

Fish Biodiversity and Coupled Climate, Cultivation and Culture in the Great Plains

Student Investigator:
Richard Lehrter

Post-Doctoral Assoc.:
James Nifong

Professional Colleagues:
Dr. Melinda Daniels
Dr. Marcellus Caldas
Dr. J. Heier Stamm
Dr. Jason Bergtold
Dr. Aleksey Sheshukov
Dr. Matthew Sanderson
Dr. Gabe Granco

Project Supervisor:
Dr. Martha Mather

Funding:
National Science Foundation

Cooperators:
Kansas State University Division of Biology

Objectives:
Address how interacting dynamics between climate variation, human land and water use decisions, and aquatic ecosystem dynamics will affect fish biodiversity.

Location
Smoky Hill River. KS

Completion:
December 2019

Status
Complete

Progress and Results

Overall
Throughout the U.S., freshwater ecosystems provide valuable societal goods and services that are being adversely affected by humans. Climate, likely is exacerbating these adverse impacts. Great Plains rivers are model systems for looking at a coevolved animal community that inhabit naturally-connected dendritic ecosystems which are adversely affected by climate change and human land and water use. Because biodiversity is valued by a diverse human stakeholders including groups interested in conservation, recreation, and hunting-fishing, aquatic (i.e., fish) biodiversity is a natural link for coupling human and natural systems.

Aquatic biodiversity (e.g., fish biodiversity) has intrinsic ecological value. For example, communities with native biodiversity are often more resilient and better able to respond to disturbances. Fish comprise a large biomass in aquatic systems and have several attributes that make them an ideal focus for interdisciplinary research on natural and anthropogenic process drivers of biodiversity. First, fish distribution is strongly linked to geomorphology, hydrology, and land use. Second, fish represent an important component of ecological diversity. As such, they are a good taxa to examine how biodiversity is affected by human and climatic influences. Third, many human groups value fish. Thus, these charismatic megafauna, are an obvious link between natural and human systems.

Our collaborative research is unique in that it integrates multiple disciplines with the goal of understanding how water systems in the Great Plains (geomorphology, hydrology, ecology) are affected by human land and water use, as well as, how humans value the components of an aquatic ecosystem. All stakeholders (farmers, ranchers, urban residents, conservationists, anglers) will benefit from our interdisciplinary insights about how aquatic ecosystems are structured and function

Understanding empirical relationships between biotic diversity and components of the environment is crucial for effective interdisciplinary research and conservation in highly disturbed watersheds. The Smoky Hill River, a semi-arid prairie stream in central Kansas, is the focus of a NSF Coupled Natural and Human System grant that seeks to promote watershed sustainability by maintaining biodiversity. Following a literature review on environmental variables, diversity responses, and statistical methods, the team evaluated the importance of land use, instream flow, discontinuities (dams and confluences), and stream site type (mainstem-tributary) on fish biodiversity across three watershed regions (upper, middle, and lower) using AIC_c model selection. This analysis was repeated using multiple linear, Poisson, and negative-binomial regressions. Using fish data collected at 48 sites within the same year and season (summer 2015), patterns and drivers of fish biodiversity differed with watershed region, land use, flow, and stream site type. Fish species richness in the lower region of the Smoky Hill watershed below Kanopolis Reservoir was negatively correlated with percent developed land. However, in the upper region of the watershed, fish biodiversity was positively correlated with percent herbaceous grassland, the reference prairie condition. Summer mean flow was consistently and positively related to species richness in the middle and upper regions of the watershed where flow was limited. In the lower region of the watershed, species richness was higher in moderate-flow tributaries compared to high-flow, mainstem sites. In the flow-limited middle and upper regions, species richness was lower in the low-flow tributaries than in the moderate-flow mainstem sites. Mainstem sites hosted more Cypriniformes fishes while tributary sites contained more Perciformes species. A comparison of trends from the above-described research dataset (48 sites, 1 season, 1 year) with a broader monitoring database (different sites in different years) showed that different goals, questions, and study designs can provide alternative insights. As such, an explicit and thoughtful choice of goals prior to biodiversity sampling is critically important.

Major accomplishments under this grant included developing a CNH model incorporating linkages among atmospheric, terrestrial, aquatic, and social processes to predict impacts of climate variability, land-use, and human activity on water resources and biodiversity in the Central Great Plains. The research, described above, is a central component of this project-wide, interdisciplinary agent model that tests how interactions among hydrosystem, aquatic ecosystem, and the human system affect policy options. These results should have substantial implications for ecology and sustainable natural resource management. Resulting publications include Caldas et al. 2015, 2019; Lehrter 2018; Granco et al. 2019.

Plum Island Ecosystems LTER

Student Investigator:
Ryland Taylor

Principal Investigators:
12 Principal Investigators from multiple universities including Dr. Martha Mather

Lead PI:
Dr. Anne Giblin, MBL, Woods Hole. MA

Project Supervisor:
Dr. Martha Mather

Funding
National Science Foundation

Cooperators
Kansas State University Division of Biology

Objectives
Evaluate ecological drivers for the spatial arrangements and connectivity between ecological habitat patches

Determine the spatial arrangement and the connectivity between ecological habitat patches

Quantify distribution and movements of mobile fish predators

Location
Plum Island Estuary

Completion
December 2019

Status
Complete

Progress and Results

Overview
The Plum Island Ecosystems (PIE) LTER has been working towards a predictive understanding of the long-term response of coupled land -water ecosystems since its inception in 1998. The Plum Island Estuary-LTER includes the coupled Parker, Rowley, and Ipswich River watersheds. The present grant builds upon past progress that the research team has made in understanding the importance of spatial patterns and connections across the land-margin ecosystem. Higher trophic levels, such as fish, rely on seascape configurations that create 'hot spots' of energy that transfer up the food web.

Justification
Determining patterns and drivers of organismal distribution and abundance are fundamental and enduring challenges in ecology, especially for mobile organisms at a 'scape scale. Understanding these same issues are also fundamental for sportfish managers to satisfy anglers, a core clientele of state resource agencies.

Methods
To address the problem presented by individual predators whose distributions are dynamic across large geographic areas, here we tracked 59 acoustically-tagged migratory striped bass (*Morone saxatilis*) with an array of 26 stationary receivers in Plum Island Estuary (PIE), MA.

Questions
Specifically, we asked (1) how these predators were distributed across the estuarine seascape, (2) if these fish used three types of geomorphic sites (exits, confluences, and non-confluences) differently, (3) if distinct types of distributional "groups" existed across individual fish, and (4) if fish within distinct distributional groups used geomorphic site types and regions differently.

Results
Based on three components of predator trajectories (site specific *numbers of individuals*, *residence time*, and *number of movements*), striped bass were not distributed evenly throughout PIE. Confluences attracted tagged striped bass although not all confluences or all parts of confluences were used equally. Use of non-confluences sites was more variable than exits or confluences. Thus, geomorphic drivers and regions link mobile organisms to

physical conditions across the seascape. Based on spatial and spatial-temporal cluster analyses, these striped bass predators assembled into four seasonally-resident distributional groups. These included the (1) *Rowley River* group (fish that primarily resided in the Rowley River), (2) *Plum Island Sound* group (fish that primarily resided in the Middle Sound region), (3) *Extreme Fidelity* group (fish that spent most of their time in PIE at a single receiver location), and (4) the *Exploratory* group (fish that showed no affiliation with any particular location). These distributional personalities used geomorphic site types and regions differently. Thus, our data show a rare link between behavioral (i.e., individual animal personalities) and field ecology (seascape geomorphology) that can advance the understanding of field-based patterns and drivers of organismal distribution. This basic data can help resource managers with sampling and other management plans.

Implications:
The scientific questions, methods, and management applications for this project are very similar to the KS KDWPT blue catfish project. Both projects are ground-breaking scientifically. Both projects provide major insights into predator distribution in large systems throughout the U.S., information that is essential for sportfish management. Additional accomplishments include Ryland Taylor's thesis (2017) and Taylor et al. (2019).

Modeling the Effects of Climate Change on Fish Populations, Distribution, Movements, and Survival in Large Rivers

Investigators:
Dr. Martha Mather
Dr. Donna Parrish
Dr. Elizabeth Marschall

Funding
NMFS

Cooperators:
Kansas State University

Objective
Model the effects of climate change on mobile fish in rivers

Location
US Rivers

Completion
May, 2019

Status
Complete

Progress and Results

Mobile organisms including native fish, fish predators, and anadromous fish may be affected by climate change through several mechanisms. These include increased water temperature and altered discharge patterns. Anthropogenic impacts, especially fragmentation by dams, can exacerbate these effects by preventing, delaying, or otherwise altering distribution and movement. In this project, we use a series of individual based and statistical models to understand the relationships among water temperature, discharge, dams, fish distribution, movement, and survival.

Our present efforts are using a watershed wide model to test how American shad (*Alosa sapidissima*) offspring recruitment is affected by water temperature, water velocity, and food availability. Although previously this research has focused only on anadromous fish (salmon, shad) in large northeastern US rivers, the methods and insights have relevance to motile organisms in other stream networks where temperature and discharge are changing with climate (e.g., pallid sturgeon, paddlefish, Asian carp) in the Midwest and Northeast U.S.

Climate change is altering the spatial and temporal patterns of temperature and discharge in rivers, which is expected to have implications for the life stages of anadromous fish using those rivers. We developed an individual-based model to track American Shad within a coarse template of spatially and temporally variable habitat conditions defined by a combination of temperature, river velocity, and prey availability models. We simulated spawning at each river kilometer along a 142-km reach of the Connecticut River on each day (April 1–August 31) to understand how spawning date and location drive larval recruitment differentially across years and decades (1993–2002 and 2007–2016). For both temperature and flow, interannual variation was large in comparison to interdecadal differences. Variation in simulated recruitment was best explained by a combination of season-specific spawning temperature and location along the course of the river. The greatest potential recruitment occurred during years in which June temperatures were relatively high. In years when June and July were warmer than average, maximum recruitment resulted from spawning taking place at the upstream portion of the modeled reach. Model scenarios (stationary or passive-drift larvae; and dams or no dams) had predictable effects. We assumed that the pools above dams had negative impacts on eggs and yolk-sac larvae that may have been deposited there. Allowing eggs and larvae to drift passively with the current reduced spatial differences in recruitment success among spawning sites relative to stationary eggs and larvae. Our results demonstrate the importance of spatiotemporal environmental heterogeneity for producing positive recruitment over the long term. In addition, our results suggest the importance of successful passage of spawners to historical spawning sites in the Connecticut River upstream of Vernon Dam, especially as conditions shift with climate change.

Both these results and this methodology are widely applicable to mobile fish in large and small Great Plains rivers as well as elsewhere in the United States. Accomplishments of this project include Marschall et al. 2020.

On-Going Fisheries Projects

A Strategic Process for Fisheries Management and Aquatic Conservation

Project Supervisor
Dr. Martha Mather

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

Kansas State University

U.S. Fish and Wildlife Service

Wildlife Management Institute

Objectives
Provide strategic planning syntheses and reviews to aid management effectiveness.

Status
Ongoing

Progress and Results

Overview
A core goal of the Cooperative Research Unit program is to assist cooperators in the effective execution of their fisheries management and aquatic conservation mission. To achieve this goal, unit scientists can help state and federal colleagues be more effective in managing resources through the organizations of symposium at meetings and talks/publications that provide relevant reviews and syntheses. In 2019-2020, I have contributed talks, symposia, and syntheses that can improve natural resource agency effectiveness through strategic planning. Below are select examples.

Gear
Implementation of rigorous methodologies, including gear evaluation and standardization, is critically important for effective fisheries research and management. Although few fisheries professionals disagree with the urgent need for detailed, quantitative protocols prior to data collection, challenges exist in executing representative and generalizable gear evaluations and standardizations. Three primary areas require attention. Addressing these challenges can advance the establishment and implementation of improved sampling methodologies. As a first challenge, unless a complete census is undertaken every time resource data are collected, uncertainty about context-specific bias at the time of each individual data collection event (related to time-, place- and personnel-related sampling variation) will affect efforts to evaluate and standardize gear. Consequently, practical and philosophical cautions about data interpretation related to the inevitable uncertainty in bias need to be integrated into the development, validation, and application of standardized data including context for estimates of precision and accuracy. As a second challenge, the type of data needed and impact of specific gear bias differ with the question asked. For example, regardless of the gear used, data needed to estimate population size are quite different from those needed to quantify the impact of specific conditions on fish populations (e.g., habitat type, season, disturbances such as dams). Thus, the question asked alters the appropriateness of the sampling design for the same and different gears. As a third challenge, an integrated analysis is needed of how standardized data relates to the fisheries questions asked (e.g., what will be done with the standardized data once it is collected?; are the right questions being asked for the problem at hand?; will the resulting data be useful if unanticipated trends are detected?). By addressing these challenges, fisheries professionals can develop a more balanced

portfolio of tools that provide a broader context for the development, validation, and application of standardized data.

Strategic Planning For Fisheries.

Resource agencies manage fisheries and conserve aquatic resources based on sound data and scientific principles. This always-difficult task is ever more challenging as fish species and systems that require management are assaulted by an increasing diversity of human disturbances. Here we identify a multi-step pathway by which resource agencies and their collaborators can advance sustainable conservation and science-based fisheries management. We illustrate this approach using successful examples from a variety of agencies and fisheries. First, a shared vision created by a collaborative group of researchers and managers is essential. Second, linked goals, objectives, and questions must be established for each fisheries management problem. Third, a framework for how different types of information interact and contribute to success is needed (e.g., monitoring, applied research, basic research). Fourth, a commitment to rigorous scientific principles in research and monitoring is fundamental. Fifth, commitment to and evaluation of an agreed-upon set of goals for 5-10 years is essential. Finally, a question-driven portfolio of integrated data can operationalize this framework for specific fisheries goals. Inland and marine fisheries agencies face different challenges. However, all conservation stakeholders can benefit from developing components of this pathway as a question-based, integrative, data-driven approach can increase successful science-based management.

Fish Harvest Regulation Evaluation

Harvest regulations are essential tools that fisheries managers use to alter fish populations and achieve angler satisfaction. Evaluation of regulations is essential but evaluating all regulations for all species in all systems across multiple time periods is not logistically feasible. Thus, a strategic plan is needed that identifies what regulations need to be evaluated where, when. Specifically, an integrated framework of assessment and research (i.e., the portfolio approach) can provide a larger context in which to design, implement, and interpret harvest regulation evaluations. Using examples, we illustrate this multi-step approach. First, a shared vision for individual fisheries (species, system, individual/population, goal) that is jointly created by a collaborative group of researchers and managers is essential. Second, using a series of linked questions, objectives, and goals, the collaborative team can conceptualize (a) desired outcomes of specific harvest regulations given population characteristics, (b) challenges to achieving those outcomes, and (c) data needed to differentiate among population responses to regulations. Third, by applying a portfolio of interacting data types (e.g., assessment, applied research, basic science, synthesis), researchers and managers can operationalize a pathway to achieve the desired angler outcome given existing population conditions. Fourth, by using rigorous scientific principles, the team can improve all aspects of assessment and research. Specifically, a strategic plan that considers multiple starting population conditions, a range of harvest regulations, and different angler outcomes can integrate all assessment and research data to better inform management decisions. Fifth, adhering to a set of agreed-upon, regularly-evaluated 10-year goals allows fisheries professionals to track progress and plan next steps. Although agencies face different challenges across species, systems, and populations, all fisheries professionals can advance successful science-based management by utilizing components of this portfolio approach for harvest regulation evaluation.

Habitat

Habitat data are central to successful resource conservation. Although environmental professionals know much about habitat, managers, administrators, and policy-makers still find it difficult to make wise habitat-based conservation and restoration decisions. To achieve a larger vision for research-management collaborations, professionals need to establish “stretch” goals, which, if achieved, completely change all aspects of an activity, and, for which, the pathway to achievement is often inconceivable at the outset. Two “stretch” goals for fish habitat research are to (1) identify data needed to make defensible, science-based fish habitat decisions across a range of aquatic systems, species, and years, and (2) clarify what types of decisions are realistic under different mixes of knowledge and uncertainty. Several steps are needed for this transformative process. Philosophically, decision makers should recognize the value of data-based decisions, acknowledge inevitable knowledge gaps, and embrace some mix of data and uncertainty. Empirically, decision makers and researchers must improve connections between decision-support data and management actions, and, through synthesis, better link multiple data sources (including mechanisms and patterns). Iterative, adaptive problem maps that integrate questions, actions, data, methodologies (including species distribution models) with a discussion of data strengths, weaknesses, and uncertainty can provide defensible scientific-based habitat management.

Using Technology

Fisheries can benefit from advanced technologies (e.g., telemetry, remote sensing, social media, quantitative approaches). However, advanced technologies do not solve complex fisheries problems, improve data quality, or reduce bias by themselves. In fact, the tool utility hypothesis proposes four relationships between technology and successful problem-solving. (1) Initially, the perceived relationship is strong as general agreement exists that new tools could be valuable. (2) An assumed but often untested positive relationship follows as previously-unavailable technologies are developed and perfected. (3) However, this relationship can weaken with increased use of the technology if data collection objectives prioritize *how* to (rather than *why*) use the technology. (4) Nevertheless, benefits from advanced technology can accelerate if strategic planning structures data collection so that important questions drive technology use. We provide a framework to focus advanced technologies on common fisheries management problems (e.g., standard/standardized assessments, harvest regulation application/evaluation, habitat improvement, invasive species control, managing barriers). For these shared problems, an adaptive, iterative approach integrates questions, methods, and tool application in a way that increases data comparability across agencies and institutions. Thus, the technology we propose (a strategic framework) can enhance the utility and increase the benefits of diverse advanced technologies.

Implications

Major accomplishments of this project include invited talks and symposium including Mather et al. (2018), Mather et al. (2019), Phelps et al. (2019), Carl et al. (2019), Mather et al. (2019), Mather et al. (2020a), Mather et al. (2020b).

Wildlife Projects

Completed Wildlife Projects

Ring-necked Pheasant Population and Space Use Response to Landscapes Including Spring Cover Crops

Investigators
Alixandra Godar
Adela Annis

Project Supervisor
Dr. David Haukos

Collaborator
Jeff Prendergast

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

Objectives
Test the potential influence of cover crops on ring-necked pheasant population demography and develop spatial models predicting potential effects of cover crop presence on pheasant abundance at the landscape scale

Assess relationships among availability of invertebrates among cover crop seed mixes, chick foraging

Status
Completed

Progress and Results
Historically, ring-necked pheasant (*Phasianus colchicus*) populations fluctuate with land use practices, though the mechanisms are poorly understood. A current shift towards cover crops may alter the landscape enough to influence pheasant populations. Cover crops are planted between cash crops as an alternative to chemical fallow, where herbicide prevents plant growth until the field is planted again. Depending on the plant species, or species used, agricultural producers can improve their soil health by reducing erosion, increasing organic matter, fixing nitrogen and reducing soil compaction. Spring cover crops are planted in March or April and chemically terminated in June or July in compliance with crop insurance requirements. From late May through August, cover crops can provide a variety of benefits for wildlife, primarily additional cover and food resources. Depending on the timing of pheasants nesting and brood rearing, cover crops may provide additional resources during critical times for reproduction. Working with private landowners, we divided fields into 4 treatments, including a chemical fallow control and 3 different spring cover crops blends. Our cover crop mixes included Chick Magnet (a warm-season, broad-leafed forb mix designed for precocial chicks), GreenSpring (an agricultural forage mix with cool-season peas and oats), and a Custom Mix (designed to be adaptive with ten species). We captured pheasants in nearby Conservation Reserve Program areas using nightlighting and outfitted hens with 15-g necklace style radio-transmitters (Table 1). We monitored hen survival, nest survival, hen movements, hen resource selection, brood resource selection, cover crop growth and insect diversity. Hen survival during the breeding season was about 45% and varied by week (Table 2) while nest survival was low and negatively impacted by extreme precipitation events (Table 3). Over half of the nests were within Conservation Reserve Program (CRP) land (Table 4). Grass had the highest nest survival estimates but very few nests (Table 5). CRP, which had the most nests, had the second highest survival estimate (Table 5). Hen 95% Kernel Density home ranges were small (91.05 ha, SE = 14.43) and their movement limited across the breeding season (Table 6). Hens selected for Conservation Reserve Program (CRP) land for both locations and area with in their home ranges (Fig. 1 and 2). Hens showed some selection for the spring cover crop mixes and selected against chemical fallow and crop stubble (Fig. 1 and 2). As the landscape changes, with plantings and harvests, hens do move into growing crop fields and out of harvested fields (Fig. 3). Hen use of CRP remained the highest across the season while crop stubble and other remained the lowest (Fig. 3). Brood cover type use varied between years, but the year with the most locations had increased use of grassy areas and cover crops (Fig. 4). Placing CRP close to grassy areas and cover crop fields may help broods since brood movement is limited. Hens and broods selected for overhead cover in their vegetation but broods also selected for Hemipterans. CRP provided the most overhead cover (Fig. 5) but lower counts and biomass of Hemipterans than other cover types (Fig. 6 and 7). The cover crops differed from other available

space use and forage choice, and the potential invertebrate community in the landscape

Assess selection of cover crops and other available landscape patches by pheasants during multiple ecological states and at different spatial scales

Compare characteristics (e.g., vegetation cover, nutrient availability) among different spring cover crop types relative to potential benefits for wildlife and producer

Location:
Graham, Norton and Russell counties, Kansas

Completion
August 2020

cover types in the area and each other (Fig. 8 – 12). Future analyses will determine how the landscape around cover crop fields influences the probability of use by ring-necked pheasants and ring-necked pheasant broods.

Table 1. Summary of ring-necked pheasant individuals captured and collared in western Kansas from 2017 – 2019.

	Spring		**Fall**	
	Females	Males	Females	Males
2017	34	5	5	6
2018	37	13	7	3
2019	36	14	N/A	N/A
Total	107	32	12	9

Table 2. Ring-necked pheasant hen breeding season survival estimates for western Kansas, 2017 – 2019, based on weekly survival estimates.

Survival Rate	Estimate	Standard Error	95% LCI	95% UCI
Lowest Week Survival (6/19-6/25)	0.898	0.031	.821	.944
Highest Week Survival (5/15-5/21)	1.000	0.000	1.000	1.000
Entire Season (5/15-8/18)	0.457	0.046	0.369	0.549

Table 3. Ring-necked pheasant nest survival estimate for western Kansas, 2017 – 2019, based on extreme precipitation events.

Survival Rate	Estimate	Standard Error	95% LCI	95% UCI
Daily Nest	0.927	0.009	0.908	0.943
23-Day Incubation	0.176		0.108	0.258

Table 4. Ring-necked pheasant nest apparent survival by cover type in western Kansas, 2017 – 2019.

Cover Type	Failed Nests	Successful Nests	Total Nests	Apparent Survival
Conservation Reserve Program	38	14	45	0.31
Wheat	12	5	17	0.29
Grass	4	3	7	0.43
Unspecified	3	2	5	0.40
Crop Stubble	3	0	3	0.00
Other	2	1	3	0.33
Chemical Fallow	1	0	1	0.00
Unknown Cover Crop	1	0	1	0.00
GreenSpring	1	0	1	0.00
Hay	1	0	1	0.00
Soy	1	0	1	0.00

Table 5. Ring-necked pheasant daily nest survival estimates and 23-day incubation survival by cover type in western Kansas, 2017 – 2019.

Cover Type	Daily	Standard Error	Incubation
Conservation Reserve Program	0.937	0.011	0.224
Grass	0.950	0.024	0.307
Other	0.877	0.032	0.049
Wheat	0.921	0.022	0.151

Table 6. Ring-necked pheasant hen movement measurements in western Kansas from 2017 – 2019, including exploratory movements (the maximum distance from the mean center of the home range to an individual location) and farthest distance (the farthest distance between two individual locations).

Statistic	**Exploratory (m)**	**Farthest Distance (m)**
Minimum	405.8	653.7
Median	755.4	1246.6
Mean	863.8	1331.9
Maximum	2376.4	3415.4
Standard Deviation	386.2	536.4

Table 7. Ring-necked pheasant hen movement measurements in western Kansas from 2017 – 2019, including the initial distance moved from the nest, the maximum distance between locations, and the maximum distance from the mean center location of all locations for the brood.

	Initial Distance Moved (m)	Maximum Distance Between Locations (m)	Maximum Distance From Mean Center (
Minimum	35	273	148
Mean	164	692	438
Median	145	672	399
Maximum	462	1348	1044
Standard Error	32	73	53

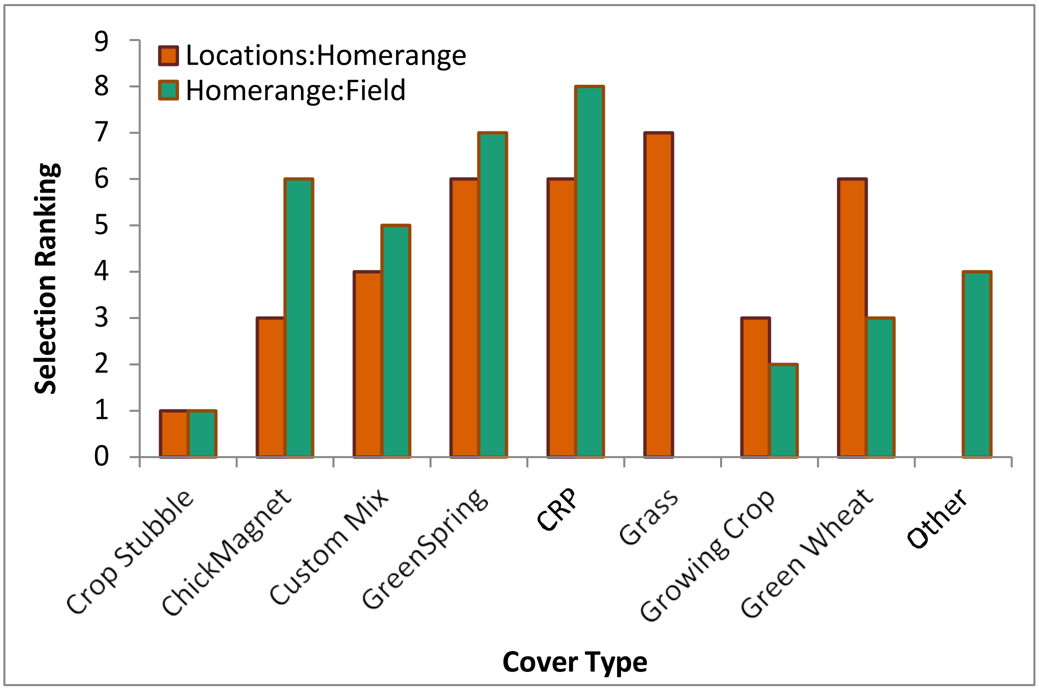


Figure 1. Ring-necked pheasant hen selection rankings in western Kansas from 2017 – 2019, comparing locations to the 95% Kernel Density Home Range Estimate and comparing the 95% Kernel Density Home Range Estimate to 1 km around the field of capture.

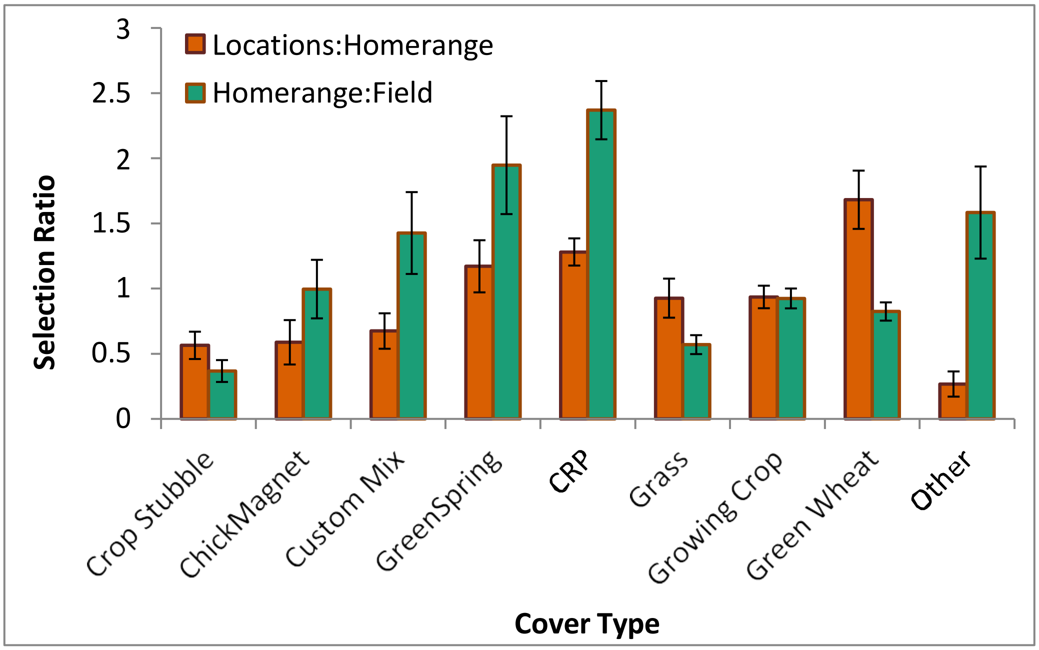


Figure 2. Ring-necked pheasant hen selection ratios (1 is used as available) in western Kansas from 2017 – 2019, comparing locations to the 95% Kernel Density Home Range Estimate and comparing the 95% Kernel Density Home Range Estimate to 1 km around the field of capture.

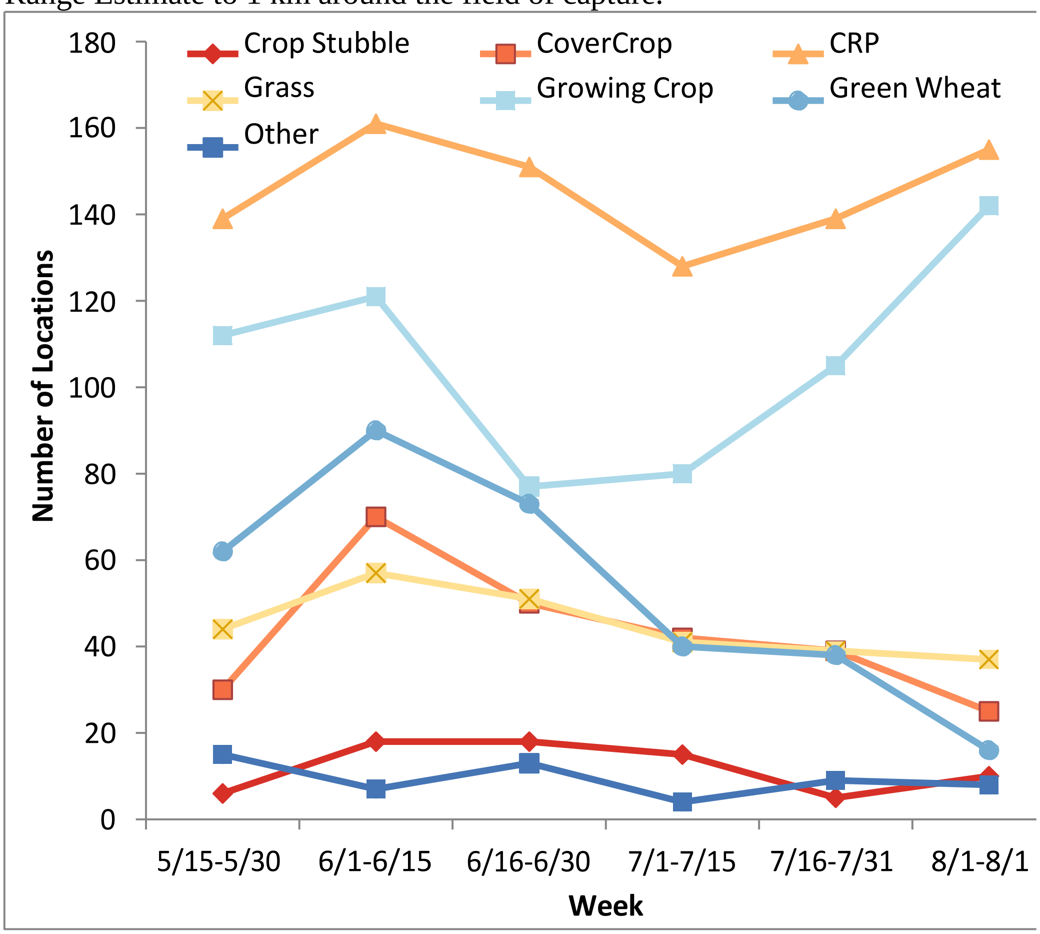


Figure 3. Ring-necked pheasant locations by cover type, across the breeding season, in western Kansas from 2017 – 2019.

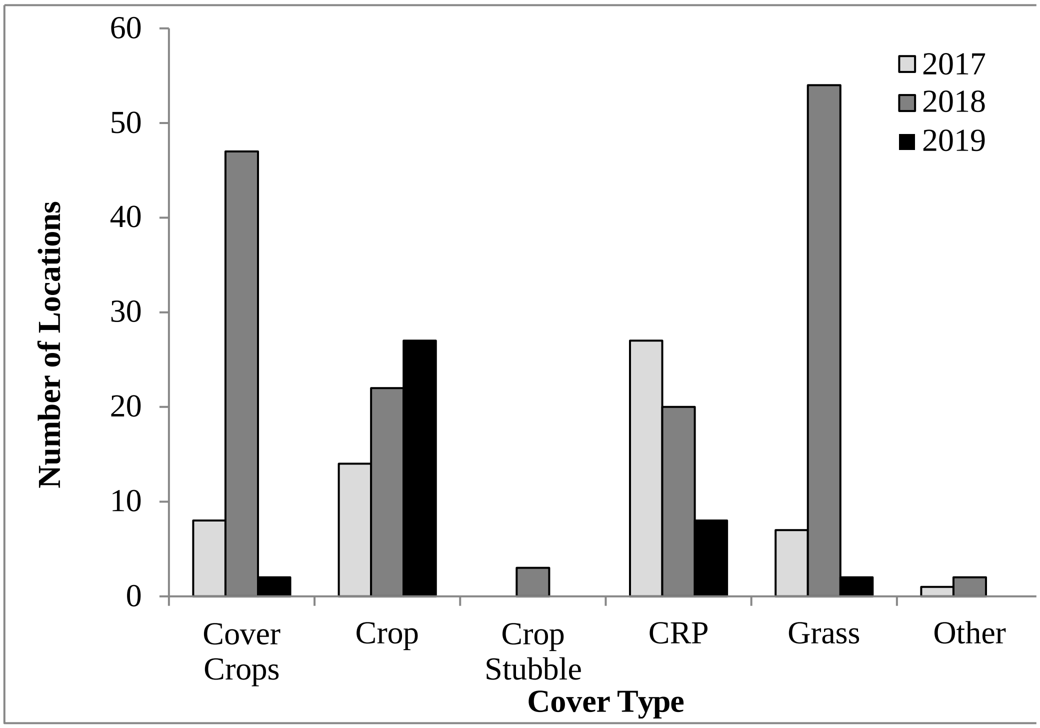


Figure 4. Ring-necked pheasant brood locations by cover type in western Kansas from 2017 – 2019.

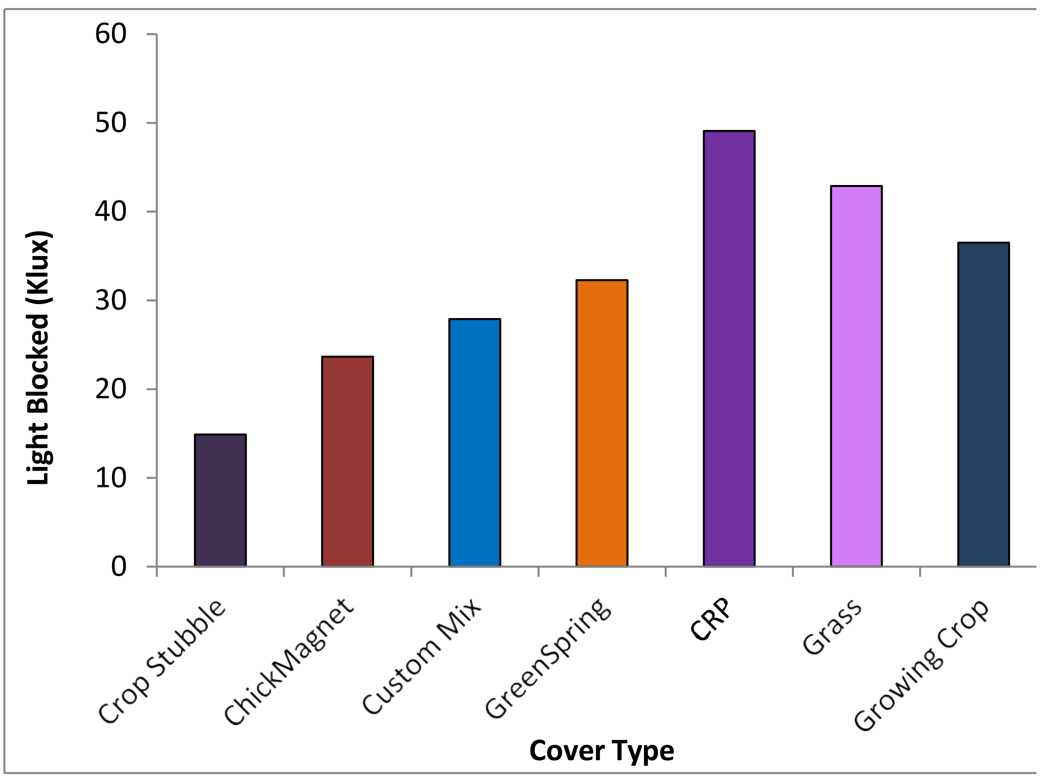


Figure 5. Average overhead cover, measured in the difference between the light intensity at 1 m above ground minus the light intensity at 0 m above ground in western Kansas from 2017 – 2018.

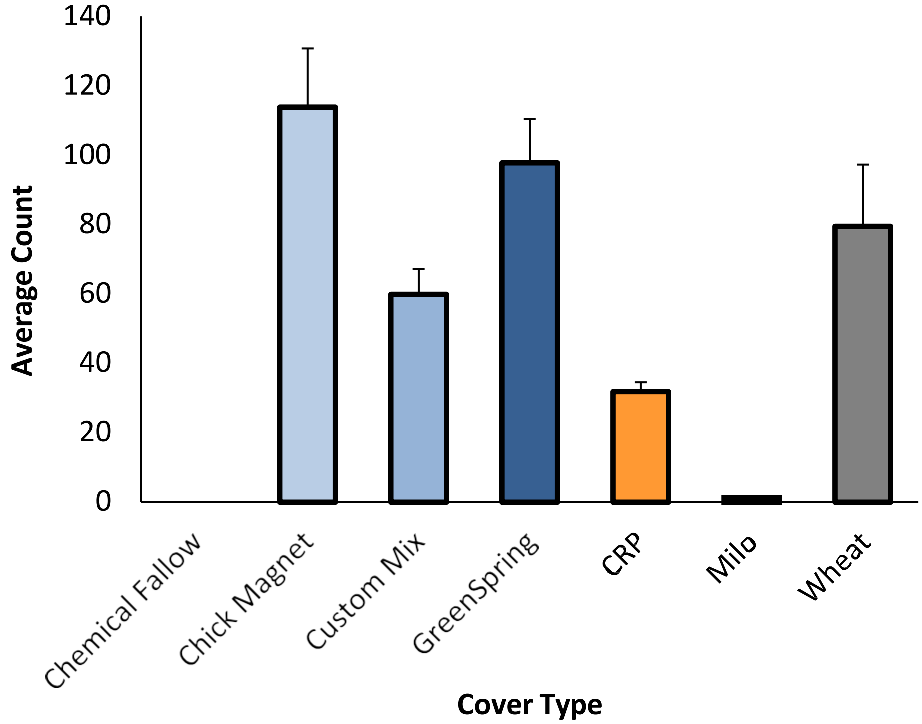


Fig. 6. Average Hemipteran count per sample bag by cover type in western Kansas from 2017 – 2018.

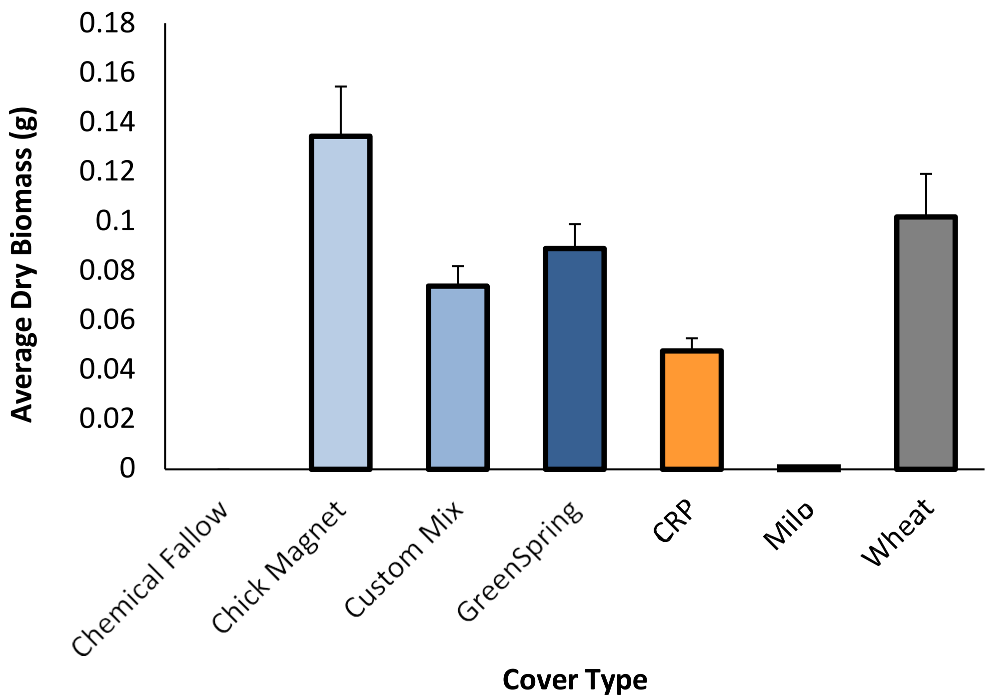


Fig. 6. Average Hemipteran dry biomass per sample bag by cover type in western Kansas from 2017 – 2018.

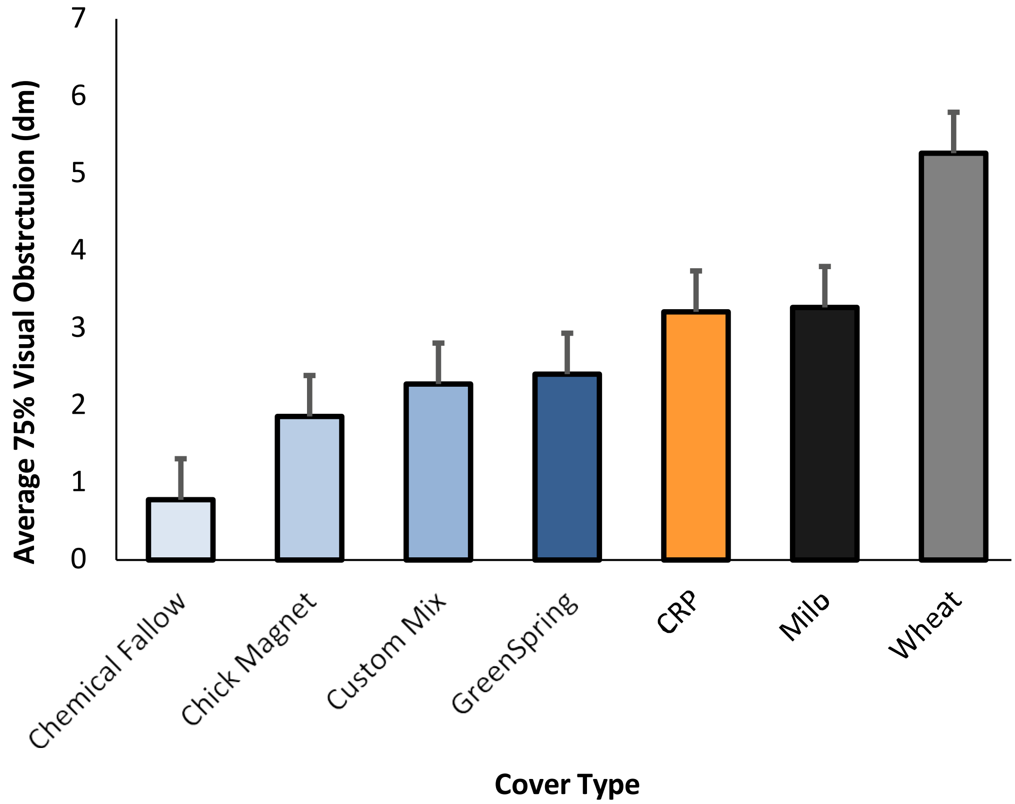


Fig. 7. Average 75% visual obstruction by cover type in western Kansas from 2017 – 2018.

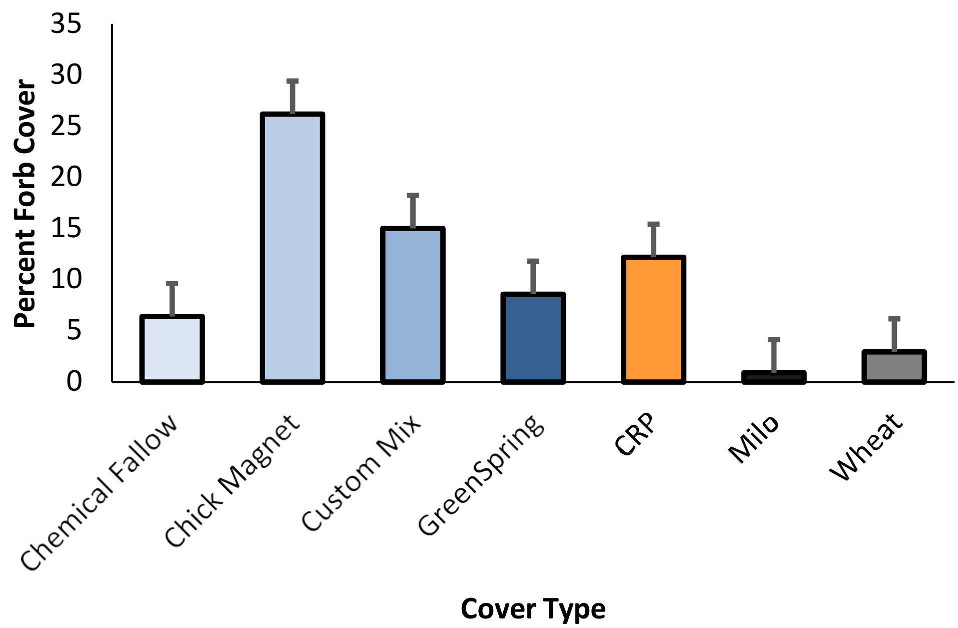


Fig. 8. Average percent forb cover by cover type in western Kansas from 2017 – 2018.

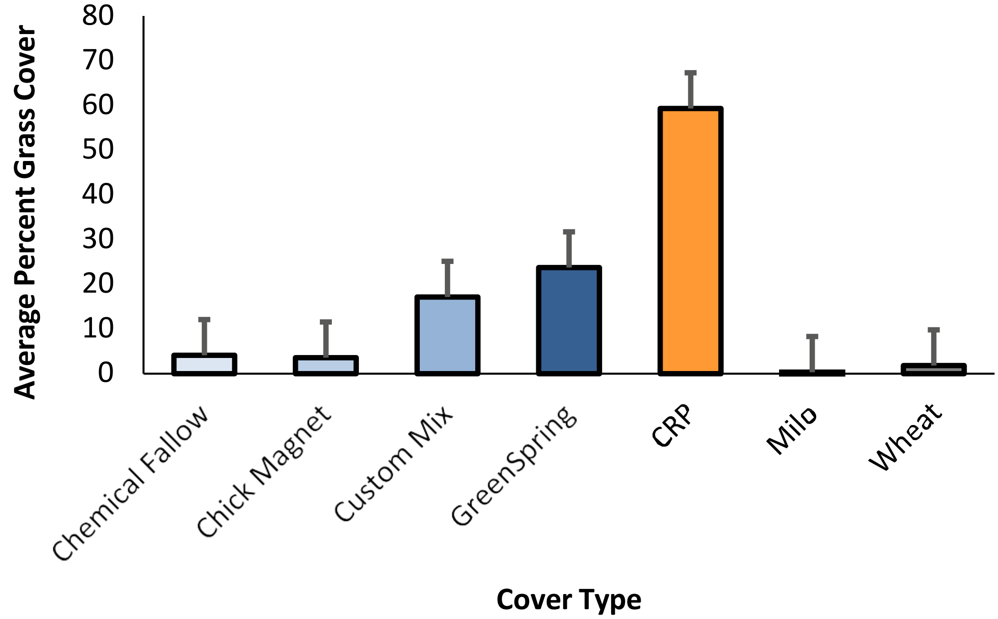


Fig. 9. Average percent grass cover by cover type in western Kansas from 2017 – 2018.

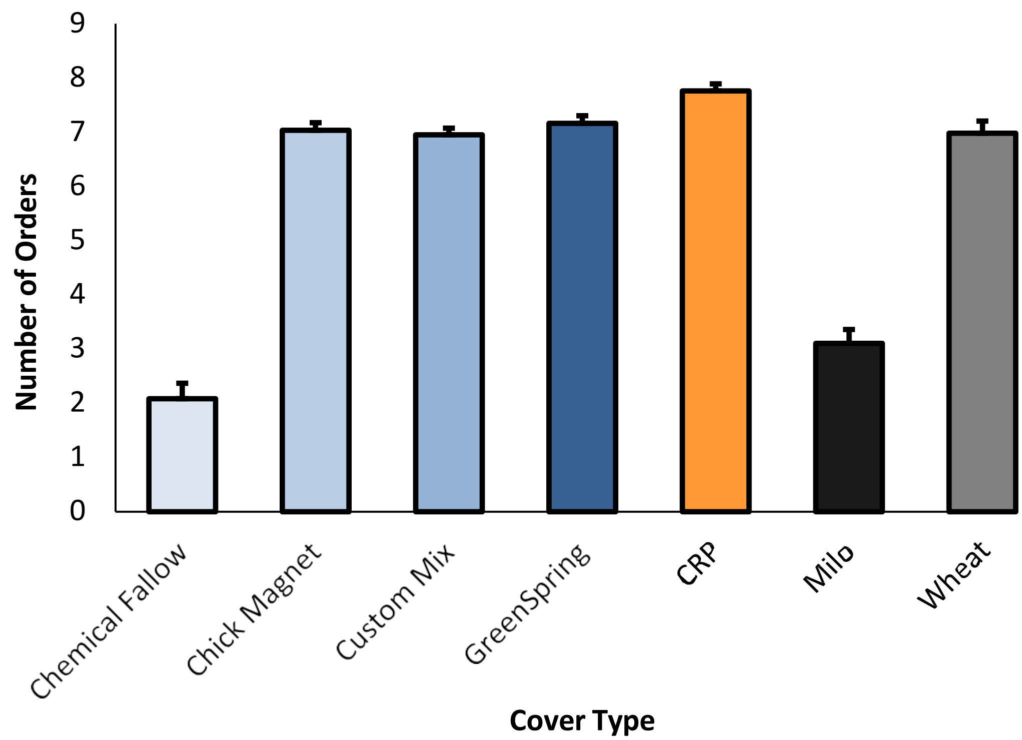


Fig. 10. Average number of insect orders present per sample by cover type in western Kansas from 2017 – 2018.

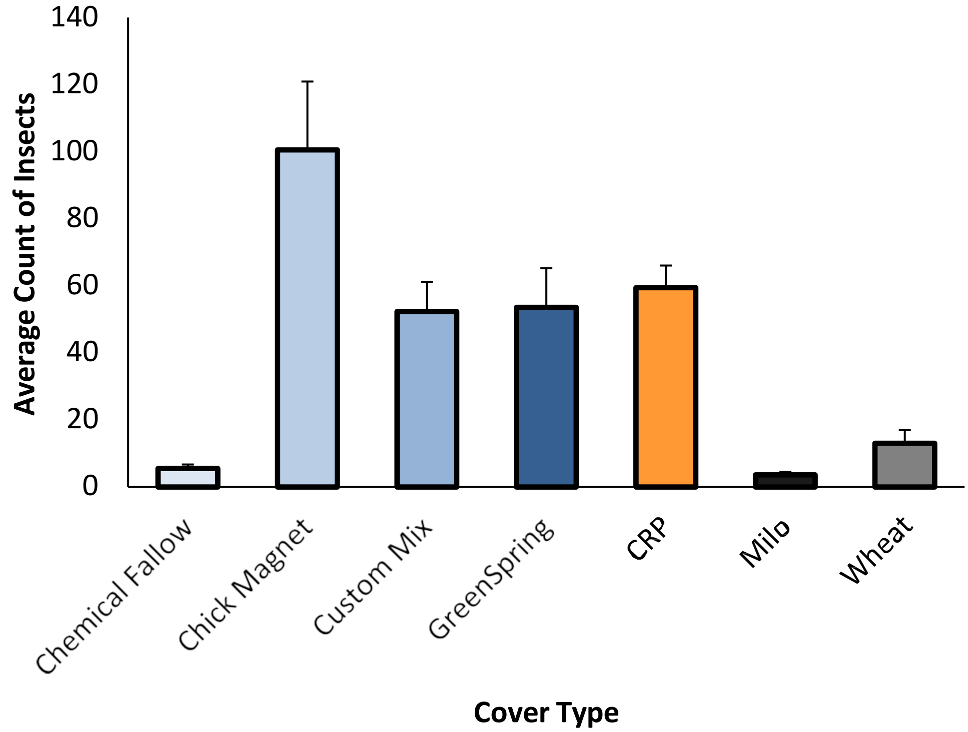


Fig. 11. Average number of insects present per sample by cover type in western Kansas from 2017 – 2018.

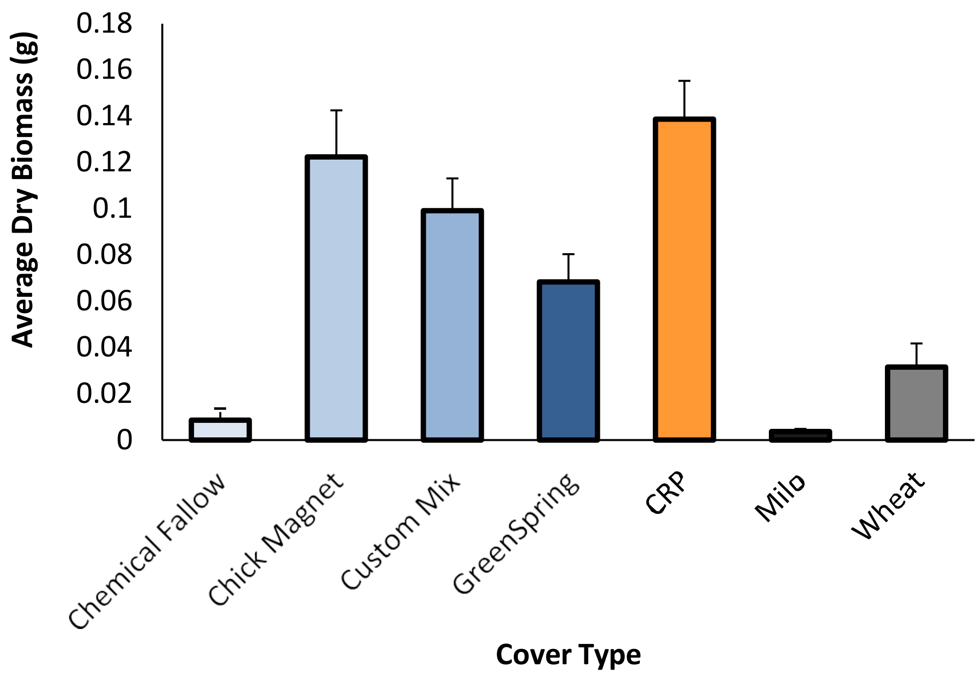


Fig. 12. Average insect dry biomass (g) present per sample by cover type in western Kansas from 2017 – 2018.

Products

Professional Presentations

Godar, A.J., A. Annis, D. Haukos, J. Prendergast. Ring-necked pheasant use of spring cover crops in western Kansas. September 2017. The Wildlife Society National Conference. Albuquerque, New Mexico.

Godar, A.J., A. Annis, D. Haukos, J. Prendergast. Do pheasants use spring cover crops? January 2018. Midwest Fish and Wildlife Conference. Milwaukee, Wisconsin.

Godar, A.J., A. Annis, D. Haukos, J. Prendergast. Can you find pheasants in spring cover crops?. February 2018. Kansas Natural Resources Conference. Manhattan, Kansas.

Godar, A.J., A. Annis, D. Haukos, J. Prendergast. Cover crops: Altering an altered landscape to benefit wildlife. March 2018. Central Mountains and Plains Section Meeting. Kearney, Nebraska.

Godar, A.J., A. Annis, D. Haukos, and J. Prendergast. Do pheasants use spring cover crops? January 2018. Midwest Fish and Wildlife Conference. Milwaukee, Wisconsin, United States.

Godar, A.J., A. Annis, D. Haukos, and J. Prendergast. Can you find pheasants in spring cover crops?. February 2018. Kansas Natural Resources Conference. Manhattan, Kansas, United States.

Godar, A.J., A. Annis, D. Haukos, and J. Prendergast. Cover crops: Altering an altered landscape to benefit wildlife. March 2018. Central Mountains and Plains Section Meeting. Kearney, Nebraska, United States.

Godar, A., C. Griffin, B. Grisham, D. Haukos, B. Ross, C. Boal, C. Hagen, M. Patten, J. Pitman, and D. Greene. Rangewide Lesser Prairie-Chicken Population Persistence with climate change. September 2018. Presented at the International Grouse Symposium. September 2018. Logan, Utah, United States.

Godar, A., A. Annis, D. Haukos, J. and Prendergast. Pheasant habitat selection: Logical or Mysterious. Presented at The Wildlife Society National Conference. October 2018. Cleveland, Ohio, United States.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. For the birds: modifying Kansas using Spring cover crops to manage for pheasants. Presented at the Kansas Natural Resources Conference. January 2019. Manhattan, Kansas, United States.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. Grassland bird response to spring cover crops in an agricultural landscape. Presented at the American Ornithological Society. June 2019. Anchorage, AK, United States.

Godar, A. and D. Haukos. Combining traditional farming with modern science. Presented at The Wildlife Society National Conference. September 2019. Reno, NV, United States.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. Scale dependency: influencing pheasant populations using cover crops. Presented at The Wildlife Society National Conference. October 2019. Reno, NV, United States.

Godar, A, A. Annis, D. Haukos, and J. Prendergast. Adding Diversity to the landscape with spring cover crops. Presented at the Kansas Natural Resources Conference. January 2020. Manhattan, Kansas, United States.

Dissertation

Godar, A. 2020. Ring-necked pheasant population and space use response to landscapes including spring cover crops. Kansas State University

Ring-necked Pheasant Survival, Nest Habitat Use, and Predator Occupancy in Kansas Spring Cover Crops

Investigators
Adela Annis

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Jeff Prendergast
Kansas Department of Wildlife, Parks, and Tourism

Objectives

Determine factors influencing survival of adults, broods, and nests within cover crop and chemical fallow crop treatments within Kansas

Assess nest-site selection of used verses available cover crop and chemical fallow treatments

Measure mesocaarnivore occupancy in different cover crop and chemical fallow crop treatments

Location:
Western and Mid-Central Kansas

Completion
September 2019

Status
Completed

Progress and Results

The ring-necked pheasant (*Phasianus colchicus*) is a popular and economically important upland gamebird in Kansas. Population declines have stakeholders seeking methods to manage populations on agricultural lands. Cover crops planted during the breeding period may provide important resources pheasants require for survival and successful reproduction. I evaluated three cover crop mixes; a custom mix, commercial mix, a wildlife mix, and a chemical fallow control in three counties in western Kansas, during 2017 and 2018 to determine their potential as a management practice for increasing pheasant habitat. I tested the relative effects of spring cover crops on female pheasant survival, nest survival, nest-site selection, and mesocarnivore occupancy. Females pheasants (73) were captured via nightlighting during February – April and fitted with 15-g very-high-frequency radio collars and monitored them by telemetry.

I placed 58 camera traps on field edges and within cover crop treatments from April to September. Vegetation data were collected at nests and random points to assess nest-site selection and weekly random vegetation points were sampled within treatments. I used known fate and nest survival models in the package RMark interface in R to investigate adult and nest survival (R Core Team 2018). Adult breeding season survival was 0.57 (SE < 0.0001, CI = 0.5739 – 0.5740). Percent spring cover crop positively influenced adult survival (AIC_c w_i = 0.450). Nest survival was 0.361 (SE < 0.001, CI = 0.3614 - 0.3614). Daily nest survival followed a pattern of high survival that gradually declined over the breeding season. Resource selection functions suggest female ring-necked pheasants selected vegetation between 5-7 dm at 50% VOR for nest sites (AIC_c w_i = 0.97). Chi-square analyses suggest females selected Conservation Reserve Program (CRP) patches for nest sites more than expected during both years (2017 χ^2_4 = 26.49, P < 0.001; 2018 χ^2_4 = 9.80, P = 0.04). CRP supported 57% of nests and 56% of successful nests relative to other cover types. All three of the monitored nests in cover crops were depredated.

Ring-necked pheasant occupancy from April through August on was greatest on edges (ψ = 0.98, SE = 0.02) and influenced by distance to nearest woody vegetation (AIC_c w_i = 0.98). Occupancy of mesocarnivores was greatest on treatment edges with a constant occupancy of 1.00 (SE = 0.00, AIC_c w_i = 0.75). Brood occupancy was from late-May through August was biologically significant on edges (95% CI, $\psi = 0.20$, SE = 0.11) with occupancy influenced by distance to Conservation Reserve Program (AIC_c $w_i = 0.72$).

Spring cover crops provide cover and foraging resources when the majority of agricultural practices are fallow. Spring cover crops do not provide sufficient vertical cover for nesting until after peak nesting occurs, especially during cooler than average winter and spring conditions such as 2018. However, there are tangible benefits of spring cover crops to other biological periods, such as adult female survival, and brood resources if placement of cover crops is targeted near quality nest habitat. My results indicate wheat is an ecological trap for nesting due to increased predation and destruction during harvest. Providing quality nest structure will reduce females nesting in wheat. Incorporation of spring cover crops is a beneficial wildlife management tool that can increase ring-necked pheasant habitat on the landscape

Products

Professional Presentations

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2017. Kansas ring-necked pheasant habitat use and survival in summer cover crops. Kansas Natural Resource Conference, Wichita, KS.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2017. Survival of ring-necked pheasants in western Kansas spring cover crops. Annual conference of The Wildlife Society, Albuquerque, NM.

Annis, A., D. Haukos, and J. Prendergast. 2017. Mesocarnivore occupancy within Kansas spring cover crops. Kansas Ornithological Society, Junction City, Kansas.

Annis, A. C., A. Godar, D. Haukos, and J. Prendergast. 2018. Effects of spring cover crops on ring-necked pheasant survival and resource selection with notes on mesocarnivore occupancy. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Kearney, Nebraska.

Annis, A. C., A. Godar, D. Haukos, and J. Prendergast. 2018. What drives nest-site selection of Kansas ring-necked pheasants? Kansas Natural Resources Conference, Manhattan, Kansas.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2018. Survival and nest-site selection of ring-necked pheasants in western Kansas spring cover crops. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2019. Are spring cover crops a hot ticket item for chicks? Kansas Natural Resource Conference, Manhattan, Kansas.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2019. Are cover crops a hot ticket item for chicks? Annual Meeting of The Wildlife Society, Reno, Nevada.

Thesis

Annis, A. 2019. Ring-necked pheasant survival, nest habitat use, and predator occupancy in Kansas spring cover crops. Kansas State University.

Dispersal, Reproductive Success, and Habitat Use by Translocated Lesser Prairie-Chickens

Investigator
Liam Berigan

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

Colorado Parks and Wildlife

Cooperators
Kansas Department of Wildlife, Parks, and Tourism:
Kent Fricke
Kraig Schultz

Colorado Parks and Wildlife:
Liza Rossi
Jonathan Reitz

Objectives
Restore long-term persistence and distribution of LEPC within the Sand Sagebrush Ecoregion

Assess the feasibility of translocations as a management tool for restoring LEPC populations

Location
Capture site: Gove, Lane, Ness, and Finney Counties of NW Kansas Release sites: Morton and Baca Counties of SW Kansas and SE Colorado

Completion
August 2020

Status
Completed

Progress and Results
The U.S. Forest Service Cimarron and Comanche National Grasslands in southwestern Kansas and southeastern Colorado were strongholds of the lesser prairie-chicken historic range. However, grazing practices on the grasslands, coupled with several years of intense winters and severe drought, led to their near extirpation by 2013. Since then, increased precipitation and a new management plan were believed to have restored lesser prairie-chicken habitat in these areas. In an attempt to restore and bolster populations in the Sand Sagebrush Ecoregion, state agencies translocated 411 lesser prairie-chickens to the U.S. Forest Service Cimarron and Comanche National Grasslands during 2016-2019. Of these lesser prairie-chickens, 279 were marked with VHF radiotransmitters and 115 were marked with SAT-PTT GPS transmitters to track their survival, movements, habitat use, and nest locations.

We estimated the nest success of lesser prairie-chickens translocated to the National Grasslands using Program MARK and determined which factors were most important in predicting nest success. We found that the number of years that had elapsed since the bird's release was the best predictor of its nesting success in any given year, indicating that a first-year effect may be suppressing the nest success of newly translocated birds. This fits with existing literature on grouse translocations, which state that translocation effects dissipate in years following release. Unfortunately, only 10.3% of translocated birds survived into the second year to take advantage of the increased nest success rate.

We measured visual obstruction and vegetation composition on the National Grasslands and nearby Conservation Reserve Program (CRP) grasslands to quantify the amount of nesting habitat available for released birds. Our objectives were to 1) determine whether extant vegetation on the National Grasslands would be used by lesser prairie-chickens and 2) determine if the implemented management plan had restored nesting habitat for lesser prairie-chickens. In regard to habitat use, we found that all 7 cover types on the Cimarron National Grassland and 2 of 3 cover types on the Comanche National Grassland were avoided in favor of selection for nearby CRP grasslands. Avoided cover types included areas of sand sagebrush prairie, which formerly hosted dozens of lesser prairie-chicken leks and seems to indicate a perceived deficiency in these cover types. Nesting was also rare on the National Grasslands, with a low rate of nesting in these areas (Cimarron: 33.3% of nests; Comanche: 26.9% of nests) compared to nearby CRP (KS CRP: 54.4% of nests; CO CRP: 71.2% of nests) despite similar area on the landscape (Cimarron: 43,416 ha; KS CRP: 31,218 ha;

Comanche: 22,020 ha; CO CRP: 31,218 ha). This low rate of nesting can be explained by a low occurrence of nesting habitat in these cover types, as only a small portion of observations on the National Grasslands recorded high value grass species (Cimarron: 1.3%-17.7% of observations within each cover type; Comanche: 1.5%-1.7%) or met visual obstruction guidelines (Cimarron: 5.3%-21.8% of observations within each cover type; Comanche: 1.5%-3.0%). The current lack of habitat on the National Grasslands is problematic, as lesser prairie-chickens depend on >63% of the landscape being grassland to reach a viable population size. Neither of the counties in which translocated lesser prairie-chickens were released (Morton, KS: 17.7% CRP; Baca, CO: 16.6% CRP) can reach this statistic with CRP grassland alone. Efforts to restore lesser prairie-chicken nesting habitat (e.g., vegetation composition and structure) on the National Grasslands are therefore likely vital to future occupancy by lesser prairie-chicken populations.

Finally, our analysis of lesser prairie-chicken movement after release showed extensive dispersal away from the release site, with 99% of birds undergoing a dispersal movement >5 km from the release site. We conducted a behavioral change point analysis on translocated birds as they dispersed to determine where they settled down and how long their dispersal lasted. Birds moved an average of 144 km during their 1-2 month dispersal movement following release. Despite the presence of leks and habitat at the release sites, 69% of released birds settled >5 km from their release site after their movements. These results indicate that dispersal is an innate response to translocation, and release site placement will not be sufficient to minimize the dispersal movement.

Products

Professional Presentation

Berigan, L., D. Haukos, D. Sullins, and K. Fricke. 2018. Lesser prairie-chicken translocation: minimizing dispersal to ensure translocation success. Kansas Natural Resources Conference, Manhattan, Kansas.

Berigan, L., D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2018. Translocation of lesser prairie-chickens: does lek presence limit dispersal? Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Berigan, L., D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2018. Role of natal habitat preference induction in prairie-grouse translocation success. International Grouse Symposium, Logan, Utah.

Berigan, L. C. Aulicky, and D.A. Haukos. 2019. Avoidance of traditional habitat types by translocated lesser prairie-chickens. Annual Conference of oSTEM, Houston, Texas.

Berigan, L., C. Aulicky, D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. Overcoming post-release dispersal to successfully translocate lesser prairie-chickens. Annual Meeting of The Wildlife Society, Reno, Nevada.

Berigan, L., C. Aulicky, D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. Landscape composition explains high rates of dispersal in translocated lesser prairie-chickens. Annual Meeting of the American Ornithological Society, Anchorage, Alaska.

Berigan, L., C. Aulicky, D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. Conservation implications of lesser prairie-chicken habitat selection on the Cimarron National Grasslands. Kansas Natural Resource Conference, Manhattan, Kansas.

Berigan, L., C. Aulicky, E. Teige, D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. Dispersal, habitat use, and eventual settlement of translocated lesser prairie-chickens. 33rd Biennial Meeting of the Prairie Grouse Technical Council, Bartlesville, Oklahoma.

Thesis

Berigan, L. 2019. Dispersal, reproductive success, and habitat use by translocated lesser prairie-chickens. Kansas State University.

Lesser Prairie-Chicken Response to Patch-Burn Grazing

Investigators
Chris Gulick

Project Supervisor
Dr. David Haukos

Funding
WAFWA, NRCS LPCI

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

Objectives

Measure effects of cattle space use intensity on vegetative structure and composition within multiple grazing systems

Assess effects of cattle space use and subsequent vegetation response on lesser prairie-chicken space-use and home ranges during key life stages

Investigate characteristics of female lesser prairie-chicken dispersal routes to determine what features affect dispersal at the landscape scale

Status
Completed

Progress and Results

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is a grassland obligate whose decline has been associated with anthropogenic fragmentation and land use change. Historical habitat drivers (i.e., natural fires and free roaming grazers) created vegetation heterogeneity across the species' range, providing resources for each of their life stages. Currently, most of the lesser prairie-chicken's eastern range consists of rangelands managed with confined continuous livestock grazing without fire as a disturbance. Lesser prairie-chicken habitat is also fragmented at larger scales, limiting dispersals and threatening genetic connectivity. A need exists to determine optimum landscape management that provides seasonal habitat at small scales, and allows for dispersal and metapopulation connectivity at large scales. My first objective was to determine the relationship between cattle distributions and lesser prairie-chicken habitat among patch-burn and rotationally grazed rangelands. My second objective was to determine differences in seasonal selection by female lesser prairie-chickens, relative to fine-scale cattle distributions on these two rangelands. My final objective was to determine movement patterns and resource selection of lesser prairie-chickens during dispersal. I tracked cattle (Bos taurus) and lesser prairie-chickens via satellite telemetry in patch-burn and rotationally grazed pastures to model their space use at fine scales. I estimated vegetation change along the resulting gradient of cattle distributions. I determined seasonal selection of lesser prairie-chickens relative to cattle distributions within each management treatment. I tracked GPS-tagged lesser prairie-chickens in the Mixed-Grass Prairie and Short-Grass Prairie/CRP Mosaic ecoregions and delineated dispersals. I used step selection analysis to determine differences in resource selection along each dispersal route. Year-of-fire patches drove cattle site-selection on patch-burn grazed rangelands, which created greater vegetation heterogeneity within pastures. Lesser prairie-chickens selected for different cattle densities during different life stages. On rotationally grazed pastures, lesser prairie-chickens selected for moderate cattle densities during breeding, moderate-to-high densities during post-breeding, and selected for the greatest fine-scale cattle densities during nonbreeding. Within the patch-burn grazed treatment, females avoided moderate cattle densities during breeding and post-breeding, and selected for the lowest cattle densities during nonbreeding. Patch-burn grazed pastures were more heterogeneous and contained greater forb abundance in areas with low cattle densities, which could create better brooding and post-breeding habitat near nesting habitat. In the Mixed-Grass Prairie Ecoregion, lesser prairie-chickens selected for lower tree densities and increased grassland cover at the landscape scale during dispersal. On the Short-Grass Prairie Ecoregion, lesser prairie-chickens avoided areas containing electrical transmission lines. During dispersal, young females traveled further and took longer

Location:
Throughout southern, western, and central Kansas

Completion
May 2019

movement steps. Successful dispersals were also shorter distances than failed dispersals. Drivers of dispersal may be innate and could occur regardless of annual variation in local habitat; however, there is likely a fitness cost associated with increased dispersal length. Land-use alterations influenced habitat within home ranges and affected population connectivity by altering dispersals. Managers can benefit lesser prairie-chickens by altering grazing management to mimic historical drivers of habitat. Population connectivity could be increased by limiting electrical transmission line establishment along corridors in the Short-Grass Prairie Ecoregion and by removing trees and increasing grassland within the Mixed Grass-Prairie Ecoregion.

Products

Professional Presentations

Gulick, C., J. Lautenbach, and D.A. Haukos. 2017. Space use by cattle, and its cascading effects on lesser prairie-chicken habitat selection. Annual conference of The Wildlife Society, Albuquerque, NM.

Gulick, C., D. Haukos, and J. Lautenbach. 2018. Effect of grazing management systems on space use by cattle and lesser prairie-chickens. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Gulick, C., and D. Haukos. 2018. Spatial patterns of lesser prairie-chickens in response to different disturbance regimes. International Grouse Symposium, Logan, Utah.

Gulick, C., and D.A. Haukos. 2018. Factors affecting habitat availability for lesser prairie-chickens across different land management regimes. Kansas Natural Resources Conference, Manhattan, Kansas.

Gulick, C., and D.A. Haukos. 2019. Influence of grassland management systems on fine-scale distribution of lesser prairie-chickens and their habitat. Annual Meeting of the Society for Range Management, Minneapolis, Minnesota.

Gulick, C., and D.A. Haukos. 2019. Influence of landscape features on female lesser prairie-chicken dispersal routes. Kansas Natural Resource Conference, Manhattan, Kansas.

Gulick, C., J. Lautenbach, and D.A. Haukos. 2017. Space use by cattle, and its cascading effects on lesser prairie-chicken habitat selection. Annual conference of The Wildlife Society, Albuquerque, NM.

Gulick, C., D. Haukos, and J. Lautenbach. 2018. Effect of grazing management systems on space use by cattle and lesser prairie-chickens. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Thesis

Gulick, C. 2019. Spatial ecology and resource selection by female lesser prairie-chickens within their home ranges and during dispersal. Kansas State University.

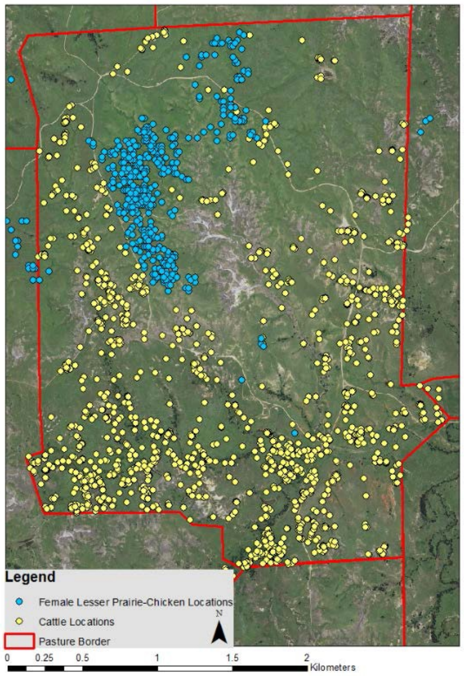


Figure 1: Cattle and female lesser prairie-chicken locations in a patch-burn grazed pasture

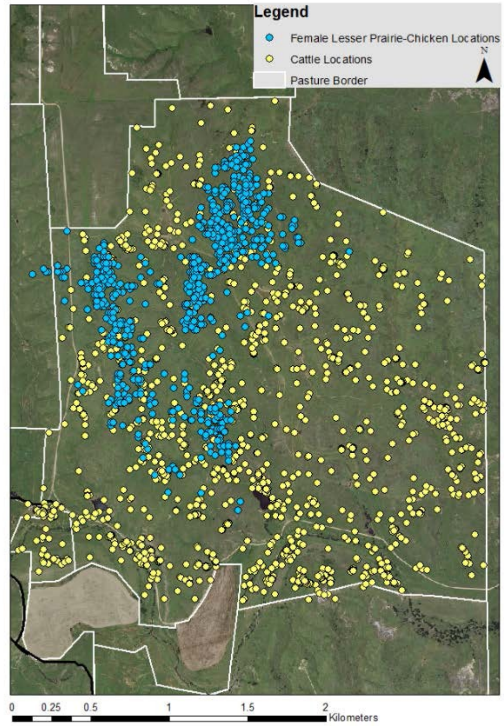


Figure 2: Cattle and female lesser prairie-chicken locations in a rotationally grazed pasture

Woody Species Mortality Following Megafire in the Mixed-Grass Prairie

Investigators
Matthias Sirch
Nick Parker
Dan Sullins

Project Supervisor
Dr. David Haukos

Funding
NRCS

Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

U.S. Fish and Wildlife Service

Objectives

Location:
Clark County Kansas

Completion:
September 2020

Status
Completed

Progress and Results

The lack of fire in contemporary grasslands has contributed to the invasion of woody plants that resist mortality to fire upon reaching a certain size. Responses to fire by woody plants can vary by species, timing of fire, and fire intensity. Knowledge of intense megafires on mortality of trees in grasslands is limited, and examination of tree encroachment dynamics will help us better manage habitat for grassland obligate species like the lesser prairie-chicken (*Tympanuchus pallidicinctus* Ridgway) that avoid tall features on the landscape. We evaluated the effect of a 2017 megafire (>40,000 ha) on tree mortality within and around lesser prairie-chicken habitat in the mixed-grass prairie of Clark County, Kansas, USA. We used remote sensing techniques to estimate burn severity and tree canopy change. We also conducted ground surveys to assess the accuracy of postfire tree canopy estimates, measure additional aspects of woody and herbaceous species postfire condition, and examine the influence of herbicide and wildfire interaction on nonnative saltcedar (*Tamarix ramosissima* Ledeb.). Our results suggest that the severity of the megafire was low relative to forest fires with higher fuel loads, but killed 25 ± 39% (mean ± SD) of trees, including 100% of eastern redcedar (*Juniperus virginiana* L.). Another 53 ± 43% of trees were top-killed and resprouted. In plots where trees were detected before the fire, 99% had tall woody features >1 m a year and a half after the fire. This indicates that trees were damaged, but habitat for grassland obligate species may not have increased because of the fire. We conclude that further postfire management is required to limit woody encroachment and promote habitat for grassland obligate species.

Products

Professional Presentations

Sirch, M., D.S. Sullins, D.A. Haukos, and J.D. Kraft. 2018. Lesser prairie-chicken response to intensive wildfire: one year post wildfire. Annual Meeting of the Kansas Ornithological Society, Lawrence, Kansas.

Sirch, M.S., D.S. Sullins, D.A. Haukos, and J. Kraft. 2019. Influence of burn severity on tree mortality and lesser prairie-chicken habitat in the mixed-grass prairie. Kansas Natural Resource Conference, Manhattan, Kansas.

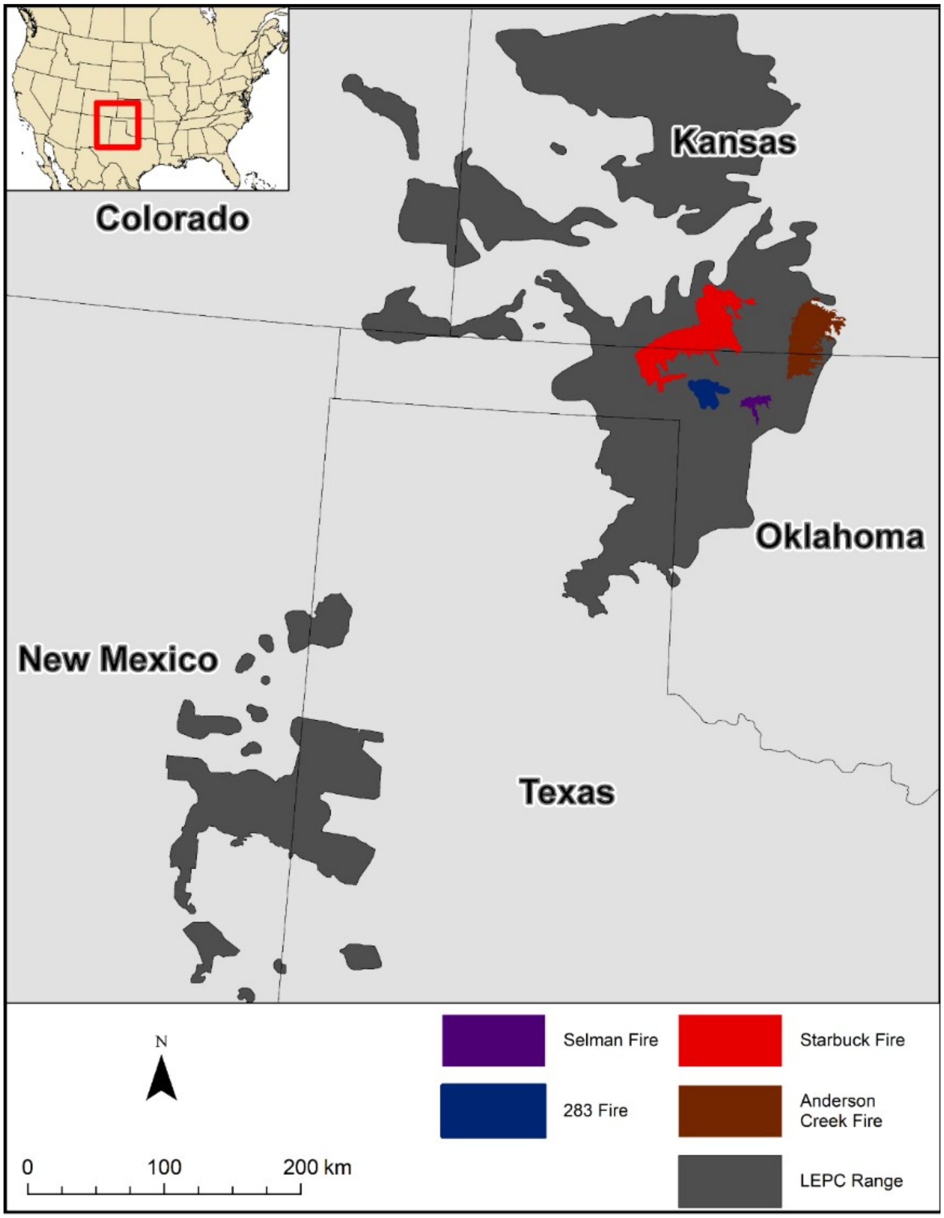


Figure 1. Notable fire perimeters in the Mixed Grass Prairie Ecoregion of Kansas and Oklahoma in 2016 (Anderson Creek) and 2017 (Starbuck, 283, and Selman; McDonald et al. 2014). The Proposed research efforts will focus on areas impacted by the Starbuck fire which burned from 7 March – 12 March 2017. The presumed range of lesser prairie-chickens is also shown (Hagen and Giesen 2005).

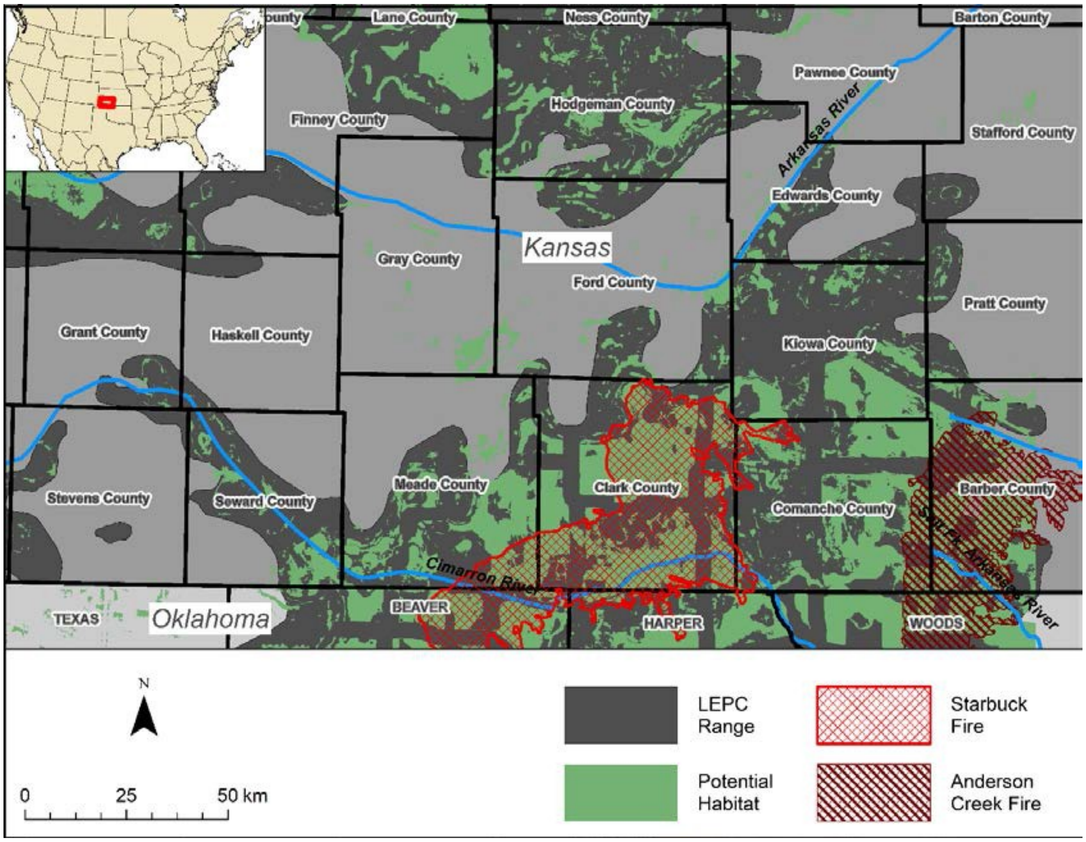


Figure 2. Perimeter of the Starbuck and Anderson Creek fire in the Mixed Grass Prairie Ecoregion of Kansas, estimated potential habitat from Sullins (2017), and the presumed range of lesser prairie-chicken from Hagen and Giesen (2005). Post fire research will focus on the Clark County portion of the Starbuck fire.

Figure 3. Photo points collected in Clark County, Kansas, on the Gardiner ranch in April 2017 (a month after the fire) and in the following October 2017. Photos on the left are from the same location and facing the same direction as photos on the right.

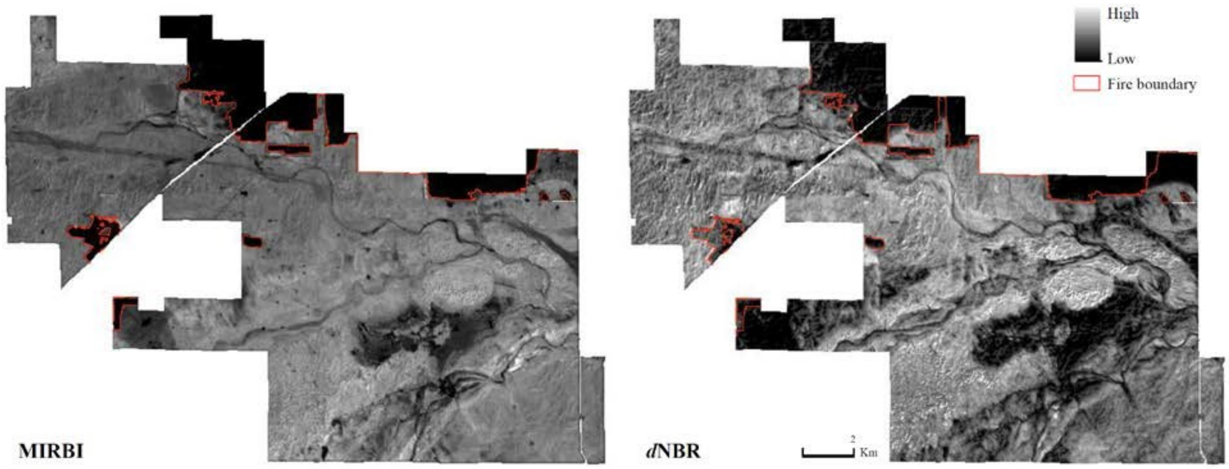


Figure 4. The Mid Infrared Burn Index (left) from March 8, 2017, and Normalized Burn Ratio (right) from March 1 and 8, 2017, calculated using Landsat 8 imagery downloaded from the USGS Earth Explorer website.

How Spatial Heterogeneity Surrounding Leks Drives Lek Attendance by Lesser Prairie-Chickens

Investigators
Jackie Gehrt
Dr. Dan Sullins

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

USDA Natural Resources Conservation Service, Lesser Prairie-Chicken Initiative

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

USDA Natural Resources Conservation Service, Lesser Prairie-Chicken Initiative

Objectives

Examine vegetation characteristics at two spatial scales from the lek, the micro-habitat 100-m and lek landscape (5-km) scales, to assess which vegetation characteristics drive lek attendance.

Quantify the presence and juxtaposition of nesting and brooding habitat across the northern portion of the Lesser Prairie-chicken range.

Assess the impact that potential brooding and nesting habitat surrounding leks have on

Status
Completed

Progress and Results

Contemporary lesser prairie-chicken populations have been on the decline since the mid-1980s. In response to these declines, the lesser prairie-chicken was briefly listed as threatened under the Endangered Species Act and numerous conservation efforts were launched to restore population abundance. Despite these measures, status of local populations remain uncertain. To better understand the cause of such dramatic population changes, perhaps we need to re-examine the understanding of reproductive habitat requirements to sustain a lesser prairie-chicken population. There have been many papers published that report the vegetative structure and location of successful nests as well as successful brood-rearing areas, but there is a gap in the literature on describing characteristics of successful leks in context of requirements to support the entire reproductive ecological state. To fill this knowledge gap while also addressing the issue of declining lesser prairie-chicken populations, we need to define drivers of lesser prairie-chicken lek site selection within the context of other reproductive requirements (i.e., nesting and brooding) that contributes to recruitment. Based on the literature, we quantified nesting habitat as points that have bare ground between 0-20% cover and average visual obstruction reading (VOR) at 75% coverage between 1.5-3.5 dm tall. Brooding habitat was defined as points that have 50% cover VOR readings between 2-5 dm, and forb cover within one standard deviation of the average between 7%-37%.

In effort to assess drivers of lek attendance, we found a strong correlation between lek attendance and VOR readings at the 5-km scale. We found that leks experienced highest attendance by both sexes when VOR readings at 75% coverage were between 1-2 dm which also falls within the desired VOR for suitable nesting habitat. When quantifying nesting and brooding habitat surrounding leks, we discovered that within all sites, 29.64% of locations within 5 km of a lek were available quality nesting habitat and 24.56% were available brooding habitat. Gove County in northwest Kansas had the most available nesting sites at 34.74% with Red Hills having the second most at 33.63%. Red Hills had the most available brooding sites at 32.98%. When assessing how these results affect lek attendance, we found that leks within the Red Hills study site experienced the most attendance with an average daily attendance of 12 birds. This supports the claim that birds are attend leks because of surrounding vegetation, specifically that which supports the nesting and brooding stages of reproductive ecology.

lek attendance, especially by males, as described in the hotspot hypothesis

Location:
Throughout Kansas and eastern Colorado

Completion
August 2018

Products

Publications

Gehrt, J.M., D.S. Sullins, and D.A. Haukos. 2020. Looking at the bigger picture: how abundance of nesting and brooding habitat influences lek-site selection by lesser prairie-chickens. American Midland Naturalist 183:52-77.

Professional Presentations

Gehrt, J.A., D.S. Sullins, and D.A. Haukos. 2018. Looking at the bigger picture: how availability of nesting and brooding habitat influences lek-site selection by lesser prairie-chickens. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Fawn Survival and Bed-site Selection of Mule Deer and White-tailed Deer in Western Kansas

Investigators
Mitchell Kern

Project Supervisor
Dr. Andrew Ricketts
Dr. David Haukos

Cooperators
Levi Jaster, KDWPT
Kansas Bowhunters Association
Mule Deer Foundation

Funding
Kansas Department of Wildlife, Parks, and Tourism

Kansas State University

Objectives

Establish survival rates, bed-site selection, and cause-specific mortalities of fawns in white-tailed and mule deer.

Location
Lenora, Kansas
Scott City, Kansas

Completion
August 2020

Status
Completed

Progress and Results:

Mule deer (Odocoileus hemionus) and white-tailed deer (O. virginianus) are common sympatric deer species in the Great Plains and western United States that have exhibited divergent population trends temporally and spatially. Mule deer populations are declining and contracting to the west while white-tailed deer populations are expanding. Species-specific differences in fawn recruitment is one proposed explanation for these observed trends, although the underlying causes remain unknown. To determine if landscape or other habitat changes are affecting the two deer species in different ways, we studied bed-site selection of mule deer and white-tailed deer fawns in western Kansas at microhabitat and landscape scales. We also assessed how fawn intrinsic factors, doe maternal condition, and bed-site habitat characteristics influenced survival of mule deer and white-tailed deer fawns. In February 2018 and 2019, we captured 120 adult does (60 mule deer, 60 white-tailed deer) using helicopter net-gun techniques and deployed 120 vaginal implant transmitters (VITs) synchronized with GPS collars deployed on does. Upon VIT expulsion, a birthing event notification was triggered, which narrowed search efforts for fawns. We captured and radio-collared 100 fawns (53 mule deer, 47 white-tailed deer) during 12 May- 23 June in 2018 and 2019. Fawns were visually located daily using ground-based radio-telemetry and we assessed bed-site selection, cause-specific mortality, and survival rates until fawns reached 10 weeks of age. Overall, fawn survival was low (0.32 ± 0.06) and did not differ between species (mule deer: 0.25 ± 0.08; white-tailed deer: 0.41 ± 0.08). Adult chest girth was positively associated with 70-day white-tailed deer fawn survival, longer fawn body length increased 7-day white-tailed deer fawn survival, and fawn sex best predicted 7-day mule deer fawn survival. Model uncertainty indicated fawn intrinsic factors and maternal conditions may be poor predictors of fawn survival. White-tailed deer survival was lower for fawns with more woodland in their home ranges and mule deer fawn survival exhibited a positive quadratic relationship with the amount of grassland within the home range. Mule deer fawn survival increased with the amount of edge and disaggregation within a home range, but landscape configuration did not explain survival of white-tailed deer fawns. We analyzed microhabitat characteristics at 2689 fawn bed-sites and 2689 paired random points. Bed-site selection differed by species; however, vegetative structure was the most influential microhabitat characteristic for both deer species. Mule deer fawns selected for 75% visual obstruction 8.4 dm tall, less grass cover, more succulent cover, and 56% shrub cover at bed-sites. White-tailed deer fawns selected for 25% visual obstruction 9.2 dm tall, 71% forest canopy cover, and less grass cover and bare-ground at bed-sites. The two species also showed differences in landscape selection. The odds of a white-tailed deer fawn bed-site increased 5.88 times in woodlands, whereas odds of a mule deer fawn bed-site increased 2.85 times in CRP. Our research suggests white-tailed deer fawns and mule deer fawns selected different characteristics for bed-sites at the microhabitat and landscape scale. Bed-site selection likely influences fawn survival, which could affect fawn recruitment. Managers should focus on maintaining heterogeneous landscapes composed mainly of native and Conservation Reserve Program grasslands with abundant cover to enhance mule deer fawn survival and bolster adult populations.

Products

Professional Presentations

Kern, M., A. Ricketts, D. Haukos,and L. Jasper. 2018. Survival and cause-specific mortality of white-tailed and mule deer fawns in western Kansas. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Kern, M., M. Kinlan, T. Karish, A. Ricketts, D. Haukos, and L. Jaster. 2019. Neonate survival rates and bed-site selection of two sympatric deer species in western Kansas. Annual Meeting of The Wildlife Society, Reno, Nevada.

Kern, M., M. Kinlan, T. Karish, A. Ricketts, D. Haukos, and Levi Jaster. 2019. Neonate survival rates and bed-site selection of two sympatric deer species in western Kansas. Kansas Natural Resource Conference, Manhattan, Kansas.

Thesis

Kern, M. 2019. Fawn survival and bed-site selection of mule deer and white-tailed deer in western Kansas. Kansas State University.

Effects of large-scale past and future wetland loss on network connectivity of the Rainwater Basin, Nebraska

Investigators
Dr. Bram Verheijen,

Project Supervisor
Dr. David Haukos

Funding
USFWS,
Great Plains Landscape Conservation Cooperative,
NSF Macrosystems

Cooperators
Andy Bishop
Dr. Dana Varner
Rainwater Basin Joint Venture, USFWS

Objectives

Compare network characteristics between the historical network and currently remaining wetlands in the Rainwater Basin to assess the effects of large-scale loss of wetlands on network connectivity at a range of maximum dispersal distances

Quantify the role of inundation probability and hydroperiod of remaining wetlands on network connectivity

Compare the relative importance of each remaining wetland to its risk of disappearing from the landscape due to sediment accumulation

Status
Completed

Progress and Results

The Rainwater Basin in Nebraska supports a complex network of spatially-isolated shallow wetlands that harbors diverse floral and faunal communities. Since European settlement, many wetlands have been lost to the network due to drainage, deliberate filling, land-use change, and increased sedimentation rates, thereby reducing the total available number and area of extant wetlands, and increasing the distance among remaining wetlands. Moreover, high rates of sediment accumulation due to agricultural practices have decreased the inundation probability and hydroperiod of many of the remaining wetlands. Many species of plants, insects, and amphibians rely on ponded wetlands for reproduction and survival, but have limited dispersal capabilities. As a result, populations may become isolated and face increased localized extinction rates if distances among ponded wetlands become too large. Unfortunately, it remains unclear how large-scale wetland losses and reductions in inundation of playa wetlands have affected connectivity and structure of the Rainwater Basin. Moreover, how potential future wetland losses will affect the Rainwater Basin network could depend on the characteristics and placement of remaining wetlands within the network.

We found that the number of functioning wetlands has decreased with more than 90% over the past century and that losses were relatively evenly distributed throughout the network. Wetland losses had large consequences for network connectivity by increasing the dispersal capabilities necessary to travel throughout the whole network from 3.5 to 10.0 km. Furthermore, the lack of ponding of several key wetlands during dry years further limits long-distance dispersal through the network for species with low dispersal capabilities. Last, we found that several wetlands with a high risk of disappearing from the landscape due to sediment accumulation were important in maintaining network connectivity for most dispersal distances.

When assessing effects of potential future wetland losses on the connectivity and structure of the Rainwater Basin, we found that a 10% loss of highly-ranked wetlands substantially decreased connectivity for species with dispersal capabilities <5.5 km, while a 40–50% loss reduced connectivity for all tested dispersal distances (0.5–12.0 km). When large proportions of highly-ranked wetlands were lost, the eastern and western halves of the Rainwater Basin network were no longer connected for any dispersal distance. Loss of low-ranked wetlands had minimal effects on network connectivity, until at least the lowest-ranked 50% were removed (Figure 1).

Compare the current Rainwater Basin network to future wetland loss scenarios to assess minimum, mean, and maximum effects of losses on network connectivity for a range of wildlife taxa.

Location
The Rainwater Basin Region, southcentral Nebraska.

Completion
July 2019

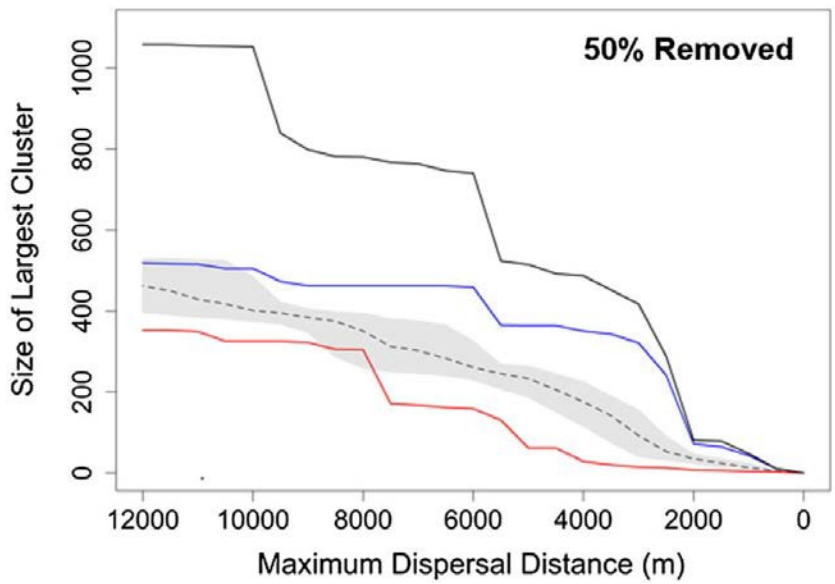


Figure 1. Maximum cluster size of the Rainwater Basin, southcentral Nebraska, USA, for maximum dispersal distances of 0–12,000 m compared among the current extent of the Rainwater Basin network (black line) and scenarios where the highest ranked (red line), lowest ranked (blue line) or a random subset (dashed gray line; 95% confidence interval in gray shading) of 50% of playa wetlands has been removed from the network

Our work suggests that conservation efforts should focus on maintaining or increasing the connectivity of the Rainwater Basin network, and should prioritize the protection of key wetlands which persistence is currently at risk. Many highly-ranked playa wetlands in the Rainwater Basin are currently unprotected and might disappear from the landscape. Protecting wetlands that are key in maintaining connectivity especially benefits species with limited dispersal capabilities (<5.5 km) for which consequences of future habitat losses might be worst.

Products

Publications

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. 2018. Effects of large-scale wetland loss on network connectivity of the Rainwater Basin, Nebraska. Landscape Ecology 33: 1939–1951.

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. 2019. Future losses of playa wetlands decrease network structure and connectivity of the Rainwater Basin, Nebraska. Landscape Ecology: 35: 453–467.

Professional Presentations

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. January 2018. Effects of large-scale wetland loss on network connectivity of the Rainwater Basin, Nebraska. The 78th Midwest Fish and Wildlife Conference. Milwaukee, Wisconsin.

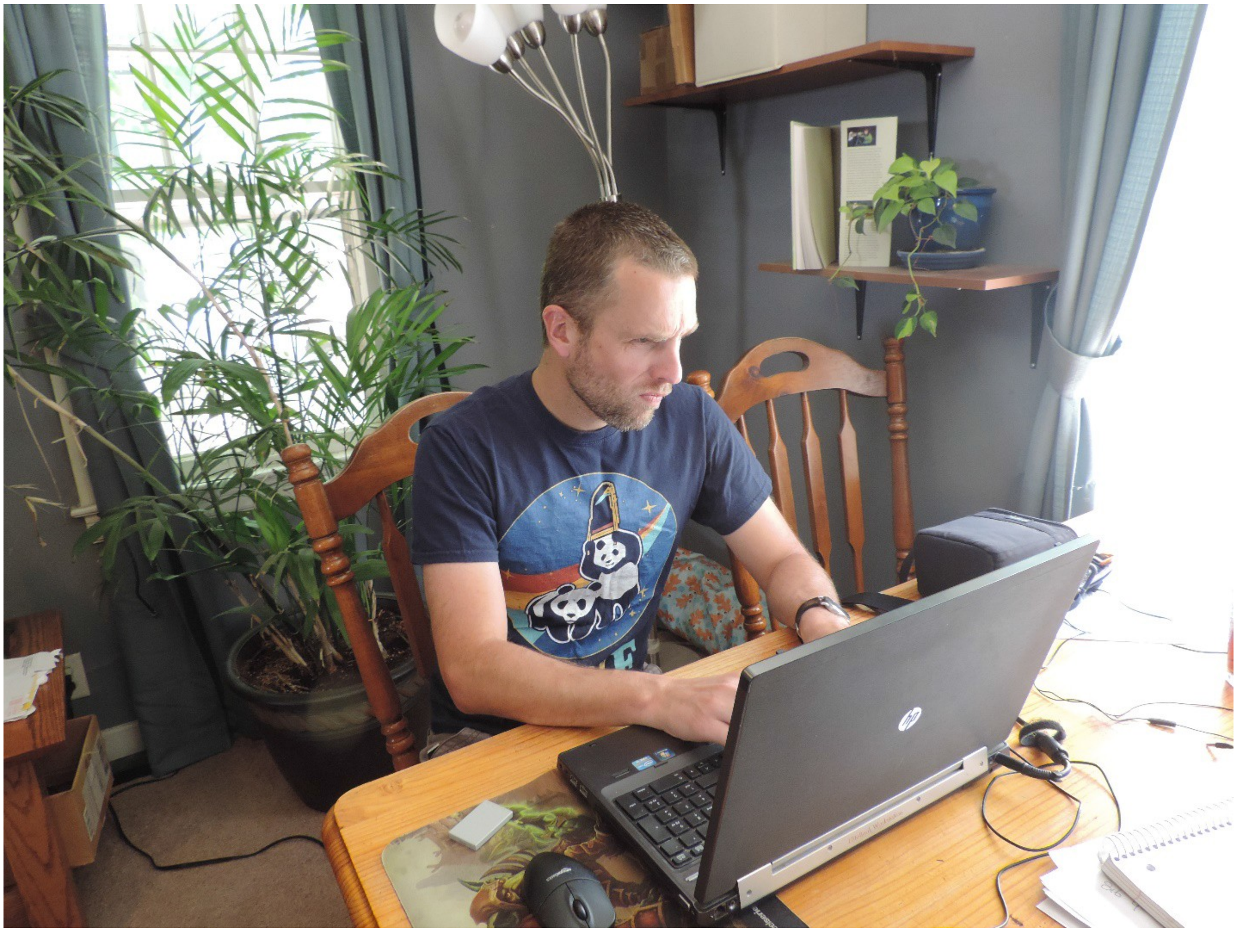
Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. February 2018. Effects of large-scale wetland loss on network connectivity of the Rainwater Basin, Nebraska. The 11th Kansas Natural Resources Conference. Manhattan, Kansas.

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. March 2018. Effects of large-scale wetland loss on network connectivity of the Rainwater Basin, Nebraska. The Annual Meeting of the Central Mountains and Plains Section of the Wildlife Society. Kearney, Nebraska.

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. October 2018. Effects of inundation probability and sediment accumulation on the connectivity and structure of the Rainwater Basin, Nebraska. The 25th Annual Conference of the Wildlife Society. Cleveland, Ohio.

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. January 2019. Wetland functionality and continued loss negatively affect network connectivity and structure of the Rainwater Basin, Nebraska. The 12th Kansas Natural Resources Conference. Manhattan, Kansas.

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. November 2019. Effects of past and potential future wetland losses on network connectivity of the Rainwater Basin, Nebraska. Invited speaker at the Ecology and Evolutionary Biology Seminar Series at Kansas State University. Manhattan, Kansas.



Landscape Patterns Contributing to Lek Establishment and Morphometrics of Attending Lesser Prairie-Chickens

Investigators
Carly Aulicky

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Kansas Department of Wildlife, Parks, and Tourism
Colorado Parks and Wildlife
Dr. David Haukos
Dr. Blake Grisham
Dr. Clint Boal
Mike Patten
Dr. Christian Hagen
Jim Pitman
Matthew Bain
Dr. Dan Sullins
Dr. Samantha Robinson
Jonathan Lautenbach
Joseph Lautenbach
John Kraft
Liam Berigan
Elisabeth Teige
Reid Plumb

Objectives

Assess morphological patterns across the lesser prairie-chicken range, and determine the influence of

Status
Completed

Progress and Results

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is a lek breeding species. As with other lek breeding species, lesser prairie-chicken habitat use can be characterized by differences in paternal care. Male lesser prairie-chickens leks in areas of short vegetation while females prioritize vegetation structure with cover for nests and broods. As nonmigratory grassland obligates, despite differences in habitat utilization, both lesser prairie-chicken sexes spend their annual cycle closely associated with lek locations. Current lesser prairie-chicken management relies on lek counts to estimate population size and conservation strategies assume leks form according to the hotspot hypothesis in areas of female home range overlap.

The density of leks on the landscape is dynamic, changing between breeding seasons and even within a breeding season. Short grass suitable for lek formation is also not limiting, raising questions about how males select where to form leks and what determines if a lek persists into subsequent breeding season. As lek density provides the best estimation of prairie-grouse populations, understanding mechanisms of lek formation a conservation issue.

The need to understand lesser prairie-chicken lek dynamics is exasperated by the conversion of native grasslands to row-crop agriculture and declining habitat quality. Lesser prairie-chickens require 486-20,234 ha of grassland, with a both short vegetation structure for male lek displays and sufficient vegetation height and visual obstruction for nesting and brooding to complete. In addition to understanding how lesser prairie-chicken breeding constraints determine their use of available grasslands, questions regarding changes to physiological attributes across the lesser prairie-chicken range are needed to supplement investigations of behavior.

The lesser prairie-chicken range is comprised of harsh environments, where precipitation strongly influences availability of resources and is a determinant of lesser prairie-chicken population density and occupied range, which boom-bust in response to weather. The contemporary lesser prairie-chicken range is divided among four ecoregions, the Short-Grass Prairie/CRP Mosaic, Sand Sagebrush Prairie, Mixed-Grass Prairie, and Sand Shinnery Oak Prairie across Colorado, Oklahoma, Texas, New Mexico, and Kansas. Across these four ecoregions, runs a ~40 cm gradient with average annual precipitation running from east (70 cm) to west (43 cm) and growing season averaging from 220 in the southern and 160 days in the northern portions of the range. The High Plains have intensive droughts every 5-10 years, which drives boom-bust pattern in lesser prairie-chicken population demography and large-scale droughts occur almost every 20 years.

Lesser prairie-chickens of each ecoregion may adapt and react differently to weather and resource stress. Because the lesser prairie-chicken is a boom-bust species largely affected by precipitation, the number of surviving individuals and past periods of drought may strongly influence current morphological phenotype across the range. Furthermore, morphometric characteristics can reflect available resources (i.e., habitat quality) during periods of growth, and patterns in morphometric traits may reflect morphological phenotypes that are better suited to times of food stress.

To address the questions about lesser prairie-chicken lek dynamics and morphometrics, my research drew upon data from across the lesser prairie-chicken range from a variety of lesser prairie-chicken projects. Researchers trapped lesser prairie-chickens on leks environmental and landscape factors on variation of morphological traits

Test spatial hypotheses underlying mechanisms for the formation of leks using lesser prairie-chicken data

Identify factors that determine the persistence of a lek into a subsequent breeding season

Assess the formation and persistence of lek at translocation release sites and compare to dynamics of leks for non-translocated males

Location: Kansas, Colorado, New Mexico, Texas, and Oklahoma

Completion: August 2020

using funnel traps, drop nets, and rocket nets during spring 1986-2019. I used the entirety of the study period for my range-wide morphometric analyses, which comprised a data set of 555 in Short Grass, 1195 Mixed Grass, 88 Sand Sagebrush, and 641 Sand Shinnery Oak records of birds measured in each ecoregion. I employed lek vegetation measurements and satellite telemetry data from females (n=72) captured in the Short Grass and Mixed Grass prairie of Kansas from 2013-2019 in my analyses regarding lek formation and persistence.

My morphometric analyses focused on lesser prairie-chicken morphometrics commonly collected across the range, which range include mass, wing lengths, pinnae lengths, tail lengths, and tarsus lengths. Additionally, I used body mass as a proxy for energy reserves and estimated fat and protein composition based on the mathematical relationship between bird mass and fat and protein composition for lesser prairie-chicken determined by Haukos et al. (1989). I determined grams of fat and protein for 969 adult male, 648 juvenile male, 243 adult female, and 477 juvenile records. I incorporated the Palmer Drought Severity Index (PDSI) to explore the relationship between weather events and lesser prairie-chicken morphology.

I tested the hotspot hypothesis and lek persistence using 53 lek locations across three Kansas field sites and 165 estimated female lesser prairie-chicken home ranges. I examined shifts in female space use from GPS telemetry point locations with an optimized hotspot analysis by study year as a test of the hotspot hypothesis I tested female density, surrounding nesting and brooding habitat, and changes to vegetation at lek sites to determine what factors influence the persistence of a lek from one breeding season to the next.

My results indicate that leks form in locations with high overlap of female home ranges, consistent with the hotspot hypothesis. Female satellite locations in the year prior influence both lek stability and formation in the subsequent breeding season (Fig 1). Where hen movements are concentrated prior to a breeding season are areas where new leks form and, in areas that have decreasing space use, leks either shrink or disappear.

Female space use also determines lek persistence at broad scales. Within 1-5km of a lek, persistence is determined by both the female space use from the previous year and the percent of surrounding grassland surrounding the lek. The number of female satellite locations increases with the percent of grassland around leks, and together percent grassland and female utilization drives stability or increased numbers in male counts. This continues at broader scales (10km), where surrounding landcover is the greatest determinant of lek persistence.

At a small scale, the number of neighboring leks within a 1km buffer is also a determining factor in lek persistence. At the level of individual lek, visual obstruction is the biggest determinant of persistence up to 40m from the lek center. The percent of horizontal grass cover up to 40m from lek center has a positive relationship with observed male max counts.

My work illustrates that lesser prairie-chicken lek dynamics are largely determined by hen movements overtime. New leks and increased maximum male counts follow shifts in female movements from the previous year, and leks that shrink or disappear do so with the corresponding decrease in female space use. Female movements are determined by the availability of grassland and the surrounding percentage of grassland landcover has a positive interaction of leks with percent grassland at all scales (Fig 2). At the lek scale, visual obstruction is the greatest determinant of male numbers from year to year.

The relationship between lek formation and female space has management implications. Since lek dynamics are driven by female lesser prairie-chickens, increasing grassland vegetation structure suitable to female nesting is more important to lek longevity and the formation of new leks than trying to maintain existing lek vegetation. Managing for short vegetation suitable for lek formation may assisting in keeping an active lek in the same area, but it cannot provide persisting lesser prairie-chicken leks without nesting habitat and female utilization in the surrounding 2-5km. This is also evident in the substantial number of lesser prairie-chickens leks in crops where the vegetation is sufficiently short and there are sufficient female locations. The positive interaction of leks with percent grassland at all scales (1-10km) despite whether or not a lek is placed in grassland habitat or cropland, is likely a larger reflection of female habitat needs.

A second important consideration is that these findings indicate that female lesser prairie-chickens are the dispersing sex, which suggests that efforts to connect populations of lesser prairie-chickens should concentrate on facilitating the movements of hens.

My research on range wide patterns in lesser prairie-chicken morphometrics indicates that ecoregion specific and age and sex morphometric differences are tied to the Great Plains drought cycle, which is largely driven by temperature and precipitation over the summer months. Previous summer precipitation has a lag effect on morphometric traits throughout all four ecoregions regardless of where they fall within the east-west precipitation gradient. Mixed Grass and Sand Shinnery Oak prairie share morphometric patterns following periods of summer drought, despite falling at opposite ends of the temperature and precipitation gradient. This suggests that allocation of resources during periods where access is likely limited is universal across the lesser prairie-chicken range.

Across all four ecoregions, it is especially notable that adult female lesser prairie-chicken morphometric traits are relatively fixed and unresponsive to changes to temperature or precipitation across all four ecoregions. However, the proceeding summer's weather does affect the traits of juvenile females. This age specific difference in influence of weather effects may be related to differences in resource allocation between juvenile and adult birds. Juvenile development necessitates allocation of resources to both fixed and annually replaced morphometric traits, while adult birds allocate resources to maintenance of feathers during molt or body mass.

Within the morphometric suite of body mass, wing chord, pinnae length, tail length, and tarsus length, body mass explains up to 95% of morphometric variation among ecoregions. This variation in mass is driven by the lower masses of lesser prairie-chickens in the Mixed Grass ecoregion, which typically have smaller morphometric characteristics than birds of the other three ecoregions within the range. The largest lesser prairie-chickens in the range are often Short Grass and Sand Shinnery Oak birds, with Sand Shinnery Oak birds exhibiting larger tarsus lengths than birds in other ecoregions and larger morphometrics of the Short Grass prairie driven by females. This suggests a selective pressure acting to increase the size of morphometric attributes in Short Grass prairie that may be distinct from climatic pressures of the Sand Shinnery Oak prairie birds.

Feather traits are subject to annual development, reflecting the access to resources prior and during the periods of their growth and for lesser prairie-chickens they also reflect differences in allocation of sexually selected traits. For female lesser prairie-chickens, feather lengths for tail and pinnae decrease after periods of extreme moisture and severe drought. However, male lesser prairie-chickens exhibit longer tail and pinnae lengths after proceeding summers of moderate to extreme drought or extreme moisture. As a sexually selected characteristic, pinnae and tail length may be an important indication of male quality after extreme weather events and may act as an important signal to distinguish healthy males from others on a lek. The sexually selected feather lengths of male lesser prairie-chickens can be juxtaposed with juvenile tarsus lengths. Tarsus lengths are a fixed feature mirroring the available resources at the time of development. Juvenile male and female lesser prairie-chickens that develop during years of drought are smaller than birds that develop in periods of normal or greater precipitation.

Out of all the morphometric characteristics considered, mass is the only one subject to rapid change. the tight constraint of female mass across ecoregions and lag Palmer Drought Severity Index conditions is a striking in comparison to the fluctuation within male mass. The constraint in female mass is likely constraints associated with the breeding season and the strong division of reproductive effort in lesser prairie-chickens as a lek breeding species. The sexually dimorphic constraint in mass is reflected in the differences in nutrient reserves, where percent body fat that is tightly constrained across lag Palmer Drought Severity Index influence and ecoregion with 8% fat for females and 2-3% in males (Fig 3).

It is intuitive to assume that breeding season nutrient reserves will have an influence on nesting outcomes. The tight percentage of breeding season body fat in hens across drought and wet years, alludes to a biological constraint on fat required to successfully breed. However, my analyses found no support for a morphometric influence on nest survival Perhaps this percentage of body fat is a determinant of the ability of hens to breed, however, hen nutrient reserves are not a significant determinant of nest survival for first nests. With increasingly dramatic climatic swings in a species range that is prone to drought every 5-10 years it is unclear what this will mean for the ability of hens to maintain ~8% body fat prior to nesting across the precipitation gradient.

As the easternmost ecoregion within the lesser prairie-chicken range, Mixed Grass prairie has the most consistent annual Palmer Drought Severity Index and the greatest amount of precipitation. Despite the increased precipitation, the influences of lag summer Palmer Drought Severity Index values on Mixed Grass prairie lesser prairie-chicken morphometric traits follows the much more dynamic drought cycles of the Sand Shinnery Oak and Short Grass prairies. Morphometric response to drought is essentially uniform across the lesser prairie-chicken range, regardless of the potential buffering effects of a more consistent annual average precipitation or greater annual rainfall than the other three ecoregions in the range. Even within the Mixed Grass ecoregion it is uncertain if lesser prairie-chickens will be able to maintain nutrient reserves to breeding constraints with increasing propensity for drought and erratic precipitation events across the Great Plains.

Together, patterns of male morphological plasticity and relatively fixed female morphology is indicative of sexual selection and breeding constraints by sex acting to shape morphological traits in the lesser prairie-chicken across the range despite some differences in size among ecoregions. As a management tool, morphometrics offer a time-capsule of selective influences on birds throughout the range that can be utilized to understand implications of changes to those selective pressures. Management can make inferences about resource access available during growth based on the size of tarsus lengths, seasonal influences in wing lengths, and rapid response in changes in bird mass. Furthermore, changes to the constrained ranges of adult female morphometric traits could act as important signal of massive underlying change in future management that would be overlooked without collecting and examining morphometric traits.

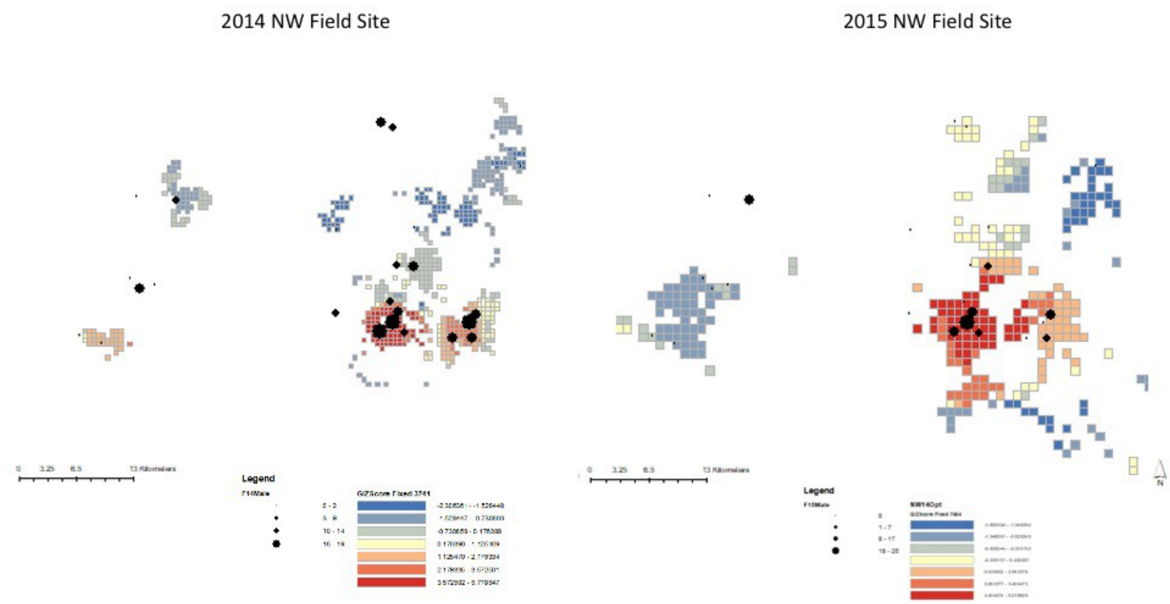


Figure 1. Areas with high concentrations of hen satellite locations were determined using the optimized hotspot tool in ArcGIS. To determine the relationship between female space use and changes to lek dynamics, spatial locations from the year prior to lek observations were utilized. Warm colors correspond to high concentrations of hen locations while cooler areas indicate the least spatial locations. Points correspond to lek locations, with point size increasing with maximum numbers of recorded males. These two maps indicate changes to leks within the Northwestern field site, which exemplifies the same trends as the other three Kansas field sites, showing a close relationship between concentrated areas of female locations and shifts of leks on the landscape to follow.

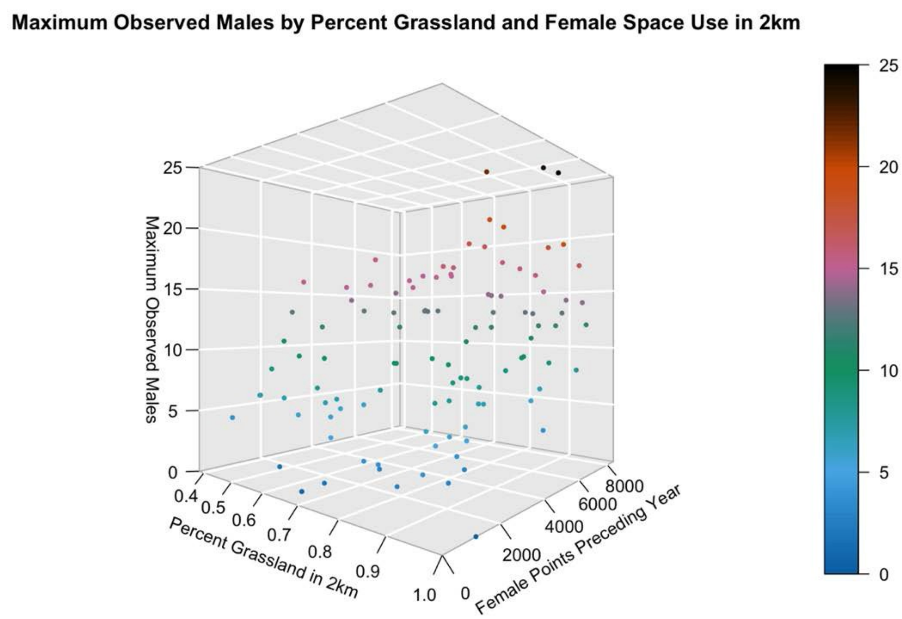


Figure 2. There is a relationship between the number of female points observed prior to lek observations, the percent of available grassland land cover within 2 km, and the maximum number of males on a lek. With increasing percentage of grassland on the landscape, there is an increase in the number of female points and an increase in the maximum number of observed males on a lek. For leks with less percent grassland, such as those in cropland, the number of maximum observed males is still closely tied to the number of female points within 2 km the prior year.

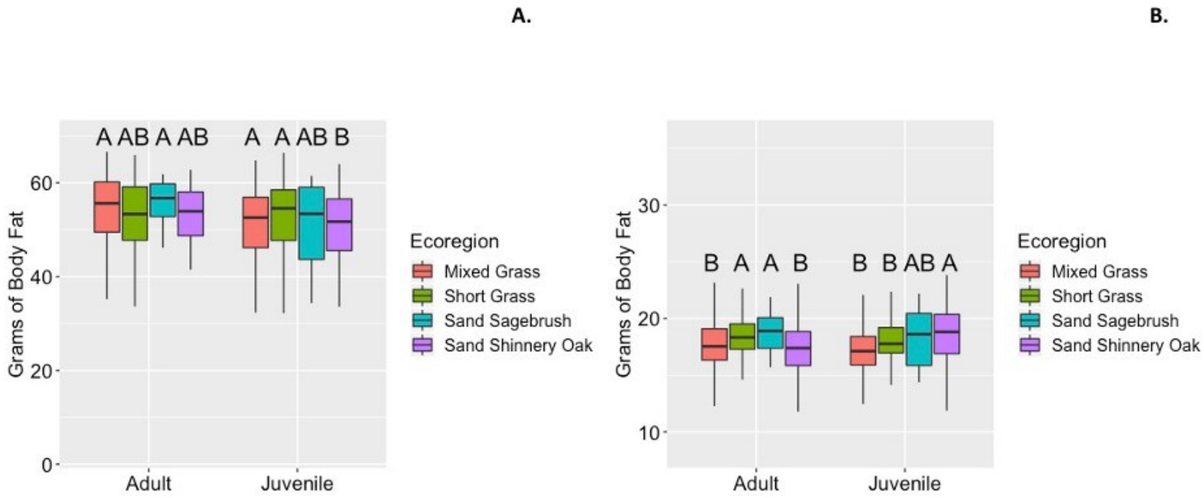


Figure 3. Calculations of lesser prairie-chicken body fat indicate that there is a strong sexual size dimorphism. Female birds (A.) have a higher body fat content (~8%) than males (B; 2-3%). Furthermore, the amount of body fat is tightly constrained across ecoregions, suggesting that there is selective pressure on percent body fat.

Products

Professional Presentations

Aulicky, C., and D. Haukos. 2018. Testing the hotspot hypothesis: lesser prairie-chickens lek formation and female space use. International Grouse Symposium, Logan, Utah.

Aulicky, C., and D. Haukos. 2018. What can we learn from morphology? A study of the lesser prairie-chicken (Tympanuchus pallidicinctus) in Kansas. Kansas Natural Resources Conference, Manhattan, Kansas.

Aulicky, C., and D.A. Haukos. 2018. What the lek: testing the hotspot hypothesis. Annual Conference of oSTEM, Houston, Texas.

Aulicky, C., D. Haukos, and K. Fricke. 2018. Not just dusty data: what can we learn from range-wide analyses of lesser prairie-chicken morphology? Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Aulicky, C., and D. Haukos. 2019. Size matters: effects of climate on lesser prairie-chicken body size. Annual meeting, oSTEM, Detroit, Michigan. Poster

Aulicky, C., and D. Haukos. 2019. Testing the Hotspot Hypothesis: lesser prairie-chicken lek formation and female space use. Annual Meeting of The Wildlife Society, Reno, Nevada.

Aulicky, C., and D. Haukos. 2019. Testing the hotspot hypothesis: lesser prairie-chicken lek formation and female space use. Annual Meeting of the American Ornithological Society, Anchorage, Alaska.

Aulicky, C., and D.A. Haukos. 2019. Testing the hotspot hypothesis: lesser prairie-chicken lek formation and female space use. Kansas Natural Resource Conference, Manhattan, Kansas.

Aulicky, C.S.H., and D.A. Haukos. 2019. Not just dusty data: what can we learn from range-wide analyses of lesser prairie-chicken morphology? 33rd Biennial Meeting of the Prairie Grouse Technical Council, Bartlesville, Oklahoma.

Aulicky, C., and D. Haukos. 2020. Lesser prairie-chicken lek formation, lek persistence, and female space use. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Aulicky, C., and D. Haukos. 2020. What determines lesser prairie-chicken lek persistence? Kansas Natural Resource Conference, Manhattan, Kansas.

Dissertation

Aulicky, C. 2020. Lek dynamics and range-wide morphometric patterns of lesser prairie-chickens. Kansas State University.

On-Going Wildlife Projects

Assessment of Temperate-Breeding Canada Goose Management in Kansas

Investigator
J. Boomer Malanchuk

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Thomas Bidrowski - Kansas Department of Wildlife, Parks, and Tourism

Objectives
Estimate vital rates for resident Canada geese, including normal wild and translocated groups

Assess and revise aerial survey to more accurately estimate nesting population

Determine the extent and effects of molt migration

Status
On-going

Progress and Results

Resident, or temperate-breeding, Canada geese (*Branta canadensis*) were once extirpated in Kansas. Today, Kansas' goose population is a valuable resource providing abundant viewing and hunting opportunities to thousands annually. Kansas Department of Wildlife, Parks, and Tourism (KDWPT) began reintroducing geese in 1980 with hopes of re-establishing the breeding population. By 1989, 10,000 geese (6,000 gosling and 4,000 adults) had been released at wildlife management areas and state reservoirs. These successful reintroductions led to translocating flocks to new parts of the state with no historic record of nesting geese. By 2001, KDWPT stopped translocating geese to increase population abundance. Currently, KDWPT translocates nuisance flocks from urban areas to rural reservoirs with the goal of reducing overabundant urban flocks. The same method that was used to recover Canada geese from extinction is now used to manage overabundance.

I used 13,639 bandings and 1,073 direct recoveries from 2012–2017 to estimate survival and recovery rates. Normal, Kansas-banded, Canada geese were recovered in Kansas (82%), 15 other states, and 2 Canadian provinces. Translocated geese were recovered in 1 Canadian province and 6 states (91% in Kansas; Table 2.2). All recoveries were reported in the Central and Mississippi flyways. I used 1,073 direct recoveries (normal wild = 859, translocated = 814) to determine direct recovery rate was 2.5 times greater for translocated geese (17.4%) than normal geese (6.9%) for 2012-2017. Direct recovery rate was never less than double for translocated geese in any given year; excluding 2017 when there were no recoveries of translocated geese.

I used Brownie dead-recovery models to compare survival and recovery probabilities between translocated and non-translocated (normal wild) Kansas-banded Canada geese for 2012-2017. Model-estimated annual survival differed between status (normal wild S = 0.761, 95% CI 0.734-0.785; translocated S = 0.598, 95% CI 0.528-0.665). Recovery probability differed between normal and translocated adults (normal wild f = 0.074, 95% CI = 0.069-0.078; translocated f = 0.138, 95% CI = 0.120-0.158) and juveniles (normal wild f = 0.067, 95% CI = 0.059-0.075; translocated f = 0.250, 95% CI = 0.199-0.310). Recovery probability did not differ between status in the sub-adult age class (normal wild f = 0.126, 95% CI = 0.115-0.137; translocated f = 0.090, 95% CI = 0.055-0.144). Translocation successfully reduces survival and increases recovery probability of nuisance urban geese.

Aerial surveys to count nesting pairs of Canada geese were canceled April 2020 due to COVID-19.

Location:
Kansas

Completion:
August 2021

Presentations

Malanchuk, J. B. Survival, recovery, and translocation of Kansas-banded Canada geese. Presentation at Kansas Natural Resource Conference, Manhattan, KS. 30-31 January 2020.

Malanchuk, J. B. Population status and vital rates of temperate-breeding Canada geese in Kansas. Presentation at Kansas Natural Resource Conference, Manhattan, KS. 30 September – 4 October 2019.

Intrinsic and Extrinsic Drivers of Home Range Area, Daily Displacements, and Long-Distance Movements of Lesser Prairie-Chickens

Investigators
Dr. Bram Verheijen,

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

United States Department of Agriculture (USDA) Farm Services CRP Monitoring, Assessment, and Evaluation

USDA Natural Resources Conservation Service, Lesser Prairie-Chicken Initiative

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

U.S. Fish and Wildlife Service

United States Department of Agriculture

Great Plains LCC

Objectives
Estimating home range areas and daily displacements by female lesser prairie-chickens at four sites in Kansas and Colorado to improve our understanding of breeding season space use in the three northernmost occupied ecoregions.

Status

On-going

Progress and Results

Grassland ecosystems in the conterminous United States have experienced large-scale declines since European settlement, which have led to habitat loss and fragmentation for many wildlife species. Lesser prairie-chickens (*Tympanuchus pallidicinctus*) have been especially affected, as their occupied range and population numbers have declined by ~90%. An important consideration in the conservation and management of Lesser prairie-chickens is an assessment of space estimated by home range areas and daily movements during the breeding season. Unfortunately, available estimates are largely limited to one of the four currently occupied ecoregions, and large spatial variation in landscape fragmentation, and vegetative structure and composition complicates management of the species. Management of lesser prairie-chickens is further complicated because habitat needs vary among the lekking, nesting, brooding, and post-breeding stages of the breeding season. Although breeding stage-specific habitat requirements of breeding stages have been previously described, home ranges and movements of female lesser prairie-chickens during these stages remains relatively unclear.

During 2013-2018, we tested home range areas and daily displacements of female lesser prairie-chickens varied among ecoregions and breeding stages at 4 study sites in Kansas and Colorado, USA, that together represent 3 of the 4 currently occupied ecoregions. We captured and equipped females with VHF ($n = 39$) or GPS transmitters ($n = 157$), and estimated home range areas and daily displacements with kernel density estimators or biased random bridge models. Across all sites, home range areas averaged 190.4 ha (± 19.1 ha SE) for birds with VHF and 283.6 ha (± 23.1 ha) for birds with GPS transmitters, while daily displacement averaged 374.8 m (± 14.3 m). Average home range areas and daily displacements were greater in the Short-Grass Prairie/CRP Mosaic ecoregion (233.0–420.8 ha, 468.5 m, respectively) compared to our sites in the Mixed-Grass Prairie in southcentral Kansas (146.4–183.9 ha, 281.0–319.5 m). Home range areas and daily displacements were greatest during lekking (252.8 ha, 539.7 m) and smallest during the brooding stage (81.4 ha, 221.3 m), when hen movements are restricted by mobility of chicks (Figure 1).

Comparing home range areas and daily displacements among study sites and breeding stages to test the relative effects of extrinsic site differences and individual resource needs on variation of space use by breeding female lesser prairie-chickens

Location
Kansas and eastern Colorado

Completion
May 2021

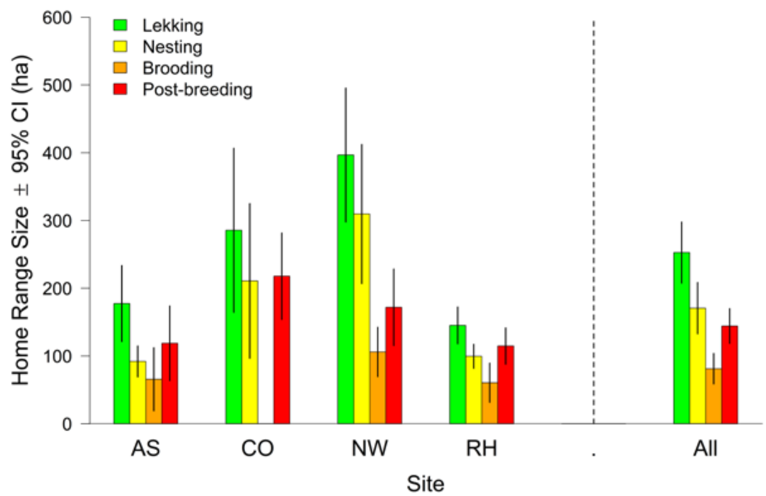


Figure 1. Breeding season home range areas of female lesser prairie-chickens captured in Kansas and Colorado during 2013–2018 and equipped with GPS transmitters. Shown are mean breeding season home range areas (ha) and 95% confidence intervals for each site and breeding stage pooled across years. The Ashland (AS) and Red Hills (RH) sites are located in the Mixed-Grass Prairie Ecoregion, the Colorado (CO) site is located in the Sand Sagebrush Prairie Ecoregion, and the Northwest (NW) site is located in the Short-Grass Prairie/CRP Mosaic Ecoregion.

Ecoregion- and breeding stage-specific estimates of movements and space use of lesser prairie-chickens will help managers determine the spatial configuration of breeding stage-specific habitat on the landscape. Furthermore, ecoregion- and breeding stage specific estimates are crucial when estimating the amount of breeding habitat needed for lesser prairie-chicken population to persist.

Products

Professional Presentations

Verheijen, B.H.F., C.K.J. Gulick, J.D. Kraft, J.D. Lautenbach, J.M. Lautenbach, R.T. Plumb, S.G. Robinson, D.S. Sullins, and D.A. Haukos. 2019. How can breeding stage-specific estimates of home range size of female lesser prairie-chickens aid conservation efforts? American Fisheries Society & The Wildlife Society 2019 Joint Annual Conference. Reno, Nevada

Verheijen, B.H.F., C.K.J. Gulick, J.D. Kraft, J.D. Lautenbach, J.M. Lautenbach, R.T. Plumb, S.G. Robinson, D.S. Sullins, and D.A. Haukos. November 2019. How can breeding stage-specific estimates of home range size of female lesser prairie-chickens aid conservation efforts? 33rd Meeting of the Prairie Grouse Tech Council. Bartlesville, Oklahoma.

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 Supervisor
Dr. Daniel Sullins

Funding
Kansas State University

Cooperators
Kansas Department of Wildlife, Parks, and Tourism (Kent Fricke)

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

Objectives
Evaluate the influence of natural disturbances on NDVI-related metrics

Compare NDVI metrics among used and available locations

Relate NDVI variation to nesting phenology

Location:
Kansas, Colorado, New Mexico, and Texas

Completion
Expected January 2022

Status
On-going

Progress and Results
The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is one of many grassland nesting species that has experienced sharp declines in population size, range, and habitat quality as a result of anthropogenic and ecological changes. As this species continues to decline, it is crucial to identify and preserve optimal reproductive habitat in order to promote persistence in the future. The vast majority of the Great Plains is privately owned, making monitoring for this species exceptionally difficult. However, with continuing advancements in remote sensing technology, the ability to monitor reproductive habitat for lesser prairie-chickens has never been more accessible. One of many factors influencing reproduction and reproductive success is the timing of nest initiation, which we predict to be associated with vegetative greenness. A powerful remote sensing tool that directly measures vegetative greenness is the Normalized Difference Vegetation Index (NDVI). I plan to use this tool to estimate and better characterize optimal reproductive habitat for lesser prairie-chickens.

I have access to data collected at >20,000 locations throughout the study area that encompass a range of conditions such as wildfire, drought, precipitation, grazing practices, and ecoregions. Data was collected from 1989-2018 from over 400 birds that were captured and fitted with either GPS or VHF transmitters. Locations include nest sites, brood sites, used locations, and random locations. For NDVI-related analyses, high resolution imagery from both public (Landsat, MODIS, etc.) and commercial (Worldview, GeoEye) sensors will be used.

I will first examine the relationship between grazing, fire, and drought on NDVI, NDVI heterogeneity, and phenology metrics (i.e. start of season, amplitude, etc.) by using location data collected throughout the study area and remotely sensed imagery. In doing so, we hope to link NDVI to on-the-ground vegetative characteristics with the disturbance processes that maintain high quality grasslands. I will then analyze over 300 individual nest and brood sites from throughout the study area. At each site mean NDVI, heterogeneity and variability of NDVI, as well as various phenology metrics will be calculated. These values will also be calculated at multiple spatial scales around nest and brood points using a moving window analysis in ArcGIS. Lastly, I will examine the relationship between plant phenology and lesser prairie-chicken reproduction. Individuals that nest earlier are more likely to successfully hatch a nest and raise a brood, leading to the prediction that timing of initiation may be related to the timing of vegetative greenup. However, other factors and models will be assessed that may better explain the relationship between timing of nest initiation and reproductive success. Results from this study will assist in future management and monitoring of grasslands and at-risk grassland nesting birds remotely and at broad scales.

Lesser Prairie-Chicken Translocation to the Sand Sagebrush Ecoregion: Demographics

Investigators
Elisabeth Teige

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

Colorado Parks and Wildlife

Cooperators
Kansas Department of Wildlife, Parks, and Tourism:
Kent Fricke
Kraig Schultz

Colorado Parks and Wildlife:
Liza Rossi
Jonathan Reitz

Objectives
Restore long-term persistence and distribution of LEPC within the Sand Sagebrush Ecoregion

Assess the feasibility of translocations as a management tool for restoring LEPC populations

Location
Capture site: Gove, Lane, Ness, and Finney Counties of NW Kansas Release sites: Morton and Baca Counties of SW Kansas and SE Colorado

Completion
May 2021

Status
On-going

Progress and Results

The U.S. Forest Service Cimarron and Comanche National Grasslands in southwestern Kansas and southeastern Colorado, respectfully, were strongholds of the lesser prairie-chicken historic range. However, several years of intense winters and severe drought, and grazing practices on the grasslands, caused near extirpation by 2013. Since then, increased precipitation and a new management plan were believed to have restored lesser prairie-chicken habitat in these areas. In an attempt to recolonize the National Grasslands and support populations in the Sand Sagebrush Ecoregion, state agencies translocated 411 lesser prairie-chickens from Northwest Kansas to the U.S. Forest Service Cimarron and Comanche National Grasslands during 2016-2019. Of these lesser prairie-chickens, 279 were marked with VHF radio transmitters and 115 were marked with SAT-PTT GPS transmitters to track their survival, movements, and life stage habitat use.

Initially, 26 males and one female were translocated in the fall of 2016 to help facilitate lek establishment. All subsequent translocations had an increased number of birds captured and took place during the spring leking period (Table 1). From 2017-2020 the number of leks established and active birds at leks increased or remained constant, except a few leks that became inactive and several leks found in 2020 in Kansas (Fig. 1.). As of 2020 there are 20 leks active with 119 birds across the study area, most being established by translocated males. Of these leks, four are located on the National Grasslands.

Nesting and brood survival is crucial component in the lesser prairie-chicken life cycle and can be used to understand the initial success of a translocation. From 2017-2019 a total of 113 nests have been documented (inclusive of renests). Of these, 59 nests were successful and produced 98 chicks that survived to 35 days post hatch. The 2020 nesting season is still ongoing; however, with dry weather conditions nesting may be less successful.

Currently 303 mortalities have been recorded with a majority of mortalities being avian, mammalian, or unable to be determined. This is expected due to the length of the project and life expectancy for lesser prairie-chickens. Survival and home range analyses will be conducted to allow for a comparison between translocated birds and their native counterparts. This information can help to determine how behaviors may differ, successfulness of the translocation, and inform possible future translocations of lesser prairie–chickens.

Table 1. Total lesser prairie-chickens translocated from 2016-2020.

	Kansas		Colorado		
	Males	Females	Males	Females	Total
Fall 2016	13	0	13	1	27
Spring 2017	16	19	29	19	83
Spring 2018	32	37	39	36	144
Spring 2019	40	49	22	46	157
Total	101	105	103	102	411

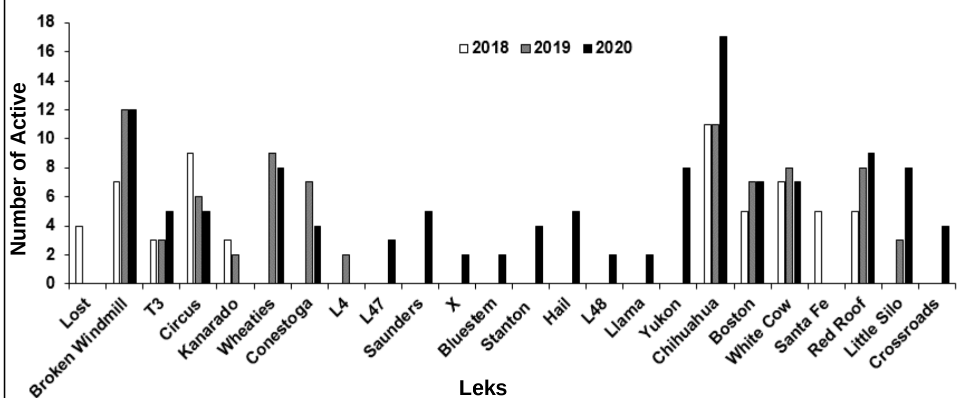


Fig. 1. Number of active birds at leks throughout the study area from 2018-2020.

Products

Professional Presentations

Teige E., Berigan L., Aulicky C., Haukos D., Fricke K., Reitz J., Schultz K., and Rossi L. (2020). Where Do They Go? Lesser Prairie-Chicken Space Use Following Translocation to the Sand Sagebrush Prairie Ecoregion. (Oral Presentation). Kansas Natural Resources Conference. Manhattan, KS.

Teige E., Berigan L., Aulicky C., Haukos D., Fricke K., Reitz J., Schultz K., and Rossi L., (2019). Assessing a Lesser Prairie-Chicken Translocation in the Sand Sagebrush Prairie Ecoregion. (Oral Presentation). Prairie Grouse Technical Council Conference. Bartlesville, OK.

Teige E., Berigan L., Aulicky C., Haukos, D., Fricke K., Rossi L., Reitz J., and Schultz K. (2019). A New Hope: Monitoring the Effectiveness of Lesser Prairie-Chicken Translocation in the Sand Sage Ecoregion of Southwestern Kansas and South Eastern Colorado. (Poster Presentation). The Wildlife Society Annual Conference (joined with American Fisheries Society). Reno, NV.

Response of Greater Prairie-Chickens to Natural and Anthropogenic Disturbance on Fort Riley

Investigators
Jacquelyn Gehrt

Collaborators
Shawn Stratton
Derek Moon

Project Supervisor
Dr. David Haukos

Funding
Fort Riley Environmental Division

Cooperators
Fort Riley Environmental Division

Objectives

Estimate female survival rates and nest success of Greater Prairie-chickens during the breeding season on Fort Riley Military Reserve

Assess resource selection by female Greater Prairie-chickens during the breeding season. Resource selection will be measured at multiple scales and in response to landscape disturbances experienced at Fort Riley Military Reserve

Evaluate space use by female Greater Prairie-chickens during the breeding season. Home

Status
On-going

Progress and Results

Much of the extant range-wide Greater Prairie-chicken population occurs in the tallgrass prairies of Kansas. Most of the remaining tallgrass prairies are located within the Flint Hills ecoregion, which remains relatively intact due to the Flint Hills' rocky soil and inability to be cultivated. These extant prairies largely serve as refuges for Greater Prairie-chicken populations to persist. However, changes and intensification of grassland management practices (i.e. frequent burning and overgrazing) have caused population numbers in Kansas to steadily decline over the past several decades from an estimated 530,000 in 1989 to 77,898 in 2018. One area where these intensifications have not occurred is on Fort Riley Military Reserve, a 41,000 ha parcel of tallgrass prairie where grazing is not allowed and burning takes place in a mosaic-style regime that allows for a heterogeneous landscape to remain even after burning commences. Fort Riley Military Reserve experiences disturbances that are uncommon to the rest of the Flint Hills in that they experience military training events throughout the year. These events bring about sound disturbance, vehicle disturbance, and increased foot traffic on the landscape.

The goal of this project is to understand how the Greater Prairie-chicken population on Fort Riley Military Reserve responds to the disturbances listed above and integrate our findings into management practices on the reserve. We captured and outfitted 37 female Greater Prairie-chickens with transmitters during the 2019 and 2020 field seasons. We tracked their movements, monitored their nests, and conducted vegetation surveys at points used by and available to Greater Prairie-chickens to determine survival and resource and space use.

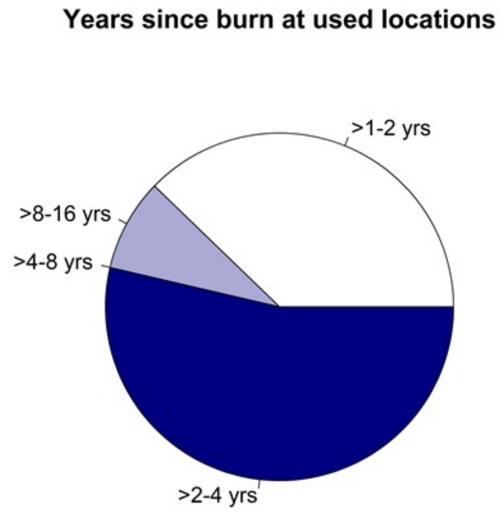
With the unusually large amount of precipitation during the 2019 season, nest survival and adult survival were poor (0.3704 ± 0.34 and 0.4149 ± 0.09 respectively). Apparent nest survival during the 2020 season thus far is 22% and apparent (female) adult survival is 73%. During the 2019 season we found females to use areas burned greater than 1 to every 2 years disproportionately more than what was available on Fort Riley Military Reserve (see figure below). We found space use to be very limited during the 2019 season with the 95% KDE estimate being 223ha $\pm$ 176 ha, nearly 2.5 times smaller than Greater Prairie-chicken studies conducted in nearby areas.

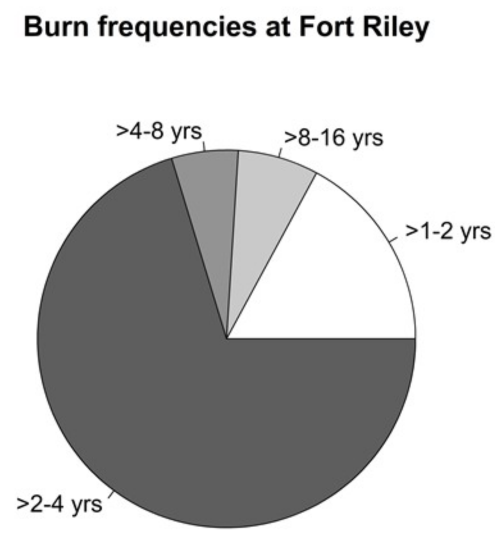
During the 2020 season we aim to understand how Greater Prairie-chickens respond to smaller disturbances such as power lines, fences, hayed areas, and food plots on Fort Riley Military Reserve. We are also interested in understanding the effects of the extreme precipitation experienced last season on this year's survival and recruitment.

range and daily displacement will be calculated while evaluating landcover types and movements in response to disturbances on the landscape.

Location:
Riley and Geary counties, Kansas

Completion
August 2021





Presentations

Gehrt, J.M., S. Stratton, and D.A. Haukos. Demographic Responses of Greater Prairie-chickens to Fire, Haying, and Military Activity on Fort Riley Military Reservation. The 13th Kansas Natural Resources Conference. Manhattan, Kansas. January 2020.

Gehrt, J.M., D.S. Sullins, and D.A. Haukos. The comings and goings of Lesser Prairie-chickens: intrinsic and extrinsic influences on female nest attendance. 33rd Meeting of the Prairie Grouse Tech Council. Bartlesville, Oklahoma. November 2019.

Gehrt, J.M., D.S. Sullins, and D.A. Haukos. Taking an incubation break: the where, when, and why of these cryptic breaks. American Fisheries Society and The Wildlife Society 2019 Joint Annual Conference. Reno, Nevada. September 2019.

Lesser Prairie-Chicken and Grassland Response to Megafire in the Mixed-Grass Prairie

Investigators
Nicholas Parker

Collaborators
Kent Fricke
Christian Hagen

Project Supervisor
Dr. Dan Sullins
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

USDA Lesser Prairie-Chicken Initiative

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

Objectives

Estimate effects of megafire on lesser prairie-chicken demography

Assess impacts of megafire on vegetation and the distribution, availability, and quality of lesser prairie-chicken habitat

Compare lesser prairie-chicken resource selection before and after megafire

Location:
Clark County, Kansas

Completion
May 2021

Status
On-going

Progress and Results

Megafires (wildfire > 40,000 ha) are increasing worldwide and can pose a threat to wildlife. The lesser prairie-chicken (*Tympanuchus pallidicintus*) is an imperiled prairie-grouse species of the Southern Great Plains that has seen a rise of megafires across its range in recent years. Both the Great Plains and lesser prairie-chickens have evolved with fire, and recent studies have documented the benefits of small prescribed fire and wildfire for lesser prairie-chickens. However, we do not know how lesser prairie-chickens may respond to the size and scope of megafires. Lesser prairie-chicken existence in reduced and highly fragmented habitats make populations particularly susceptible to stochastic events like megafire.

The Starbuck fire burned 252,000 ha in Kansas and Oklahoma in March 2017, right through a key part of the lesser prairie-chicken range in the mixed-grass prairie ecoregion. Having studied lesser prairie-chickens in Clark County, KS (85% of which burned) prior to the fire (2014-2016), we had the unique opportunity to return following the fire to assess its impacts on the lesser prairie-chicken population and their habitat. Post-fire work began with lek counts and establishment of photo point monitoring immediately following the fire in 2017. In 2018 and 2019, lesser prairie-chickens were caught on lek and outfitted with SAT-PTT transmitters to measure movement, survival, and reproductive success. Vegetation was measured at used and random locations across the study site, following pre-fire protocols. Intensive field work ended in February 2020, but leks were surveyed in the spring of 2020 and we are continuing to monitor surviving birds.

We documented a 77% decrease in male attendance at leks in the first two years following fire, with the decline leveling off in 2020. Adult survival post-fire has remained comparable to pre-fire, but nest survival has trended downward. Brood survival was low in 2018, but improved in 2019. Lesser prairie-chickens avoided burned areas following the fire and increased selection of Conservation Reserve Program (CRP) fields, indicating these more isolated habitat patches may provide a refuge during extreme events like wildfire. Vegetation measurements one year post-fire revealed decreased visual obstruction and litter, along with increased bare ground, pointing to reduced lesser prairie-chicken nest habitat. In 2019, litter and bare ground returned to pre-fire levels, while visual obstruction remained reduced, indicating habitat may be improving. Overall data point to slow but steady recovery, with megafires potentially impacting lesser prairie-chicken populations for years following disturbance.

Products

Professional Presentations

Parker, N.J., Sullins, D.S., Haukos, D.A., Fricke, K.A., Hagen, C.A., Influence of a megafire on lesser prairie-chicken habitat use and quality in the mixed-grass prairie. Kansas Natural Resources Conference. Manhattan, KS. 2020. (Oral Presentation)

Parker, N.J., Sullins, D.S., Haukos, D.A., Fricke, K.A., Hagen, C.A., Lesser prairie-chicken and grassland response following intense wildfire in Kansas. 33rd Meeting of the Prairie Grouse Technical Council. Bartlesville, OK. 2019. (Oral Presentation)

Parker, N.J., Sullins, D.S., Haukos, D.A., Fricke, K.A., Hagen, C.A., Rising from the ashes? Lesser prairie-chicken and grassland response to intense wildfire in Kansas. American Fisheries Society and The Wildlife Society Joint National Conference. Reno, NV. 2019. (Poster)

Survival, Movement, and Resource Selection of Male Mule Deer and White-tailed Deer in Western Kansas

Investigators
Maureen Kinlan

Project Supervisor
Dr. David Haukos
Dr. Drew Ricketts

Collaborators
Levi Jaster

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

U.S. Fish and Wildlife Service

United States Geologic Survey

Kansas State Horticulture and Natural Resources, Kansas State Department of Biology

Location:
Western Kansas

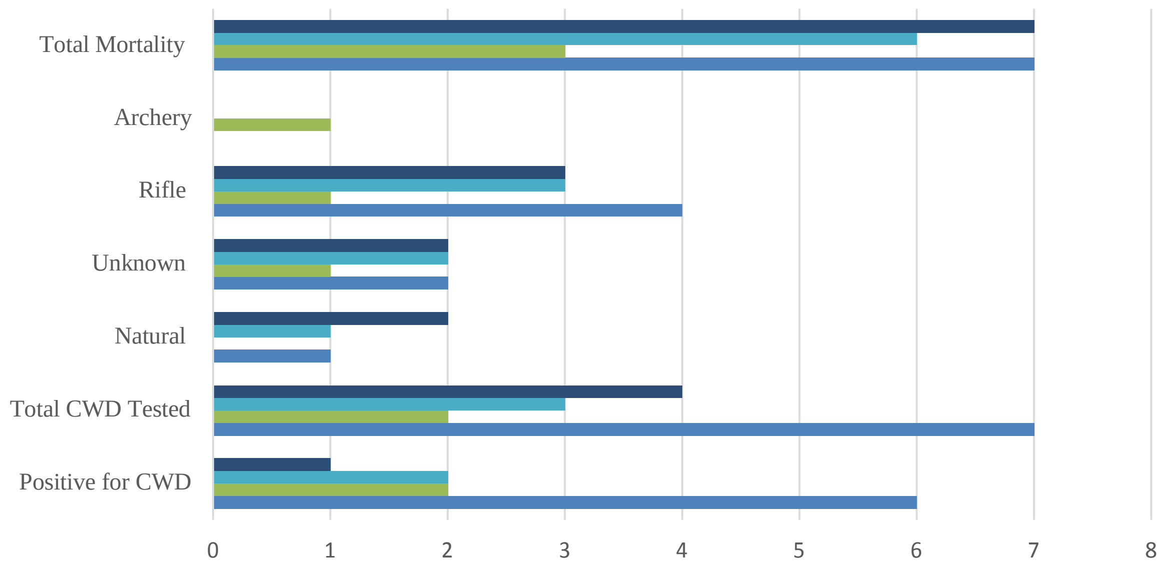
Completion:
Fall 2020

Status
On-Going

Progress and Results

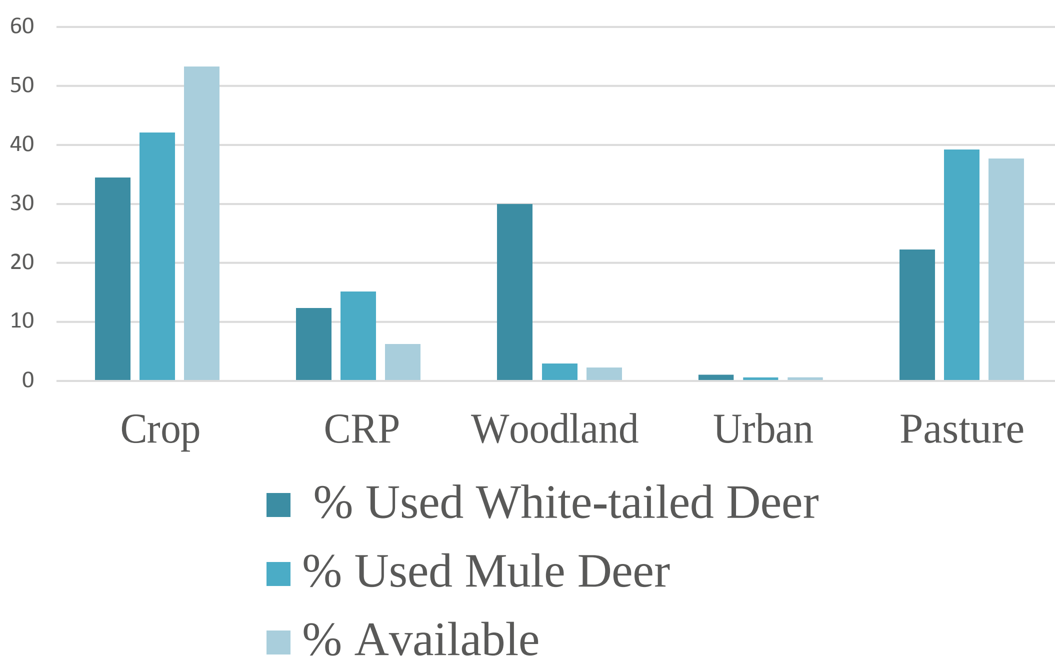
The abundance and occupied range of mule deer (*Odocoileus hemionus*) in Kansas have been declining for twenty years. The two predominant hypotheses for the loss of mule deer and concurrent expansion of white-tailed deer (*O. virginianus)* are changes in land use and competitive dominance of white-tailed deer over mule deer. Despite the popularity and income that stem from hunting revenue, there have been no recent studies that provide critical insight on how to improve management and conservation of sympatric populations of both species in Kansas. My objectives were to evaluate seasonal survival rates, cause-specific mortality, movement patterns, space use, resource selection and the influence of hunting on adult male mule deer and white-tailed deer in western Kansas. Cooperators aerially captured and GPS-collared 60, 25, and 26 male mule deer and white-tailed deer at two different study sites in 2018, 2019, and 2020, respectively. Each deer was fitted with a high resolution GPS/VHF collar that recorded bi-hourly locations and used an activity sensor to identify mortality events. I assigned each deer to four different age classes. I calculated average daily and average hourly movement rate for both species and defined the rut breeding period. I compared used and available proportions of categorical land cover and continuous macro habitat features. Resources were used differentially between species and study site during rut periods during fall 2019. Hunting influenced the activity of rutting males, by dramatically reducing hourly average movement rates during the 10-day firearm period. Rut (~November 7th-19th) occurs for both species approximately 2 to 3 weeks prior to the 10-day firearm period (November 28th: 2018, December 4th: 2019) Peak movement periods occur simultaneously between species, with variation between study sites. Deer perceived a threat on the landscape prior to the onset of the 10-day firearm period. Known fate models were used to evaluate landscape factors affecting survival and estimate seasonal survival rates. White-tailed deer had lower annual survival (2018: 0.600±0.08, 2019: 0.621±0.09) than mule deer both years (2018: 0.645± 0.08, 2019: 0.656 ± 0.08). Harvest was the predominant cause of mortality and greatest in the north site where 41% of mule deer, and 22% of white-tailed deer were harvested during 2018 and 2019. In the south site, 16% of mule deer and 14% of white-tailed deer were harvested. Other sources of mortality stemmed from deer-vehicle collisions, natural (includes disease, old age, and starvation), and unknown causes. At this time male harvest is not presumed to be a main driver behind mule deer population declines in western Kansas.

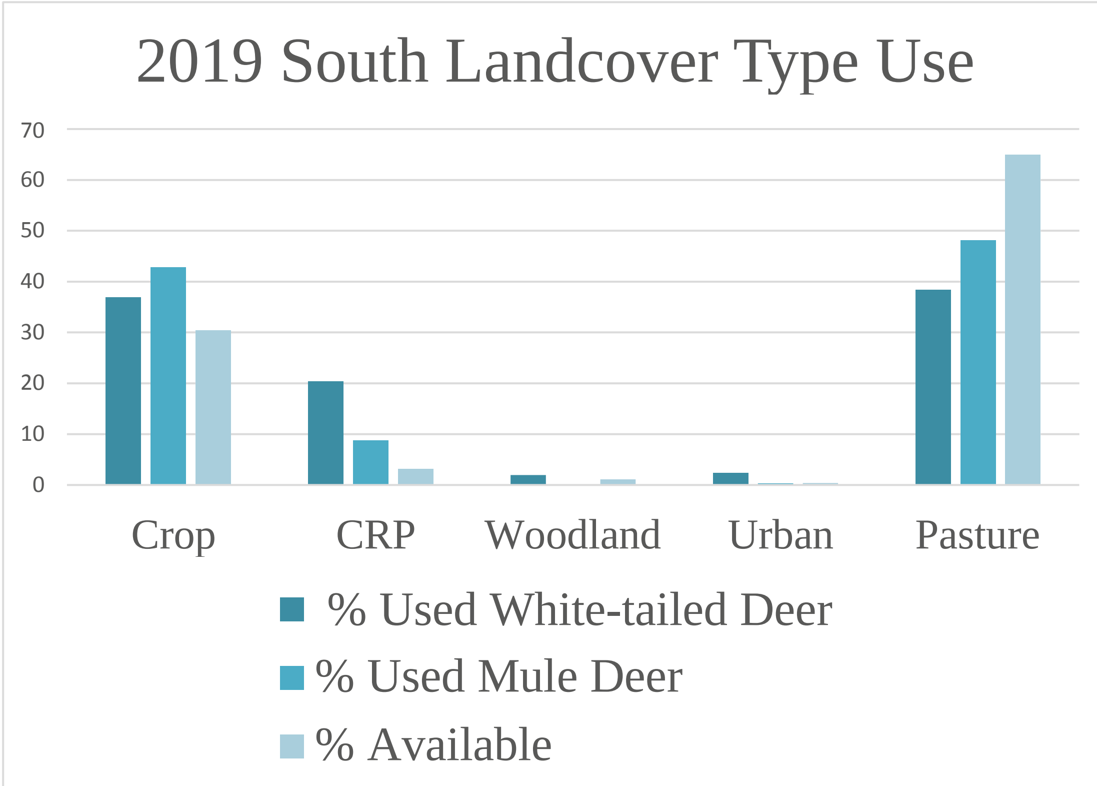
2019 Combined Mortality and Chronic Wasting Disease Results



	Positive for CWD	Total CWD Tested	Natural	Unknown	Rifle	Archery	Total Mortality
South WTD	1	4	2	2	3	0	7
North WTD	2	3	1	2	3	0	6
South MD	2	2	0	1	1	1	3
North MD	6	7	1	2	4	0	7

2019 North Landcover Type Use





Products

Professional Presentations

Kinlan, M., D. Haukos, A. Ricketts, and L. Jasper. 2018. Seasonal survival and movements of male mule deer and white-tailed deer in western Kansas. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Kinlan, M., D. Haukos, A. Ricketts, and Levi Jaster. 2019. Movement patterns and resource selection of male mule deer and white-tailed deer in western Kansas. Annual Meeting of The Wildlife Society, Reno, Nevada.

Kinlan, M., D. Haukos, A. Ricketts, and Levi Jaster. 2019. Seasonal survival, land-cover selection, and movements of male mule deer and white-tailed deer in western Kansas. Kansas Natural Resource Conference, Manhattan, Kansas.

Kinlan, M.A., D. Haukos, A.M. Ricketts, and L. Jaster. 2020. Influence of hunting on survival of adult male mule and white-tailed deer in western Kansas. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

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

Investigators
Talesha Karish

Project Supervisor
Dr. David Haukos
Dr. Andrew Ricketts

Cooperators
Levi Jaster, KDWPT

Funding
Kansas Department of Wildlife, Parks, and Tourism

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
December 2021

Status
On-going

Progress and Results:
Mule deer (*Odocoileus hemionus*) and white-tailed deer (*O. virginianus*) are two common sympatric deer species in the Great Plains and western United States that have been exhibiting divergent population trends temporally and spatially. Mule deer populations are declining and contracting to the west while populations of white-tailed deer are increasing and expanding. The two predominant hypotheses for the loss of mule deer and concurrent expansion of white-tailed deer are changes in land use and indirect competition between white-tailed deer and mule deer Limited research has been conducted in Kansas and the midwest to understand why two similar species are exhibiting different population trends.

Over 3 years we captured and collared a total of 180 female deer in two study sites. Each year we captured 60 female deer; 30 white-tailed deer, 30 mule deer, split evenly between the study site. Does were captured and transported to a central processing location where we conducted disease sampling, age verification, pregnancy checks (ultrasound imagery), body fat indices (palpation and ultrasound imagery), morphological measurements, and inserted Vaginal Implant Transmitters (VITs) for pregnant does. The does received high resolution GPS/VHF collar that recorded bi-hourly locations with a 3-axis activity sensor.

We split the year into seasons based on the reproductive stage of the doe. Parturition and lactation are energetically demanding of females and their resource needs, activity patterns and home ranges will change to accommodate the needed increase in energy. Using data gained by monitoring the captured fawns, we were able to tell what stage the females were in accurately. Resource selection was modeled using logistic regression in different spatial scales. The species selection patterns were found to be more similar at the landscape scale than at smaller scales. White-tailed deer did not have any difference in resource selection at within home range compared to core area selection. However, Mule deer did have differences in selection between home ranges and core areas, in the most biological stressful periods for them.

The preliminary results of activity patterns showed that while there was noticeable difference between the species in peaks and duration of activity, there was no difference in the patterns of the species between the study sites. The activity patterns of both species changed the most during the fawning season, with activity being spread out more instead of peaks of activity at dawn and dusk. Neither hunting nor rut appeared to have any effect on the activity patterns, but again these are preliminary results.

As of 6/15/20, we had a total of 30 adult female mortalities over the entire 3-year study. The breakdown of the mortalities are, 6 mortalities were classified as capture myopathy, 3 car hits, 2 hunter harvests, 1 hunter loss, 1 due to cwd. and 17 mortalities were of unknown causes.

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.

List of Scientific, Peer Reviewed Publications: 2018-present

Book Chapters

Albanese, G., and D. Haukos. 2019. Toward a theory of connectivity among depressional wetlands of the Great Plains: resiliency to natural and anthropogenic disturbance within a wetland network. Pages 159-176 in E. Beever, S. Prange, and J. Franklin (editors). Disturbance Ecology and Biological Diversity: Context, Nature, and Scale. CRC Press/Taylor and Francis Group, Boca Raton, Florida, USA.

Caldas, M., M. Mather, J. Bergtold, M. Daniels, G. Granco, J. Aistrup, D. Haukos, A.Y. Sheshukov, M. Sanderson, and J.L. Heier Stamm. 2019. Lessons learned in operationalizing interdisciplinary collaboration. Pages 265-294 in Dr. Stephen Perz, editor. Social-Ecological Systems Science, University of Florida, Gainesville, USA.

Peer Reviewed Journal Articles

Andersson, K., C.A. Davis, G. Harris, and D.A. Haukos. 2018. Nonbreeding duck use and management contribution trends for Central Flyway refuges. Journal of Fish and Wildlife Management 9:45-64.

Ashbaugh, H.M., W.C. Conway, D.A. Haukos, D.P. Collins, C.E. Comer, and A.D. French. 2018. Evidence for exposure to selenium by breeding interior snowy plovers (Charadrius nivosus) in saline systems of the Southern Great Plains. Ecotoxicology 27:703-718.

Becker, T.A., A.A. Ahlers, S. Hesting, and D.A. Haukos. 2018. Spatiotemporal distribution of waterfowl disease outbreaks in Kansas, USA. Prairie Naturalist 50:4-14.

Bruckerhoff, L., R. Connell, J. Guinnip, E. Adhikari, A. Godar, K. Gido, A. Boyle, A. Hope, A. Joern, and E. Welti. 2020. Harmony on the prairie? Grassland plant and animal community responses to variation in climate and land management. Ecology 101:e02986.

Caldas, M.M, M. Sanderson, M. Mather, M. Daniels, J. Bergtold, J. Aistrup, J.H. Stamm, D. Haukos, K. Mankin, A. Sheshukov, and D. Carr-Lopez. 2015. Bringing culture into sustainability science research and policy. Proceedings National Academy of Sciences 112:8157-8159.

Fritts, S. R., B. A. Grisham, R. D. Cox, C. W. Boal, D. A. Haukos, P. McDaniel, C. A. Hagen, and D. U. Greene. 2018. Interactive effects of severe drought and grazing on the life history cycle of a bioindicator species. Ecology and Evolution 8:9550–9562.

Gehrt, J.M., D.S. Sullins, and D.A. Haukos. 2020. Looking at the bigger picture: how abundance of nesting and brooding habitat influences lek-site selection by lesser prairie-chickens. American Midland Naturalist 183:52-77.

Gerber, K. M., M. E. Mather, and J. M. Smith. 2019. Multiple metrics provide context for the distribution of a highly mobile fish predator, the blue catfish. Ecology of Freshwater Fish 128:141-155.

Gerber, K. M., M. E. Mather, J. M. Smith, and Z. Peterson. 2019. Evaluation of a field protocol for internally-tagging fish predators using difficult-to-tag ictalurid catfish as examples. Fisheries Research: 209:58-66.

Granco, G., J.L. Heier Stamm, J.S. Bergtold, M.D. Daniels, M.R. Sanderson, A.Y. Sheshukov, M. Mather, M.M. Caldas, S.M. Ramsey, R. Lehrter, D. Haukos, J. Gao, S. Chatterjee, J. Nifong, and J. Aistrup. 2019. Evaluating environmental change and behavioral decision-making for sustainability policy using an agent-based model: a case study for the Smoky Hill River Watershed, Kansas. Science of the Total Environment 695 (2019) 133769.

Haukos, D.A., C.W. Boal, S. Carleton, and B. Grisham. 2018. Roles of Cooperative Research Units in contemporary conservation of natural resources. Transactions of the North American Wildlife and Natural Resources Conference 80:124-132.

Hellgren, E.C, D.J. Austen, D.A. Haukos, J.R. Mawdsley, J.F. Organ, and B.K. Williams. 2018. Barriers and bridges in reconnecting natural resources science and management: summary of a workshop. Transactions of the North American Wildlife and Natural Resources Conference 81:215-221.

Hitchman, S. M., M. E. Mather, J. M. Smith, J. S. Fencl. 2018. Habitat mosaics and path analysis can improve biological conservation of aquatic biodiversity in ecosystems with low-head dams. Science of the Total Environment 619–620:221–231

Hitchman, S.M, M. E. Mather, J. Smith, and J. Fencl. 2018. Identifying keystone habitats with a mosaic approach can improve biodiversity conservation in disturbed ecosystems. Global Change Biology 24:308-321.

Kearns, B., S. McDowell, J. Moon, E. Rigby, W. C. Conway, and D. Haukos. 2019. Distribution of contaminants in the environment and wildlife habitat use: a case study with lead and waterfowl on the Upper Texas Coast. Ecotoxicology 28:809–824.

Kraft, J. D., D. A. Haukos, M. R. Bain, M. B. Rice, S. G Robinson, D. S. Sullins, C. A. Hagen, J. Pitman, J. Lautenbach, R. Plumb, and J. Lautenbach. 2020. Using grazing to manage herbaceous structure for a heterogeneity-dependent bird. Journal of Wildlife Management In Press

Lautenbach, J.M., D.A. Haukos, D.S. Sullins, C.A. Hagen, J.D. Lautenbach, J.C. Pitman, R.T. Plumb, S,G. Robinson, and J.D. Kraft. 2019. Factors influencing nesting ecology of lesser prairie-chickens. Journal of Wildlife Management 83:205-215.

Marschall, E. A., D. C. Glover, M. E. Mather, and D. L. Parrish. 2020. Modeling larval American Shad recruitment in a large river. North American Journal of Fisheries Management 1548-8675 online

McCullough, K., G. Albanese, D.A. Haukos, A.M. Ricketts, and S. Stratton. 2019. Management regime and habitat response influence abundance of regal fritillary (Speyeria idalia) in tallgrass prairie. Ecosphere 10(8):e02845.

McCullough, K., D.A. Haukos, and G. Albanese. 2020. Regal fritillary (Speyeria idalia) sex ratio in tallgrass prairie: effects of survey timing and management regime. Submitted to American Midland Naturalist In Press.

Meyers A.R., S.A. Carleton, W.R. Gould, C. Nichols, D.A. Haukos, and C.A. Hagen. 2018. Temporal variation in breeding season survival and cause-specific mortality of lesser prairie-chickens. Journal of Fish and Wildlife Management 9:496-507.

Ogden, S., D.A. Haukos, K.C. Olson, J. Lemmon, J. Alexander, G.A. Gatson, and W.H. Fick. 2019. Grassland bird and butterfly response to sericea lespedeza control via late-season grazing pressure. American Midland Naturalist 181:127-169.

Owen, R.K., E. B. Webb, D.A. Haukos, F.B Fritschi, and K.W. Goyne. 2020. Barnyardgrass (Echinochola crusgalli) emergence and growth in a changing climate in Great Plains wetlands. Wetlands Ecology and Management 28:35-50.

Owen, R.K., E.B. Webb, D.A. Haukos, and K.W. Goyne. 2020. Projected climate and land use changes drive plant community composition in agricultural wetlands. Environmental and Experimental Botany 175 (2020) 104039.

Peterson, J.M., J.E. Earl, S.D. Fuhlendorf, D. Elmore, D.A. Haukos, A.M. Tanner, and S.A. Carleton. 2020. Estimating response distances of lesser prairie-chickens to anthropogenic features during long-distance movements. Ecosphere 11(9):e03202.

Plumb, R.T., J.M. Lautenbach, S.G. Robinson, D.A. Haukos, V.L. Winder, C.A. Hagen, D.S. Sullins, J.C. Pitman, and D.K. Dahlgren. 2019. Lesser prairie-chicken space use in relation to anthropogenic structures. Journal of Wildlife Management 83:216-230.

Riecke, T.V., W.C. Conway, D.A. Haukos, J.A. Moon, and C.E. Comer. 2019. Nest survival of black-necked stilts, Himantopus mexicanus, on the upper Texas Coast. Waterbirds 42:261-271.

Robinson, S.G., D.A. Haukos, R.T. Plumb, J.D. Kraft, D.S. Sullins, J.M. Lautenbach, J.D. Lautenbach, B.K. Sandercock, C.A. Hagen, A. Bartuszevige, and M. A. Rice. 2018. Effects of landscape characteristics on annual survival of lesser prairie-chickens. American Midland Naturalist 180:66-86.

Robinson, S.G., D.A. Haukos, R.T. Plumb, J.M. Lautenbach, D.S. Sullins, J.D. Kraft, J.D. Lautenbach. C.A. Hagen, and J.C. Pitman. 2018. Nonbreeding home range size and survival of lesser prairie-chickens. Journal of Wildlife Management 82:374–382.

Ross, B.E., D.A. Haukos, and P.T. Walther. 2018. Quantifying changes and drivers of mottled duck density in Texas. Journal of Wildlife Management 82:374–382.

Ross, B.E., D.A. Haukos, C. Hagen, and J. Pitman. 2018. Combining multiple sources of data to inform conservation of Lesser Prairie-Chicken populations. Auk 135:228-239.

Ross, B.E., D.S. Sullins, and D.A. Haukos. 2019. Using an individual-based model to assess common biases in lek-based count data to estimate population trajectories of lesser prairie-chickens. PLoS ONE 14(5): e0217172.

Schindler, A.R., D.A. Haukos, C.A. Hagen, and B.E. Ross. 2020. A decision-support tool to prioritize candidate landscapes for lesser prairie-chicken conservation. Landscape Ecology 35:1417-1434.

Schindler, A.R., D.A. Haukos, C.A. Hagen, and B.E. Ross. 2020. A multi-species approach to manage effects land cover and weather on upland game birds. Ecology and Evolution In Press.

Sullins, D.S., D. A. Haukos, J. Craine, J. M. Lautenbach, S. G. Robinson, J. D. Lautenbach, J. D. Kraft, R. T. Plumb, B. K. Sandercock, and N. Fierer. 2018. Identifying diet of a declining prairie grouse using DNA metabarcoding. Auk 135:583–608.

Sullins, D.S., J.D. Kraft, D.A. Haukos, S.G. Robinson, J. Reitz, R.T. Plumb, J.M. Lautenbach, J.D. Lautenbach, B.K. Sandercock, and C.A. Hagen. 2018. Selection and demographic consequences of Conservation Reserve Program grasslands for lesser prairie-chickens. Journal of Wildlife Management 82:1617-1632.

Sullins, D.S., W.C. Conway, D.A. Haukos, and C.E. Comer. 2019. Using pointing dogs and hierarchical models to evaluate American woodcock winter habitat. Proceedings of 11th American Woodcock Symposium 11:154–167.

Sullins, D.S., D.A. Haukos, J.M. Lautenbach, J.D. Lautenbach, S.G. Robinson, M.B. Rice, B.K. Sandercock, J.D. Kraft, R.T. Plumb, J.H. Reitz, J.M.S. Hutchinson, and C.A. Hagen. 2019. Strategic regional conservation for lesser prairie-chickens among landscapes of varying anthropogenic influence. Biological Conservation 238 (2019) 108213.

Taylor, R. B., M. E. Mather, J. M. Smith, and K. M. Gerber 2019. Confluences function as ecological hotspots: geomorphic and regional drivers can identify patterns of fish predator distribution within a seascape. Marine Ecology Progress Series 629:133-148.

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. 2018. Effects of large-scale wetland loss on network connectivity of the Rainwater Basin, Nebraska. Landscape Ecology 33:1939–1951

Verheijen, B.H.F., H.L. Clipp, A.J. Bartolo, W.E. Jensen, and B.K. Sandercock. 2019. Effects of patch-burn grazing on density and territory size of dickcissels. Avian Conservation and Ecology 14: 7.

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. 2020. Future losses of playa wetlands decrease network structure and connectivity of the Rainwater Basin, Nebraska. Landscape Ecology 35:453–467.

Theses and Dissertations

Alixandra Godar. (Ph.D., 2020, Haukos) Ring-necked pheasant population and space use response to landscapes including spring cover crops. (Post-Doctoral Research Associate, Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University).

Carly Aulicky. (Ph.D., 2020, Haukos) Lek dynamics and range-wide morphometric patterns of lesser prairie-chickens. (Post-Doctoral Research Associate, Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University)

Liam Berigan. (M.S., 2019, Haukos) Dispersal, reproductive success, and habitat use by translocated lesser prairie-chickens. (PhD Candidate, University of Maine)

Chris Gulick. (M.S., 2019, Haukos) Spatial ecology and resource selection by female lesser prairie-chickens within their home ranges and during dispersal. (PhD 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. (Game Warden, Wyoming Game and Fish)

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)

Undergraduate Student Research Mentorships

Lucas, Hallie. 2018. Kansas State University. Project: Comparison of avian diversity in playa wetlands along a latitudinal gradient. (Haukos)

List of Presentations 2018-present

Annis, A. C., A. Godar, D. Haukos, and J. Prendergast. 2018. Effects of spring cover crops on ring-necked pheasant survival and resource selection with notes on mesocarnivore occupancy. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Kearney, Nebraska.

Annis, A. C., A. Godar, D. Haukos, and J. Prendergast. 2018. What drives nest-site selection of Kansas ring-necked pheasants? Kansas Natural Resources Conference, Manhattan, Kansas.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2018. Survival and nest-site selection of ring-necked pheasants in western Kansas spring cover crops. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2019. Are spring cover crops a hot ticket item for chicks? Kansas Natural Resource Conference, Manhattan, Kansas.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2017. Kansas ring-necked pheasant habitat use and survival in summer cover crops. Kansas Natural Resource Conference, Wichita, KS.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2017. Survival of ring-necked pheasants in western Kansas spring cover crops. Annual conference of The Wildlife Society, Albuquerque, NM.

Annis, A.C., A. Godar, D. Haukos, and J. Prendergast. 2019. Are cover crops a hot ticket item for chicks? Annual Meeting of The Wildlife Society, Reno, Nevada.

Aulicky, C., and D. Haukos. 2019. Size matters: effects of climate on lesser prairie-chicken body size. Annual meeting, oSTEM, Detroit, Michigan. Poster

Aulicky, C., and D. Haukos. 2018. Testing the hotspot hypothesis: lesser prairie-chickens lek formation and female space use. International Grouse Symposium, Logan, Utah.

Aulicky, C., and D. Haukos. 2018. What can we learn from morphology? A study of the lesser prairie-chicken (Tympanuchus pallidicinctus) in Kansas. Kansas Natural Resources Conference, Manhattan, Kansas.

Aulicky, C., and D. Haukos. 2019. Testing the Hotspot Hypothesis: lesser prairie-chicken lek formation and female space use. Annual Meeting of The Wildlife Society, Reno, Nevada.

Aulicky, C., and D. Haukos. 2019. Testing the hotspot hypothesis: lesser prairie-chicken lek formation and female space use. Annual Meeting of the American Ornithological Society, Anchorage, Alaska.

Aulicky, C., and D. Haukos. 2020. Lesser prairie-chicken lek formation, lek persistence, and female space use. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Aulicky, C., and D. Haukos. 2020. What determines lesser prairie-chicken lek persistence? Kansas Natural Resource Conference, Manhattan, Kansas.

Aulicky, C., and D.A. Haukos. 2018. What the lek: testing the hotspot hypothesis. Annual Conference of oSTEM, Houston, Texas.

Aulicky, C., and D.A. Haukos. 2019. Testing the hotspot hypothesis: lesser prairie-chicken lek formation and female space use. Kansas Natural Resource Conference, Manhattan, Kansas.

Aulicky, C., D. Haukos, and K. Fricke. 2018. Not just dusty data: what can we learn from range-wide analyses of lesser prairie-chicken morphology? Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Aulicky, C., D. Haukos, K. Fricke, L. Rossi, J. Reitz, and K. Schultz. 2021. Translocated lesser prairie-chicken lek dynamics and female space use. Midwest Fish and Wildlife Conference, virtual.

Aulicky, C.S.H., and D.A. Haukos. 2019. Not just dusty data: what can we learn from range-wide analyses of lesser prairie-chicken morphology? 33rd Biennial Meeting of the Prairie Grouse Technical Council, Bartlesville, Oklahoma.

Berigan, L. C. Aulicky, and D.A. Haukos. 2019. Avoidance of traditional habitat types by translocated lesser prairie-chickens. Annual Conference of oSTEM, Houston, Texas.

Berigan, L., C. Aulicky, D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. Overcoming post-release dispersal to successfully translocate lesser prairie-chickens. Annual Meeting of The Wildlife Society, Reno, Nevada.

Berigan, L., C. Aulicky, D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. Landscape composition explains high rates of dispersal in translocated lesser prairie-chickens. Annual Meeting of the American Ornithological Society, Anchorage, Alaska.

Berigan, L., C. Aulicky, D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. Conservation implications of lesser prairie-chicken habitat selection on the Cimarron National Grasslands. Kansas Natural Resource Conference, Manhattan, Kansas.

Berigan, L., C. Aulicky, E. Teige, D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. Dispersal, habitat use, and eventual settlement of translocated lesser prairie-chickens. 33rd Biennial Meeting of the Prairie Grouse Technical Council, Bartlesville, Oklahoma.

Berigan, L., D. Haukos, D. Sullins, and K. Fricke. 2018. Lesser prairie-chicken translocation: minimizing dispersal to ensure translocation success. Kansas Natural Resources Conference, Manhattan, Kansas.

Berigan, L., D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2018. Translocation of lesser prairie-chickens: does lek presence limit dispersal? Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Berigan, L., D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2018. Role of natal habitat preference induction in prairie-grouse translocation success. International Grouse Symposium, Logan, Utah.

Blackmore, P., J. Taylor, L. Skabelund, D. Haukos, and B. Chamberlain. 2018. Butterflies using urban green roofs in the tallgrass prairie landscape. Annual Meeting of US Regional Association of the International Association for Landscape Ecology, Chicago, Illinois.

Gehrt, J., D. Sullins, and D. Haukos. 2019. Taking an Incubation break: the where, when, and why of lesser prairie- chickens leaving their nests. Annual Meeting of The Wildlife Society, Reno, Nevada.

Gehrt, J., D. Sullins, and D. Haukos. 2019. Taking an incubation break: The where, when, and why of lesser prairie- chickens leaving their nests. Kansas Natural Resource Conference, Manhattan, Kansas.

Gehrt, J.A., D.S. Sullins, and D.A. Haukos. 2018. Looking at the bigger picture: how availability of nesting and brooding habitat influences lek-site selection by lesser prairie-chickens. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Gehrt, J.M., D.S. Sullins, and D.A. Haukos. 2019. The comings and goings of lesser prairie-chickens: intrinsic and extrinsic influence on female nest attendance. 33rd Biennial Meeting of the Prairie Grouse Technical Council, Bartlesville, Oklahoma.

Gehrt, J.M., S. Stratton, and D.A. Haukos. 2020. Demographic responses of greater prairie-chickens to fire, haying, and military activity on Fort Riley Military Reservation in Riley, Kansas. Kansas Natural Resource Conference, Manhattan, Kansas.

Gerht, J.A., D. Moon, and D.A. Haukos. 2020. Effects of management strategies and military activity on greater prairie-chicken ecology on Fort Riley Military Reservation. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Gerht, J.A., D. Moon, and D.A. Haukos. 2020. Greater Prairie-chicken habitat selection within a mosaic burning regime on Fort Riley Military Reservation. Annual meeting of the Kansas Ornithological Society, virtual.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. 2018. Can you find pheasants in spring cover crops? Kansas Natural Resources Conference, Manhattan, Kansas.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. 2018. Cover crops: Altering an altered landscape to benefit wildlife? Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Kearney, Nebraska.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. 2018. Do pheasants use spring cover crops? Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. 2018. Pheasant habitat selection: logical or mysterious. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. 2019. For the birds: modifying western Kansas using spring cover crops to manage for pheasants. Kansas Natural Resource Conference, Manhattan, Kansas.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. 2019. Grassland bird response to spring cover crops in an agricultural landscape. Annual Meeting of the American Ornithological Society, Anchorage, Alaska.

Godar, A., A. Annis, D. Haukos, and J. Prendergast. 2019. Scale dependency: influencing pheasant populations using cover crops. Annual Meeting of The Wildlife Society, Reno, Nevada.

Godar, A., A. Piernicky, D. Haukos, and J. Prendergast. 2020. Adding diversity to the landscape with spring cover crops. Kansas Natural Resource Conference, Manhattan, Kansas.

Godar, A., A. Piernicky, D. Haukos, and J. Prendergast. 2020. Influence of spring cover crops on ring-necked pheasant populations in Kansas. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Godar, A., A. Piernicky, D. Haukos, and J. Prendergast. 2020. Supporting grassland birds using spring cover crops. Annual meeting of the Kansas Ornithological Society, virtual.

Godar, A., and D. Haukos. 2019. Resource selection of pheasants in response to use of cover crops. Graduate Student Forum, Division of Biology, Kansas State University, Manhattan.

Godar, A., and D. Haukos. 2020. Bugs and Birds. Nebraska Pheasants Forever Team Meeting. Fall meeting, virtual (Invited presentation).

Godar, A., and D. Haukos. 2020. Ring-necked pheasant population and space use response to landscapes including spring cover crops. "Frontiers in Agriculture" speaker, Agricultural Conservation Committee, Association of Fish and Wildlife Agencies, Fall meeting, virtual (Invited presentation).

Godar, A.J., B.A. Grisham, B.E. Ross, C.W. Boal, D. Greene, C.P. Griffin, C.A. Hagen, D.A. Haukos, M.A. Patten, and J.C. Pitman. 2018. Rangewide lesser prairie-chicken population persistence with climate change. International Grouse Symposium, Logan, Utah.

Granco, G., J. Heier Stamm, M. Daniels, J. Bergtold, M. Caldas, M. Sanderson, A. Sheshukov, M. Mather, and D. Haukos. 2018. Culture influences on human decision-making processes toward environmental policy: an integrative model of human-environment interaction. International Congress on Environmental Modelling and Software, Fort Collins, Colorado.

Griffin, C., A. Godar, D. Greene, B. Grisham, C. Boal, D. Haukos, G. Beauprez, J. Pitman, and C. Hagen. 2018. A range–wide assessment on the influence of anthropogenic structure dispersion and land cover patch size on lesser prairie-chicken lek attendance. International Grouse Symposium, Logan, Utah.

Gulick, C., and D. Haukos. 2018. Spatial patterns of lesser prairie-chickens in response to different disturbance regimes. International Grouse Symposium, Logan, Utah.

Gulick, C., and D.A. Haukos. 2018. Factors affecting habitat availability for lesser prairie-chickens across different land management regimes. Kansas Natural Resources Conference, Manhattan, Kansas.

Gulick, C., and D.A. Haukos. 2019. Influence of grassland management systems on fine-scale distribution of lesser prairie-chickens and their habitat. Annual Meeting of the Society for Range Management, Minneapolis, Minnesota.

Gulick, C., and D.A. Haukos. 2019. Influence of landscape features on female lesser prairie-chicken dispersal routes. Kansas Natural Resource Conference, Manhattan, Kansas.

Gulick, C., D. Haukos, and J. Lautenbach. 2018. Effect of grazing management systems on space use by cattle and lesser prairie-chickens. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Hagen, C., J. Kraft, J. Lautenbach, and D. Haukos. 2018. Holy cow! How grazing management strategies influence lesser prairie-chicken space use and demography. International Grouse Symposium, Logan, Utah.

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

Haukos, D.A. 2018. Beyond format and style. Workshop Presentation as part of “Don’t Get Rejected! Tips for Writing Manuscripts That Get Accepted and Published”. Annual Conference of The Wildlife Society, Cleveland, Ohio (Invited)

Haukos, D.A. 2018. Ecosystem services and playa lakes of the Great Plains. Keynote Speaker, Playa Lakes Workshop and Tour, Kansas Alliance of Wetlands and Streams, Oakley, Kansas (Invited)

Haukos, D.A. 2018. Lesser prairie-chickens – a case study in cooperative conservation. Invited presentation in symposium “Challenges of balancing stakeholder engagement and scientific decision-making to inform wildlife policy” Annual Conference of The Wildlife Society, Cleveland, Ohio (Invited)

Haukos, D.A. 2018. Role of soil health in conservation of wetlands. Kansas Soil Health Coalition, Phase 2, Manhattan, Kansas (Invited).

Haukos, D.A. 2018. Wildlife, farming, and ranching in Kansas - ecology, economics, and expectations. Keynote address, Phi Beta Kappa Induction Ceremony, Kansas State University, Manhattan, Kansas (Invited)

Haukos, D.A. 2019. Animals as indicators of environmental changes. Special Session “One Health and Animal Research - A Cross-Link to Promote Human, Animal, and Environmental Health”, American Association for Laboratory Animal Science National Meeting. Denver, Colorado (Invited).

Haukos, D.A. 2019. Lesser prairie-chicken response to changing landscapes and climate. Plenary presentation, Western Association of Fish and Wildlife Agencies, Manhattan, Kansas (Invited).

Haukos, D.A. 2020. Ecosystem services and playa lakes of the Great Plains. Keynote Speaker, Playa Lakes Workshop and Tour, Kansas Alliance of Wetlands and Streams, Garden City, Kansas (Invited)

Haukos, D.A. 2020. Effects of saline lakes and playa wetland ecological state changes on sandhill crane space use of the Southern High Plains. North American Crane Workshop, Lubbock, Texas (Invited)

Haukos, D.A., and W.C. Conway. 2018. Playas and Saline Lakes – Threatened Systems of the Semi-Arid High Plains. Annual conference of the Society of Wetland Scientists, Denver, CO. Invited presentation in symposium "Arid Wetlands: Conservation Challenges and Research Needs" (Invited)

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.

Kern, M., A. Ricketts, D. Haukos, and L. Jasper. 2018. Survival and cause-specific mortality of white-tailed and mule deer fawns in western Kansas. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Kern, M., M. Kinlan, T. Karish, A. Ricketts, D. Haukos, and L. Jaster. 2019. Neonate survival rates and bed-site selection of two sympatric deer species in western Kansas. Annual Meeting of The Wildlife Society, Reno, Nevada.

Kern, M., M. Kinlan, T. Karish, A. Ricketts, D. Haukos, and Levi Jaster. 2019. Neonate survival rates and bed-site selection of two sympatric deer species in western Kansas. Kansas Natural Resource Conference, Manhattan, Kansas.

Kern, M. J., M. A. Kinlan, T. Karish. K, A. M. Ricketts, D. A. Haukos, and L. A. Jaster. 2020. Fawn survival of white-tailed and mule deer in Kansas. Kansas Natural Resource Conference. Manhattan, KS.

Kinlan, M., D. Haukos, A. Ricketts, and L. Jasper. 2018. Seasonal survival and movements of male mule deer and white-tailed deer in western Kansas. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Kinlan, M., D. Haukos, A. Ricketts, and Levi Jaster. 2019. Movement patterns and resource selection of male mule deer and white-tailed deer in western Kansas. Annual Meeting of The Wildlife Society, Reno, Nevada.

Kinlan, M., D. Haukos, A. Ricketts, and Levi Jaster. 2019. Seasonal survival, land-cover selection, and movements of male mule deer and white-tailed deer in western Kansas. Kansas Natural Resource Conference, Manhattan, Kansas.

Kinlan, M.A., D. Haukos, A.M. Ricketts, and L. Jaster. 2020. Influence of hunting on survival of adult male mule and white-tailed deer in western Kansas. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Malanchuk, J. B., D. S. Sullins, and D. A. Haukos. 2019. Probability of mottled duck pair pond use on the Chenier Plain, Texas. North American Duck Symposium, Winnipeg, Manitoba.

Malanchuk, J., D. Haukos, and T. Bidrowski. 2019. Population status and vital rates of temperate-breeding Canada geese in Kansas. Annual Meeting of The Wildlife Society, Reno, Nevada.

Malanchuk, J., T. Bidrowski, and D. Haukos. 2020. Survival, recovery, and translocation of Kansas-banded Canada geese. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Malanchuk, J.B., and D. Haukos. 2020. Survival, recovery, and translocation of temperate-breeding Kansas-banded Canada geese. Kansas Natural Resource Conference, Manhattan, Kansas.

Mather, M. E. 2018. Implicit gender bias limits workplace diversity in the scientific profession: evidence, consequences, and remedies, Ecology and Evolutionary Biology seminar, Kansas State University, Manhattan, KS.

Mather, M. E. 2018. Strategic science–based natural resource conservation and sustainability: balancing tradition and innovation to guide change. Michigan State University, Department of Fisheries and Wildlife, East Lansing, MI.

Mather, M. E., 2018. Using empirical data on fish mobility to identify, test, and refine conceptual frameworks that can advance science-based aquatic conservation. Kansas State University Division of Biology Seminar, Manhattan, KS.

Mather, M. E. 2020. Why aren't we more successful in conserving rivers and river fish? 150th Annual Meeting of American Fisheries Society, Columbus, OH. Invited Presentation for Symposium Entitled "Merging Data Science and Fisheries and Aquatic Science to Solve Big Problems."

Mather, M. E. 2020. Combining Freakonomics with Data Fusion to Advance Big Data Approaches for Fisheries and Aquatic Conservation Problem Solving. 150th Annual Meeting of American Fisheries Society, Columbus, OH. Invited Presentation for Symposium Entitled "Merging Data Science and Fisheries and Aquatic Science to Solve Big Problems."

Mather, M. E., D. Shoup, and Q. Phelps. 2018. Thinking critically and comprehensively about choice of sampling gear in fish data collection: a review and perspective on what we need to know about gear to improve fisheries research and science-based aquatic resource conservation. Presentation in symposium on Standardized Gear. 78th Midwest Fish and Wildlife Meeting, January, Milwaukee, WI.

Mather, M. E., D. Shoup. Q. Phelps. 2018. Placing gear evaluation and standardization in a broader context that advances science-based fisheries management. Invited presentation, Symposium, Midwest Fish and Wildlife Meeting, Milwaukee, WI, January 2018

Mather, M. E., J. M. Dettmers, D. L. Parrish, R. A. State, and E. A. Marschall. 2018. A portfolio of integrated monitoring and research can advance successful science-based conservation and fisheries management. Invited Presentation (Symposium: Fisheries Successes), Annual Meeting, American Fisheries Society, Atlantic City, NJ.

Mather, M. E., J. M. Dettmers, R. A. Stein, D. L. Parrish, D. Glover. 2019. A portfolio approach to integrated assessment and research can provide a larger context for the successful evaluation of fisheries harvest regulations. 79th Midwest Fish and Wildlife Meeting, January, Cleveland, OH.

Mather, M. E., J. M. Smith, J. M. Dettmers, S. M. Hitchman, J. T. Finn. 2019. Identifying and operationalizing big hairy audacious goals for fish habitat research, management, and conservation. Presentation is part of a symposium entitled "Habitat Modeling Across Terrains and Disciplines: Addressing Common Challenges in Fisheries and Wildlife ."149th Annual American Fisheries Society Meeting and Joint Conference with The Wildlife Society in Reno, Nevada, September 29-October 3, 2019.

Mather, M.E., D. Shoup, and Q. Phelps. 2019. Ensuring that technological advances actually advance the fisheries profession: Developing a strategic framework that uses advanced technologies to solve persistent fisheries problems. Presentation is part of a symposium entitled "Integrating Advanced Technologies to Improve Data Quality and Reduce Bias in Fisheries and Wildlife Population Research and Management." 149th Annual American Fisheries Society Meeting and Joint Conference with The Wildlife Society in Reno, Nevada, September 29-October 3, 2019.

Morris, S.A., C.W. Boal, D.A. Haukos, and B.A. Grisham. 2020. Variability in lesser prairie-chicken egg morphometrics and appearance across a climate gradient. Annual Meeting of the Texas Chapter of the Wildlife Society, Corpus Christi, Texas.

Nifong, J., M. E. Mather, S. Hitchman, J, Smith. 2018. Integrating spatial patterns into future conservation, restoration, and management programs. Kansas Natural Resource Conference, Manhattan, KS.

Owen, R.K., D. Fowler, E.B. Webb, K.W. Goyne, and D.A. Haukos. 2019. Playas to potholes: how will climate change impact soil biogeochemistry in Great Plains prairie wetlands? Annual Meeting of the Soil Science Society of America, San Diego, California.

Parker, N.J., D.S. Sullins, D.A. Haukos, K.A. Fricke, and C.A. Hagen. 2020. Effects of a megafire on lesser prairie-chickens in the mixed-grass prairie. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Parker, N.J., D.S. Sullins, D.A. Haukos, K.A. Fricke, and C.A. Hagen. 2020. Influence of a megafire on lesser prairie-chicken habitat use and quality in the Mixed-Grass Prairie. Kansas Natural Resource Conference, Manhattan, Kansas.

Parker, N.J., D.S. Sullins, D.A. Haukos, K.A. Fricke, and C.A. Hagen. 2019. Lesser prairie-chicken and grassland response following intense wildfire in Kansas. 33rd Biennial Meeting of the Prairie Grouse Technical Council, Bartlesville, Oklahoma.

Parker, N.J., D.S. Sullins, D.A. Haukos, K.A. Fricke, and C.A. Hagen. 2019. Rising from the ashes? Lesser prairie-chicken and grassland response to intense wildfire in Kansas. Annual Meeting of The Wildlife Society, Reno, Nevada.

Peterson, J., S. Fuhlendorf, D. Elmore, A. Tanner, J. Earl, D. Haukos, and S. Carleton. 2018. Effects of anthropogenic structures on the long-distance movements of lesser prairie-chickens. Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.

Portillo-Quintero, C., B. Grisham, D. Haukos, C. Boal, C. Hagen, and Z. Wan. 2018. Trends of the landscape structure of plant communities of sand shinnery oak prairie in the Southern High Plains. Society of Range Management, Sparks, Nevada.

Ross, B.E., D.S. Sullins, and D.A. Haukos. 2018. Using an individual-based model to assess monitoring for lesser prairie-chicken population growth rates. International Grouse Symposium, Logan, Utah.

Ross, B.E., D.S. Sullins, and D.A. Haukos. 2018. Using an individual-based model to assess monitoring for lesser prairie-chicken population growth rates. Kansas Natural Resources Conference, Manhattan, Kansas.

Rossi, L., K. Fricke, J. Reitz, K. Schultz, and D. Haukos. 2018. Managing for recover of a prairie icon: the future of lesser prairie-chicken management. International Grouse Symposium, Logan, Utah.

Schindler, A., B. Ross, and D. Haukos. 2018. A multi-species approach to managing the effects of weather and land cover on upland game birds. Kansas Natural Resources Conference, Manhattan, Kansas.

Schindler, A.R., B. E. Ross, and D. A. Haukos. 2019. The use of decision-support software to select candidate areas for lesser prairie-chicken conservation. Annual Meeting of US-IALE (International Association of Landscape Ecologists), Fort Collins, Colorado.

Sirch, M., D.S. Sullins, D.A. Haukos, and J.D. Kraft. 2018. Lesser prairie-chicken response to intensive wildfire: one year post wildfire. Annual Meeting of the Kansas Ornithological Society, Lawrence, Kansas.

Sirch, M.S., D.S. Sullins, D.A. Haukos, and J. Kraft. 2019. Influence of burn severity on tree mortality and lesser prairie-chicken habitat in the mixed-grass prairie. Kansas Natural Resource Conference, Manhattan, Kansas.

Sullins, D. S., B. E., Ross, and D. A. Haukos. 2018. Potential bias of lesser prairie-chicken population estimates when not accounting for individual heterogeneity. Kansas Natural Resources Conference, Manhattan, Kansas.

Sullins, D., D. Haukos, and C. Hagen. 2019. Hierarchical ecological benefits of the Conservation Reserve Program in the Southern Great Plains. Annual Meeting of The Wildlife Society, Reno, Nevada. (Invited)

Sullins, D.S., B.E. Ross, and D.A. Haukos. 2018. Influence of individual heterogeneity on lesser prairie-chicken population persistence. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Sullins, D.S., D.A. Haukos, J.M. Lautenbach, and J.D. Kraft. 2018. Tradeoffs of nest and brood habitat availability for lesser prairie-chickens. International Grouse Symposium, Logan, Utah.

Sullins, D.S., M.S. Sirch, J. Kraft, and David A. Haukos. 2019. Lesser prairie-chicken response to herbaceous vegetation change following intensive wildfire. Kansas Natural Resource Conference, Manhattan, Kansas.

Teige, E., L. Berigan, C. Aulicky, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2020. Assessing the role of translocation in lesser prairie-chicken conservation. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Teige, E., L. Berigan, C. Aulicky, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2019. A new hope: monitoring the effectiveness of lesser prairie-chicken translocation in the Sand Sagebrush Ecoregion of southwestern Kansas and southeastern Colorado. Annual Meeting of The Wildlife Society, Reno, Nevada.

Teige, E., L. Berigan, C. Aulicky, D. Haukos, K. Fricke, K. Schultz, J. Reitz, and L. Rossi. 2020. Where do they go? Lesser prairie-chicken space use following translocation to the Sand Sagebrush Prairie Ecoregion. Kansas Natural Resource Conference, Manhattan, Kansas.

Teige, E.C., L.A. Berigan, C.S.H. Aulicky, D.A. Haukos, K. Fricke, K. Schultz, J. Reitz, and L. Rossi. 2019. Assessing a lesser prairie-chicken translocation in the sand sagebrush prairie ecoregion. 33rd Biennial Meeting of the Prairie Grouse Technical Council, Bartlesville, Oklahoma.

Verheijen, B.H.F, C.K.J. Gulick, J.D. Kraft, J.D. Lautenbach, J.M. Lautenbach, R.T. Plumb, S.G. Robinson, D.S. Sullins, and D.A. Haukos. 2019. How can breeding stage-specific estimates of movements and space use of female lesser prairie-chickens (Tympanuchus pallidicinctus) aid conservation efforts? Annual Meeting of The Wildlife Society, Reno, Nevada.

Verheijen, B.H.F., and D.A. Haukos. 2019. How can breeding stage-specific estimates of movements and space use of female lesser prairie-chickens aid conservation efforts? 33rd Biennial Meeting of the Prairie Grouse Technical Council, Bartlesville, Oklahoma.

Verheijen, B.H.F., C.K.J. Gulick, C.A. Hagen, J.D. Kraft, J.D. Lautenbach, J.M. Lautenbach, R.T. Plumb, S.G. Robinson, D.S. Sullins, and D.A. Haukos. 2020. Extrinsic and intrinsic drivers of resource selection by female lesser prairie-chickens. Annual Meeting of The Wildlife Society, Louisville, Kentucky.

Verheijen, B.H.F., C.K.J. Gulick, J.D. Kraft, J.D. Lautenbach, J.M. Lautenbach, R.T. Plumb, S.G. Robinson, D.S. Sullins, and D.A. Haukos. 2020. Is grassland always grassland? Spatiotemporal variation in grassland patch selection by lesser prairie-chickens. Annual meeting of the Kansas Ornithological Society, virtual.

Verheijen, B.H.F., D. M. Varner, and D. A. Haukos. 2018. Wetland functionality and continued loss negatively affect network connectivity and structure of the Rainwater Basin, Nebraska. Kansas Natural Resource Conference, Manhattan, Kansas.

Verheijen, B.H.F., D. M. Varner, and D.A. Haukos. 2018. Effects of inundation probability and sediment accumulation on the connectivity and structure of the Rainwater Basin, Nebraska. Annual Meeting of The Wildlife Society, Cleveland, Ohio.

Verheijen, B.H.F., D. M. Varner, and D.A. Haukos. 2018. Effects of large-scale wetland loss on network connectivity of the Rainwater Basin. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Kearney, Nebraska.

Verheijen, B.H.F., D. M. Varner, and D.A. Haukos. 2018. Effects of large-scale wetland loss on network connectivity of the Rainwater Basin. Kansas Natural Resources Conference, Manhattan, Kansas.

Verheijen, B.H.F., D. M. Varner, and D.A. Haukos. 2018. The effects of large-scale wetland loss on network connectivity of the Rainwater Basin, Nebraska. Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.

Verheijen, B.H.F., D.M. Varner, and D.A. Haukos. 2020. Effects of future wetland losses on network connectivity of the Rainwater Basin, Nebraska. 25th Annual Rainwater Basin Joint Venture Information Seminar, Great Bend, Nebraska.

Verheijen, B.H.F., H.L. Clipp, A.J. Bartolo, W.E. Jensen, and B.K. Sandercock. Effects of patch-burn grazing on density and territorial space use of Dickcissels. The 27th International Ornithological Congress. Vancouver, British Columbia, Canada. August 2018.

Whitson, M.D., W.C. Conway, D.A. Haukos, D.P. Collins, J.A. Moon, and P. Walther. 2019. Use of moist-soil management technique for wintering waterfowl in fallow rice fields on the upper Texas coast. North American Duck Symposium, Winnipeg, Manitoba. Poster

Whitson, M.W., W.C. Conway, D.A. Haukos, D.P. Collins, J.A. Moon, and P. Walther. 2019. Use of moist-soil management techniques for wintering waterfowl in fallow rice fields on the upper Texas Coast. Annual Meeting of The Texas Chapter of The Wildlife Society, Conroe, Texas.

Whitson. W.D., B.A. Grisham, C.A. Hagen, W.C. Conway, D.A. Haukos, and C. Villalobos. 2020. Habitat selection and nest success response by lesser prairie-chickens to prescribed burning and grazing treatments. Annual Meeting of the Texas Chapter of The Wildlife Society, Corpus Christi, Texas.

Whitson. W.D., B.A. Grisham, C.A. Hagen, W.C. Conway, R. Howard, D.A. Haukos, and C. Villalobos. 2019. Lesser prairie-chicken habitat selection and nest success response to various prescribed burning and grazing regimes in eastern New Mexico. Prairie Grouse Technical Council, Bartlesville, Oklahoma

Committees and Other Professional Assignments
2018-present

<u>Addie Annis (GRA, Graduated May 2019)</u>

- Teaching Assistant, Principals of Biology (Fall 2018 [2 sections])
- Hill City, Kansas Chamber of Commerce Monthly Meeting. Ring-necked Pheasant Project Update Presentation, 2018.
- 2019 Grade school Ring-necked pheasants presentation to kids aged 7-12 and outside telemetry group activity

<u>Carly Aulicky (GTA, Graduated December 2020)</u>

- Teaching Assistant, Principals of Biology (2 sections Fall 2018, 2 sections Fall 2019)
- US-UK Fulbright Commission Summer Institute Program, application reviewer, 2018
- Kansas State Biology Division Graduate Student Relations Committee, co-chair, 2019-present
- Flint Hills Human Rights Project, volunteer, 2017-present
- Kansas State University Graduate Student Ambassador, ambassador, 2016-present
- Kansas State University oSTEM chapter, vice president 2019-2020
- oSTEM Leadership and Education Program, volunteer 2019
- 2018Science Communication Graduate Seminar Course
- The Wildlife Society co-graduate student advisor for the Kansas State student chapter 2019-2020
- Diversity and Allies Co-chair of the Rainbow Lorikeets caucus, a joint effort with American Ornithological Society and National Organization of Gay and Lesbian Scientists and Technical Professionals
- Vice President of the Kansas State University oSTEM chapter
- Committee member of oSTEM Leadership and Education Program
- Out in Science, Technology, Engineering, and Mathematics (oSTEM) mentorship program, member of committee designing a permanent national program
- Graduate student member of Principals of Biology Course Committee
-

<u>Liam Berigan (GRA, Graduated December 2019)</u>

- Teaching Assistant, Principles of Biology BIOL 198 (2 sections Fall 2018, Fall 2019)
-

<u>Jackie Gehrt (GRA)</u>

- Teaching Assistant, Principals of Biology BIOL 198 (Spring 2018, 2019), Organismic Biology BIOL 401 (Fall 2019, 2020),

<u>Alix Godar (GRA, Graduated August 2020)</u>

- Teaching Assistant, Principals of Biology (Fall 2017, 2 sections Fall 2018)

<u>Chris Gulick (GTA, Graduated August 2019)</u>

- Teaching Assistant, Principals of Biology (Fall 2017, 2 sections Fall 2018)
- Presentor - Pollinators: Rangeland Health and Cattle Production. Kansas Grazing Lands Coalition Field Tour. June 2018.

<u>David Haukos</u>

- Editor-in-Chief, Wildlife Society Bulletin 2016-2020

- 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
- Western Association of Fish and Wildlife Agencies – Lesser Prairie-Chicken Science Work Group 2014-Current
- Board Member At Large – Kansas Chapter of The Wildlife Society (2017-2018)
- Kansas Alliance of Wetlands and Streams – Board Member 2018-Current
- Abstract Reviewer, The Wildlife Society 2018, 2019, and 2020 Annual Meetings
- External Reviewer, P/T Application, University of Wyoming, 2018
- Reviewed draft report for BLM SGP Rapid Environmental Assessment Vol II (Species and Assemblages), 2018
- External Reviewer, P/T Application, Montana State University, 2019
- Reviewed and scored 2 proposals for Wind Wildlife Research Fund, 2019
- USGS RGE Panel, 2019
- The Wildlife Society – Certification Review Board, CMPS Representative 2020-2023.
- NRES (Natural Resources and Environmental Sciences Secondary Major), Governing Board, KSU – Natural Sciences Representative 2020-2022.

Talesha Karish (GRA)

- Teaching Assistant, Organismic Biology (Fall 2018, 2019) Principals of Biology (Fall 2020)
- May 2020- Safe Capture Chemical Immobilization through San Diego Zoo Global Academy, Safe Capture International Inc.

Mitchell Kern (GRA Graduated December 2019)

- Teaching Assistant, Advanced Habitat Management, WOEM (Fall 2018, 2019), Wildlife Conflicts, WOEM (Spring 2020)
- Booth, Lenora Summer Festival

Maureen Kinlan (GRA)

- Teaching Assistant, Principles of Biology (Fall 2018, 2019, 2020), Wildlife Management and Techniques (Spring 2019, 2020)
- May 2020- Safe Capture Chemical Immobilization through San Diego Zoo Global Academy, Safe Capture International Inc.:

John Malanchuk (GRA)

- Teaching Assistant, Wildlife Management and Techniques Lab (Spring 2018, 2019, 2020), Mammalogy (Fall 2018 [2 sections]; Fall 2019 [2 sections])
- The Wildlife Society co-graduate student advisor for the Kansas State student chapter, 2019-2020.

<u>Martha Mather</u>

- Subject Editor, Wetlands Ecology and Management 2008-current
- Co-Chair, Kansas Chapter, American Fisheries Society, Membership Committee 2012-2020
- Most Promising Undergraduate Student Selection Committee, KSU, May 2017, 2018, 2019, 2020
- Invited Speaker WSFR Field Trip. Kansas Division of Fisheries, Wildlife, and Parks, May 2018
- Organizer and Participant, North Central Division, American Fisheries Society Symposium, 2019. Using Assessments to Evaluate Harvest Regulations: Advancing Science-based Fisheries Management, 79th Midwest Fish and Wildlife Meeting, January, Cleveland, OH.
- Judge, Kansas State University Graduate School Research Forum, 2017, 2018.
- Presenter, Faculty Data Blitz, Student Recruitment, 2018, 2020
- Faculty Host, David Crook, Oz to Oz Seminar Speaker, October, 2018

<u>Elisabeth Teige (GRA)</u>

- Teaching Assistant Principals of Biology (Fall 2019; Organismic Biology Fall 2020, Spring 2021)

Award ceremony for 2019 Kansas Conservation Champion (January 30, 2019). Shown from left to right are: **Brad Loveless** (Secretary of Kansas Department of Wildlife, Parks, Tourism as of January 2019), **Martha Mather** (award nominator), **Lucas Kramer** (son, KDWPT employee), **Joe Kramer** (awardee, formerly KDWPT), **Sandy Kramer** (spouse), **Matt Hough** (nominator, DU), and **Mike Nyhoff** (nominator, KDWPT)

Awards and Recognition
2018-present

Adela Annis

- Wayne Sandfort Student Travel grant from the Central Mountains and Plains Section of The Wildlife Society Fall 2018 $500
- 3rd Place in Student Poster Contest at Central Mountains and Plains Section of The Wildlife Society Annual Meeting. 2018

Carly Aulicky

- American Ornithology Society Travel Award in Support of Diversity & Inclusion $1,000, conference registration, and 2020 membership fees
- Kansas Natural Resources Conference Student Registration Scholarship 2019 $50, 2020 $65
- 2018 Kansas Chapter of the Wildlife Society Student Travel Fall 2018 $450
- Kansas State University Graduate Student Council Travel Grant Fall 2018 $450
- Student Travel Grant from KSU Graduate Student Council, Fall 2018 $350
- Biology Graduate Student Association Travel Grant Fall 2018 $500
- Kansas State College of Arts and Sciences Travel Grant Fall 2018 $800

Liam Berigan

- American Ornithological Society Travel Award of $490 to present at the 2019 American Ornithological Society Annual Meeting
- Kansas Natural Resources Conference 2018 Student Fee Scholarship ($50)
- Kansas Natural Resources Conference 2019 Student Fee Scholarship ($50)
- Student Travel Grant from KSU Graduate Student Council, Fall 2018 $450
- Biology Graduate Student Association Travel Grant Fall 2018 $500
- Kansas State College of Arts and Sciences Travel Grant Fall 2018 $800

Jackie Gehrt

- Travel grant from The Wildlife Society, 2018 $500

Alix Godar

- First Place in the Student Poster competition at the Central Mountains and Plains Section of The Wildlife Society, 2018
- Best Slides at Graduate Students on Parade 2018
- BSGA Travel Grant 2018 $500; 2019 $500
- Central Mountains and Plains Travel Grant 2018 $150
- American Ornithological Society Travel Award of $490 to present at the 2019 American Ornithological Society Annual Meeting
- Kansas Natural Resource Conference Student Registration Scholarship-2015, 2016, 2017, 2019, 2020

David Haukos

- The Wildlife Society – Wildlife Publications Award – Edited Book 2018. D. Haukos and C. Boal, editors. Ecology and Conservation of Lesser Prairie-Chickens.
- Texas Chapter of The Wildlife Society Scientific Publication of the Year Award: Book

2018 for D. Haukos and C. Boal, editors. Ecology and Conservation of Lesser Prairie-Chickens.

- The Wildlife Society – Caesar Kleberg Award for Excellence in Applied Wildlife Research. 2019
- The Wildlife Society – 2020 Wildlife Publication Award – journal paper category, shortlisted (top 5) Daniel Sullins, David Haukos, Joseph Lautenbach, Jonathan Lautenbach, Samantha Robinson, Mindy Rice, Brett Sandercock, John Kraft, Reid Plumb, Jonathan Reitz, J.M. Shawn Hutchinson, and Christian Hagen. 2019. Strategic conservation for lesser prairie-chickens among landscapes of varying anthropogenic influence. Biological Conservation https://doi.org/10.1016/j.biocon.2019.108213.

Mitchell Kern
- Graduate Student Council Travel Grant: 2018 $400
- KNRC Registration Grant: 2019 and 2020 $60
- The Kansas Chapter of The Wildlife Society Travel Grant: 2019 $320

Maureen Kinlan
- Central Mountains and Plains Wayne Sandfort Travel Grant; $100.00, Fall 2019
- Graduate Student Council Travel Award; $400.00, Fall 2019
- Kansas Chapter of the Wildlife Society; $320.00, Fall 2019

John Malanchuk
- Kansas Natural Resources Conference Student Scholarship, 2019 $60
- Delta Waterfowl – Waterfowl breeding ecology graduate course. Prairie Pothole and Prairie Parkland region, North Dakota/ Manitoba, 11-25 May 2019.
- Smithsonian-Mason School of Conservation. Estimating animal abundance and occupancy graduate and professional short course. 8-19 July 2019.

Martha Mather
- Promoted to Adjunct Professor, Kansas State University, Spring 2019

Elisabeth Teige
- Central Mountains and Plains Section of The Wildlife Society - Wayne Sandfort Student Travel Grant, 2020 - $100

BramVerheijen
- Travel Grant, The Wildlife Society, 2019 - $350

Additional Award
- The Wildlife Society's Wildlife Restoration Awards - Wildlife Management – Kansas Wildlife, Parks, and Tourism, Lesser Prairie-Chicken Project, Kansas Cooperative Fish and Wildlife Research Unit. 2019

Cooperating Landowner Awards

Ed Kroger, Hash Knife Ranch. 2018. The Wildlife Society Central Mountains and Plains Section, Citizen Conservation Award

Stacy Hoeme, Hoeme Land and Cattle. 2019. The Wildlife Society Central Mountains and Plains Section, Citizen Conservation Award

University Courses Taught by Unit Faculty 2010-2020

2010

Ornithology	Instructor: Dr. Jack F. Cully, Jr. Assistant Unit Leader
Biopolitics and Natural Resource Policy	Instructor: Dr. David Haukos Texas Tech University
Fisheries Management and Techniques	Instructor: Dr. Craig P. Paukert Acting Unit Leader
Advances Fisheries Science	Instructor: Dr. Craig P. Paukert Acting Unit Leader

2011

Professional Skills	Co-Instructor: Dr. Martha Mather Assistant Unit Leader

2012

Wildlife Conservation – Terrestrial Portion	Dr. David Haukos Unit Leader
Advanced Spatial Modeling	Instructors: Dr. David Haukos, Dr. Gene Albanese Unit Leader, Research Associate
Professional Skills	Co-Instructor: Dr. Martha Mather Assistant Unit Leader
	Co-Instructor:

River Regimes	Dr. Martha Mather Assistant Unit Leader

2013

Wildlife Conservation – Terrestrial Portion	Dr. David Haukos Unit Leader
Professional Skills	Co-Instructor: Dr. Martha Mather Assistant Unit Leader

2014

Wildlife Conservation – Terrestrial Portion	Dr. David Haukos Unit Leader
Professional Skills	Co-Instructor: Dr. Martha Mather Assistant Unit Leader
Advanced Spatial Modeling	Instructors: Dr. David Haukos, Dr. Gene Albanese Unit Leader, Research Associate
Bayesian Methods in Ecology	Instructors: Dr. David Haukos, Dr. Beth Ross Unit Leader, Research Associate

2015

Wildlife Conservation – Terrestrial Portion	Dr. David Haukos Unit Leader
Professional Skills	Co-Instructor: Dr. Martha Mather Assistant Unit Leader
Introduction to WOEM, Pistols and Rifles, Hunter Education Instructor	Thomas Becker, WOEM

2016

Wildlife Conservation – Terrestrial Portion	Dr. David Haukos

	Unit Leader
Professional Skills	Co-Instructor: Dr. Martha Mather Assistant Unit Leader
Habitat Ecology and Management	Dr. David Haukos Unit Leader

2017

Wildlife Conservation – Terrestrial Portion	Dr. David Haukos Unit Leader
Professional Skills	Co-Instructor: Dr. Martha Mather Assistant Unit Leader
Habitat Ecology and Management	Dr. David Haukos Unit Leader
Population Biology	Co-Instructor Dr. David Haukos Unit Leader

2018

Wildlife Conservation – Terrestrial Portion	Dr. David Haukos Unit Leader
Natural Resource Selection	Dr. David Haukos, Dr. Dan Sullins Unit Leader, Research Associate
Population Biology	Dr. David Haukos Unit Leader

2019

Introduction to Fisheries, Wildlife, Conservation, and Environmental Biology (BIOL 433) – Terrestrial Portion	Dr. David Haukos Unit Leader
Natural Resources/Environmental Science Project (NRES). Capstone Course (BAE/DAS/GENAG 582)	Dr. David Haukos, Unit Leader, Faculty Team Mentor

Design and Analyses of Wildlife Population Studies (BIOL 890)	Dr. David Haukos, Unit Leader, Dr. Bram Verheijen, Research Associate
Habitat Ecology and Management (BIOL 890)	Dr. David Haukos, Unit Leader
2020	
Introduction to Fisheries, Wildlife, Conservation, and Environmental Biology (BIOL 433) – Terrestrial Portion	Dr. David Haukos Unit Leader
Professional Skills (BIOL 863)	Co-Instructor: Dr. Martha Mather Assistant Unit Leader
Demographic Methods (BIOL 823)	Dr. David Haukos, Unit Leader,

Kansas State University Degrees Completed 1996 – 2020

2020

Alixandra Godar. (Ph.D., 2020, Haukos) Ring-necked pheasant population and space use response to landscapes including spring cover crops. (Post-Doctoral Research Associate, Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University).

Carly Aulicky. (Ph.D., 2020, Haukos) Lek dynamics and range-wide morphometric patterns of lesser prairie-chickens. (Post-Doctoral Research Associate, Kansas Cooperative Fish and Wildlife Research Unit, Kansas State University)

2019

Liam Berigan. (M.S., 2019, Haukos) Dispersal, reproductive success, and habitat use by translocated lesser prairie-chickens. (PhD Candidate, University of Maine)

Chris Gulick. (M.S., 2019, Haukos) Spatial ecology and resource selection by female lesser prairie-chickens within their home ranges and during dispersal. (PhD 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. (Game Warden, Wyoming Game and Fish)

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 Professor, Wildlife and Outdoor Enterprise Management, Kansas State University)

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. (Field Representative, Indigo Inc.)

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. (Ecologist, Fort Riley, DOD)

Sarah Ogden (M.S. 2016; advisor Haukos) – Responses of grassland birds and butterflies to control of sericea lespedeza with fire and grazing. (Ecologist, Lake County Conservation District, Montana)

Thomas Becker (M.S. 2016; advisor Haukos, Horticulture and Natural Resources) – Retrospective review of avian diseases in Kansas. (Biotech, Cuyahoga Valley National Park)

2015

Samantha Robinson (M.S.2015; advisor Haukos). Landscape conservation design, movements, and survival of lesser prairie-chickens in Kansas and Colorado. (Ph.D graduate, Virginia Tech University, 2020; Program Manager for Avian Conservation, Delaware Department of Natural Resources and Environmental Control)

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.

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, Voyagers National Park, National Park Service)

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.

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. (Wildlife Biologist, Aransas 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.

2004

No degrees granted

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: Gipson) 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.