Biennial Report

August 2016 - August 2018

Kansas Cooperative
Fish and Wildlife Research Unit

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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

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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.

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, 2 new projects were initiated, 10 projects were ongoing, and 10 projects were completed. Thirteen students finished Master's degrees and 2 finished Ph.D. degrees.

New Projects:

Evaluating Black Rail Habitat Availability, Occupancy Probability, and Response to Wetland Management Practices in Kansas (with E. Webb, MOCFWRU)

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

On-going 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

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

Plum Island Ecosystems LTER

Coupled Climate, Cultivation and Culture in the Great Plains: Understanding Water Supply and Water Quality in a Fragile Landscape (Mather on-going)

Completed Projects:

Early Spawn and Natural Spawn Age-0 Largemouth Bass: Food Habits and Habitat Use Evaluation

Use of Moist-Soil Management for Waterfowl on the Texas Coast

Breeding Season Survival, Space Use, Movement, and Habitat Use of Female Lesser Prairie-Chickens (*Tympanuchus pallidicinctus*) in Kansas and Colorado

Landscape Conservation Design, Movements, and Survival of Lesser Prairie-Chickens in Kansas and Colorado.

Verifying ground-based habitat quality monitoring and micro-habitat selection by lesser prairie-chickens (*Tympanuchus pallidicinctus*) with remote sensing technology

Landscape Demography and Spatial Use of Lesser Prairie-Chickens in Kansas and Colorado

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

A Multi-Scale Examination of the Distribution and Habitat Use Patterns of the Regal fritillary (*Speyeria idalia*) within the Fort Riley Military Reservation

Climatic and Anthropogenic Forcing of Wetland Landscape Connectivity in the Great Plains

Restoration of Tall-Grass Prairie Infested with *L. cuneata*

Master's Theses Completed:

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 (Aquatic Technician, NEON Project)

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. (Natural Resource Specialist, Oregon Department of Fish and Wildlife).

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)

Mike Whitson (M.S., 2017; advisor Conway/Haukos, Texas Tech University) – Use of moist-soil management techniques for wintering waterfowl in fallow rice fields on the upper Texas coast. (Ph.D candidate, Texas Tech University)

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. (GIS Specialist, 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. (Environmental Biologist, Indiana DNR)

Hannah Ashbaugh (M.S. 2016; advisor Conway/Haukos Texas Tech University). Effects of heavy metals on snowy plovers nesting in saline lakes of the Southern High Plains. (Customs Agent, U.S. Fish and Wildlife Service)

Alix Godar (M.S. 2016; advisor Grisham/Boal/Haukos Texas Tech University) – Influence of climate change and land use on lesser prairie-chicken (Tympanuchus pallidicinctus) population persistence in the sand sagebrush and short-grass prairies (Ph.D candidate, Kansas State University)

Cody Griffin (M.S. 2016; Grisham/Boal/Haukos Texas Tech University) – The influence of environmental and landscape variables on lesser prairie-chickens in the Sand Shinnery Oak Prairie Ecoregion of Texas and New Mexico and the Mixed-Grass Prairie Ecoregion of Oklahoma and Kansas (Shorebird Quantitative Analyst, Florida Fish and Wildlife Conservation Commission)

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

Ph.D. Dissertations Completed:

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. (Biological Sciences instructor, Allen Community College)

Dan Sullins (Ph.D. 2017; advisor Haukos) - Regional variation in demography, distribution, foraging, and strategic conservation of lesser prairie-chickens in Kansas and Colorado. (Post-Doctoral Research Associate, 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
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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
Maiah Diel, Office Manager and Administrative Assistant
Dan Sullins, Ph.D, Research Associate – Wildlife, Division of Biology
Bram Verheijen, Ph.D, Research Associate – Wildlife, Division of Biology
James Nifong, Ph.D, Research Associate – Fisheries, Division of Biology; currently Research Biologist, U. S. Army Engineer Research and Development Center
Gene Albanese, Ph.D, Research Associate – Wildlife, Division of Biology; currently Regional Scientist, Massachusetts Audubon
Beth Ross, Ph.D, Research Associate – Wildlife, Division of Biology; currently Assistant Unit Leader, South Carolina Cooperative Fish and Wildlife Research Unit, Clemson University

Faculty Cooperators at Kansas State University

Division of Biology

Dr. Alice Boyle	Dr. Walter Dodds
Dr. Keith Gido	Dr. Andrew Hope

Department of Biological and Agricultural Engineering
Dr. Stacy Hutchinson

Department of Geography
Dr. Doug Goodin
Dr. Shawn Hutchinson

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

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

South Dakota State University
Dr. Carter Johnson

Stephen F. Austin State University
Dr. Chris Comer

Emporia State University
Dr. William Jensen

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

University of Minnesota – Duluth
Dr. Christopher Wright

State of Kansas

Kansas Department of Wildlife, Parks, and Tourism

Chris Berens
Tom Bidrowski
Dr. Lloyd Fox
Kent Fricke
Shane Hesting
Levi Jaster
Jeff Koch
Ron Marteney
Doug Nygren
Matt Peek
Jeff Prendergast
John Reinke
Richard Schultheis
Kraig Schultz
Mark Van Scoyoc
Keith Sexson
Matt Smith
Ely Sprenkle

Federal Government

U.S. Fish and Wildlife Service, Kansas
Susan Blackford
Mike Disney
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Aron Flanders
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Rachel Lauban
Jason Lugenbill
Vernon Tabor

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

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

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Dr. Mindy Rice

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

U.S. Geological Survey
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Dr. Clint Boal
Dr. Steve Hostetle
Dr. Jeff Kershner
Dr. Donna Parrish
Dr. Kevin Pope
Dr. Elizabeth Webb

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

U.S. Army, Fort Riley
Kelsey McCullough
Shawn Stratton

Other State Agencies

Colorado Wildlife and Parks
Brian Dreher
Dr. Jim Gammonly
Dr. David Klute
Liza Rossi
Jonathan Reitz

Texas Parks and Wildlife Department
Kevin Kraai

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, 2016-present
Kansas State University

Student and Degree Sought	Thesis Project	Previous Education	Advisor
Adelia Annis, MS	The influence of cover crops on survival and nest success of ring-necked pheasants in northwestern Kansas	B.S., Unity College	Dr. Haukos
*Hannah Ashbaugh, MS	Effects of heavy metals on snowy plovers nesting in saline lakes of the Southern High Plains	B.S., Tarleton State University	Dr. Haukos
Carly Aulicky, Ph.D	Landscape patterns contributing to lek establishment and morphometrics of attending lesser prairie-chickens	B.S., Rutgers University M.S., University of Glasgow	Dr. Haukos
*Thomas Becker, M.S.	Occurrence and prediction of avian disease outbreaks in Kansas	B.S., Kansas State University 3+2 Program, College of Agriculture	Dr. Haukos
Liam Berigan, M.S.	Dispersal, reproductive success, and habitat use by translocated lesser prairie-chickens	B.S., Cornell University	Dr. Haukos
*Alixandra Godar, M.S.	Influence of climate change and land use on lesser prairie-chicken (*Tympanuchus pallidicinctus*) population persistence in the sand sagebrush and short-grass prairies	B.S., University of Wisconsin – Stevens Point	Dr. Haukos
Alixandra Godar, Ph.D	Changes in space use and habitat selection by ring-necked pheasants in response to use of cover crops in northwestern Kansas	B.S., University of Wisconsin – Stevens Point M.S., Texas Tech University	Dr. Haukos
*Cody Griffin, M.S.	The influence of environmental and landscape variables on lesser prairie-chickens in the Sand Shinnery Oak Prairie Ecoregion of Texas and New Mexico and the Mixed-Grass Prairie Ecoregion of Oklahoma and Kansas	B.S., Oklahoma State University	Dr. Haukos
Chris Gulick, MS	Relative use of habitat types by lesser prairie-chickens and cattle in a patch-burn management system	B.S., Texas Tech University	Dr. Haukos

*Sean Hitchman, Ph.D.	A mosaic approach can advance the understanding and conservation of native fish biodiversity in natural and fragmented riverscapes	B.S., Univ. of South Carolina M.S., Univ. of San Diego	Dr. Mather
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
Mitchell Kern, M.S.	Factors affecting survival of fawns of sympatric white-tailed deer and mule deer among Kansas landscapes	B.S., Virginia Tech University	Dr. Haukos
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
*John Kraft, M.S	Vegetation characteristics and lesser prairie-chicken responses to land cover types and grazing management in western Kansas	B.S., Emporia State University	Dr. Haukos
*Jonathan Lautenbach, M.S.	The role of fire, microclimate, and vegetation in lesser prairie-chicken habitat selection	B.S., Fort Wayne State University	Dr. Haukos
*Richard Lehrter, M.S.	Links between food web structure, biodiversity, and resilience: effects of anthropogenic disturbance on aquatic communities in the Smoky Hill River, KS	B.S., University of Oklahoma	Dr. Mather
John Malanchuk, Ph.D	Ecology of resident Canada geese in Kansas	B.S., Rhodes College M.S., University of Wisconsin – Stevens Point	Dr. Haukos
*Willow Malone, M.S.	Biodiversity in playa wetlands in relation to watershed disturbance	B.S., Kansas State University	Dr. Haukos
*Robert Mapes, M.S.	Young of year largemouth bass (*Micropterus salmoides*) relative abundance and diet: role of habitat type, spatial context, and size	B.S., University of Toledo	Dr. Mather
*Kelsey McCullough, M.S.	A multi-scale examination of the distribution and habitat use patterns of the regal fritillary	B.S., Kansas State University	Dr. Haukos
*Sarah Ogden, M.S.	Restoration of tall-grass prairie infested with *L. cuneata*	B.S., Goucher College, Baltimore	Dr. Haukos

*Dan Sullins, Ph.D	Regional variation in demography, distribution, foraging, and strategic conservation of lesser prairie-chickens in Kansas and Colorado	B.S., Texas A&M University M.S., Stephen F. Austin State University	Dr. Haukos
*Ryland Taylor, M.S.	Using geomorphology and animal "individuality" to understand 'scape-scale predator distributions	B.S., University of Florida	Dr. Haukos, Dr. Mather
Brandon Weihs, Ph.D.	Estimating inundation frequency of playa wetlands Using 1970s LandSat MSS data: did irrigation practices artificially increase frequency and longevity of landscape wetness?	B.S., Univ. of Nebraska – Omaha M.S., Univ. of Nebraska – Omaha	Dr. Haukos
*Michael Whitson, M.S.	Use of moist-soil management techniques for wintering waterfowl in fallow rice fields on the upper Texas coast	B.S., Texas Tech University	Dr. Haukos

*Graduated

Fisheries Projects

Ongoing 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
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

Status
On-going

Progress and Results

Overall
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.; Dr. Joseph Smith, post-doctoral fellow; Dr. James Nifong, post-doctoral fellow, and Dr. Martha Mather, Principal Investigator) are sampling fish communities and instream habitat at dammed and undammed sites within the upper Neosho River, KS, and Smoky Hill River, KS. Ultimately, this research can be used to manage fish and dams in Great Plains stream and river networks.

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 have 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.

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,

Identify the role of heterogeneity in stream networks

Location
Neosho River, KS
Smoky Hill River

Completion
March, 2019

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. This helped us interpret dam impacts on fish communities.

This research will advance riverscape-scale understanding of the structure and function of aquatic ecosystems. In addition, managers will be able to place conservation actions in a synthetic, landscape-scale, multiple-stressor context. As such, our research will benefit management. Jane Fencl's M.S. research (defended April 2015) focused on how dams alter fish communities. Sean Hitchman's Ph.D. research (defended 2017) examined patterns, drivers, and consequences of habitat heterogeneity in stream networks. These projects are described in detail below.

Jane Fencl (Thesis): ***How Big of an Effect Do Small Dams Have?: Using Ecology and Geomorphology to Quantify Impacts of Low-Head Dams on Fish Biodiversity.*** 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. Two peer reviewed manuscripts have been published from Jane Fencl's thesis.

Sean M. Hitchman ***(Dissertation). A Mosaic Approach Can Advance the Understanding and Conservation of Native Fish Biodiversity in Natural and Fragmented Riverscapes.*** 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. Here, 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. Our sampling of fish and habitat along 10 3-km sites within the Upper Neosho subdrainage, KS, from June-August 2013, 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 for biodiversity 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. Two peer-reviewed manuscripts have been published from Sean Hitchman's dissertation and another manuscript is in review.

Dr. James Nifong is contributing to the final synthesis of these data with a focus on scale and integration. Together, this body of research positions the Kansas Cooperative Fish and Wildlife Research Unit, the Kansas Department of Wildlife, Parks, and Tourism Ecological Services, and the Division of Biology – Kansas State University as leaders in conservation research in aquatic landscapes.

Products

Publications

Hitchman, S. M., M. E. Mather, J. M. Smith, J. S. Fencl. 2017. 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 https://doi.org/10.1016/j.scitotenv.2017.10.272; http://www.sciencedirect.com/science/article/pii/S004896971732990X

Fencl, J., M. Mather, J. Smith, and S. Hitchman. 2017. The blind men and the elephant examine biodiversity at low-head dams: are we all dealing with the same dam reality? Ecosphere 8 (1): 1-17; DOI: 10.1002/ecs2.1973; http://onlinelibrary.wiley.com/doi/10.1002/ecs2.1973/full

Hitchman*, S.M, M. E. Mather, J. Smith, and J. Fencl. 2017. Identifying keystone habitats with a mosaic approach can improve biodiversity conservation in disturbed ecosystems. Global Change Biology 2017;1–14. DOI: 10.1111/gcb.13846; http://onlinelibrary.wiley.com/doi/10.1111/gcb.13846/epdf

Fencl J. S., M. E. Mather, K. B. Costigan, and M. D. Daniels. 2015. How big of an effect do small dams have?; Using geomorphological footprints to quantify spatial impact of low-head dams and identify patterns of across-dam variation. PLoS One 10(11): e0141210. doi:10.1371/journal.pone.0141210

Presentations

Fencl J. S., M. E. Mather, J. M. Smith, and S. M. Hitchman. 2015. Quantifying river fragmentation: impacts of low-head dams on geomorphology and fish biodiversity in the Neosho River, Kansas. North Central Division, American Fisheries Society, Indianapolis, IN.

Hitchman, S. M., M. E. Mather, J. M. Smith and J. S. Fencl. 2015. Are riffles keystone habitats in a low-gradient prairie stream?; implications for riverscape ecology and stream conservation. American Fisheries Society, Portland, OR.

Hitchman, S. M., M. E. Mather, J. M. Smith, J. S. Fencl. 2016. Viewing streams as a habitat mosaic; implications for riverscape ecology and stream conservation. Presentation was part of the symposium entitled *"Fish Research and Conservation in the 'Scapes: Needs, Progress, Challenges and Opportunities."* 146th Annual Meeting of the American Fisheries Society, Kansas City, MO, August, 2016.

Mather, M. E., J. M. Smith, C. G. Kennedy, K. M. Gerber, and R. B. Taylor. 2016. Mobile organisms in the 'scape': patterns, consequences, and challenges. Presentation was part of the symposium entitled *"Fish Research and Conservation in the 'Scapes: Needs, Progress, Challenges and Opportunities."* 146th Annual Meeting of the American Fisheries Society, Kansas City, MO, August, 2016.

Smith, J. M., M. E. Mather, and S. M. Hitchman. 2016. Operationalizing riverscapes. Presentation was part of the symposium entitled *"Fish Research and Conservation in the 'Scapes: Needs, Progress, Challenges and Opportunities."* 146th Annual Meeting of the American Fisheries Society, Kansas City, MO, August, 2016.

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.

Thesis/Dissertation

Hitchman, S. 2018. A mosaic approach can advance the understanding and conservation of native fish biodiversity in natural and fragmented riverscapes. Dissertation, Kansas State University, Manhattan.

Fencl, J. 2015. How big of an effect do small dams have? Using ecology and geomorphology to quantify impacts of low-head dams on fish biodiversity. Thesis, Kansas State University, Manhattan.

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

Student Investigator:
Richard Lehrter, M.S.

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

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
On-going

Progress and Results

Overall
Models are needed that account explicitly for human-landscape interactions. In the four components of this proposal, an interdisciplinary team develops a coupled human-landscape model that incorporates atmospheric, terrestrial, aquatic, and social processes to predict the potential impact of climate variability, climate change, land use, and human activity on water resources. In this specific project, we evaluate the effects of the above on native Kansas fish biodiversity.

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.

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.

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. Biodiversity is also valued by a diverse human stakeholders including groups interested in conservation, recreation, and hunting-fishing. Thus, biodiversity is a natural link for coupling human and natural systems. Our integrated research should provide wide benefits to both science and society.

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.

This project's contribution to this collaboration will be to relate distribution of fish communities to environmental impacts. By coordinating fish biodiversity sampling in the Smoky Hill River with geomorphology, hydrology, and land use, our research team will better understand how humans impact aquatic systems. This information can then be combined with human surveys of use and value to advance science and increase the efficiency of conservation efforts.

Richard Lehrter defended his MS thesis entitled "***Large-scale drivers of fish biodiversity differ cross an environmentally-variable watershed***" in March 2018. The results from this thesis are summarized below. 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, I 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.

The research, described above, is a central component of the 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.

Products

Publications

Caldas, M., M. Sanderson, M. Mather, M. Daniels, J. Bergtold, J. Aistrup, J. Heier Stamm, D. Haukos, K. Douglas-Mankin, A. Sheshukov, and D. Lopez-Carr. 2015. Opinion: Incorporating culture in sustainability science research and policy. Proceedings of the National Academy of Sciences 112: 8157–8159.

Presentations

Lehrter, R. and M. E. Mather. 2017. Geographic region, land use, flow, and discontinuities influence fish biodiversity across regions in a Great Plains watershed. Kansas Natural Resource Conference (Poster).

Mather, M. E., and R. Lehrter. 2017. Fish biodiversity as an interdisciplinary link for sustainability. American Fisheries Society, Tampa, FL

Thesis

Lehrter, R. 2018. Links between food web structure, biodiversity, and resilience: effects of anthropogenic disturbance on aquatic communities in the Smoky Hill River, KS. Thesis, Kansas State University, Manhattan

Plum Island Ecosystems LTER

Student Investigator:
Ryland Taylor, M.S.

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 in the coastal zone

Determine the spatial arrangement and the connectivity between ecological habitat patches in coastal watersheds and the estuarine seascape including their influence ecological processes

Ecological studies of mobile fish predators

Location
Plum Island Estuary

Completion
December 2019

Status
Ongoing

Progress and Results
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.

Understanding the role of predators requires that we understand the regional scale dynamics of highly migratory striped bass. Our involvement in this project focuses on how movements of top fish predators affect ecosystem structure and function. Specifically, using acoustic tags in conjunction with acoustic receivers, we have discovered that 65% of PIE striped bass (ages 4-6) stay in PIE to feed for > 60 days each year, winter in Delaware Bay or the Hudson River, then return to PIE the following year.

Ryland Taylor's MS thesis entitled *"Using geomorphology and animal "individuality" to understand 'scape-scale predator distributions*' was completed in 2017. The main results are summarized below.

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. 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. 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. 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 clustered 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.

The scientific questions, methods, and management applications are very similar to the 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.

Products

Presentations

Taylor, R., M. E. Mather, C. G. Kennedy, J. M. Smith, K. M. Gerber. 2015. Confluence network dynamics can create a spatial mosaic of predator interactions. Poster, Ecological Society of America, Baltimore, MD.

Mather, M. E., R. Taylor, C. G. Kennedy, J. M. Smith, L. A. Deegan, J. T. Finn, K. M. Gerber. 2015. Trade-offs between site fidelity and local dispersal create heterogeneity in consumer-mediated habitat linkages in a disturbed seascape. Ecological Society of America, Baltimore, MD. (Symposium speaker and organizer).

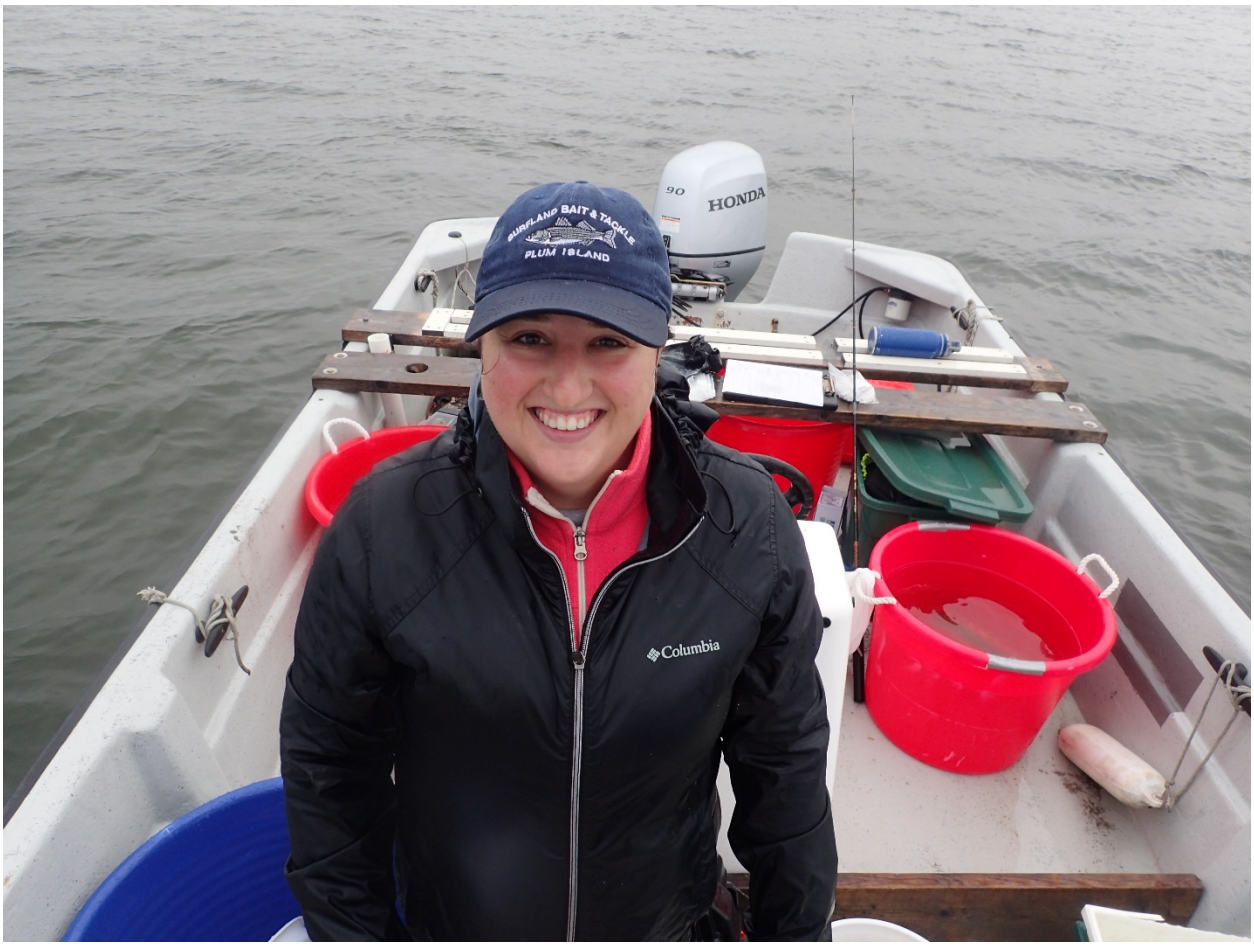
Grill*, J., R. Taylor, M. Mather. 2017. Where and how predators feed: migratory striped bass can provide general insights into sportfish foraging. Kansas Natural Resource Conference (Poster).

Taylor*, R. B., M. E. Mather, J. M. Smith, and K. M. Gerber: 2017. Site fidelity: literature, theory, and tests. Ecological Society of America, Portland, OR

Mather, M. E., J. M. Smith, K. Gerber, R. Taylor. 2017. Resmo: Patterns in residence and movement across sites can provide novel insights into field distribution of mobile consumers in pelagic ecosystems. Invited Paper, Symposium, American Fisheries Society, Tampa, FL

Thesis

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



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

Project Supervisor:
Dr. Donna Parrish

Funding
NMFS

Cooperators:
Kansas State University

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

Location
US Rivers

Expected Completion
December 2018

Status
On-going

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 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 NE 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 Midwest and Northeast.

In previous work, we modeled survival of Atlantic salmon smolts in the Connecticut River. We continue to take a modeling approach using fish life history (e.g., spawning behavior, thermal preferences, and habitat) and existing temperature and discharge data sets). The present model uses multiyear data on temperature and discharge to understand probability of recruitment for young shad that inhabit the river mainstream Connecticut River for 60-90 days before egressing the system as juveniles. Results should be applicable to mobile fish in large and small Great Plains rivers as well as elsewhere in the United States.

Completed Fisheries Projects

Young of Year Largemouth Bass (*Micropterus salmoides*) Relative Abundance and Diet during the First Summer of Life: Role of Habitat Type, Sampling Time, Stocking Treatment, and Fish Size in Hillsdale Lake, KS

Student Investigators:
Robert Mapes, M.S.

Undergraduates:
Austin Earl,
Jarrett Romine
McKenna Miller

Project Supervisor
Dr. Martha Mather

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

Kansas State University

Objectives:

(1) Does habitat type (vegetated, beach), sample event (i.e., time during the first summer) and the interaction among habitat type and sample event affect young of year largemouth bass relative abundance.

(2) Do the same variables (habitat, sample event, the interaction among habitat and sample event) affect diet composition as measured by number and weight of four major prey categories.

(3) Are distribution, habitat use, and diet of young of year largemouth bass related to stocking treatment (wild, stocked phase 1, stocked phase 2) or body size (wild, < stocked phase 1 <stocked phase 2)?

Status
Completed

Progress and Results

Habitat is an important component of fish ecology and fisheries management that together with sample time, stocking treatment, body size, and year can affect the relative abundance and diet of young largemouth bass (*Micropterus salmoides*). Here we ask four specific research questions about young of year largemouth bass in Hillsdale Reservoir, Hillsdale Lake, KS, for all young bass combined and for three separate "stocking groups" of first year largemouth bass [(1) naturally spawned or wild bass, (2) stocked phase 1 early-spawned bass, (3) stocked phase 2 early-spawned bass]. These four questions, listed as objectives in the column to the left, were addressed using data from 2014 and 2015.

Across all habitats, sample events, and stocking treatments, 949 young of year largemouth bass were collected in 2014 and 251 young of year largemouth bass were collected in 2015. In general, relative abundance and diet trends were similar across habitat, sample event, stocking treatment, and year. In 2014 and 2015, young of year largemouth bass were caught in both vegetated and beach habitats. In both years, catch per unit effort of young of year largemouth bass was lowest at the end of the sampling season, although the exact temporal dynamics differed slightly across years. In 2014 and 2015, more wild largemouth bass were caught than either of the two hatchery stocking treatments (phase 1 or phase 2). In 2014, by number, benthic invertebrates were the most common prey eaten by young of year largemouth bass. In 2014 and 2015, by weight, fish were the most common prey eaten by young of year largemouth bass. In both 2014 and 2015, diets, based on number and weight, were similar across vegetated and beach habitat types. In 2014, weight of benthic invertebrates eaten decreased as the summer progressed. In 2014, small differences were detected in the weight of benthic invertebrates eaten by phase 2 largemouth bass and the in the timing of terrestrial invertebrate consumption by wild and stocked fish. However, neither of these invertebrate prey groups constituted a major component of the diets of young of year largemouth bass by weight. In both 2014 and 2015, the weight of fish prey eaten did not differ across stocking treatments. In general, the across habitat distribution and diets of the three stocking treatments were the same as all young of year largemouth bass combined. This suggests that Hillsdale Reservoir has a robust largemouth bass population that is not recruitment limited. In both years, phase 2 largemouth bass were largest. In 2015, wild largemouth bass were the smallest. Sizes of young of year largemouth

(4) Do prey type and number differ across habitat types?

Location
Hillsdale Reservoir, KS

Completion
December, 2016

bass were not related to diet number or weight in either year.

In December, 2016, Robert Mapes completed his MS thesis entitled "*Young of year largemouth bass (Micropterus salmoides) relative abundance and diet: role of habitat type, spatial context, and size"* This thesis is similar to, but not the same as, the main project report, summarized above. The overarching goal of this thesis was to examine the spatial context of fish habitat in order to improve the effectiveness of fisheries management. To achieve this goal, we quantified approaches to fish habitat used in a select sample of the peer reviewed literature. Next, we tested how habitat type affected young of year largemouth bass relative abundance, diet, and size. Then we tested if approaches to assessing habitat provided different ecological answers to key questions using 1,200 first year largemouth bass (*Micropterus salmoides*) collected in Hillsdale Lake, Kansas, in 2014-2015. Field sampling provided several insights. First, young of year largemouth bass were more abundant in vegetation and beach habitats than in rock, wood, or offshore habitats. Second, diets were similar across vegetated and beach habitat types. Third, size increased through time. However, the size range seen for first year largemouth bass in the first summer did not alter their distribution or diet. Fourth, spatial context (choice of microhabitat, habitat type, or macrohabitat) influenced empirical insights about largemouth bass habitat use and diet. In summary, incorporating spatial context into young of year largemouth bass research could improve our scientific understanding and aid in restoration and management of reservoir and lake fisheries.

This study has contributed substantial new information about the distribution and diets of largemouth bass during their first summer. The database collected here represents one of the most detailed records of first year largemouth bass distribution and diet in the literature. All details of the research can be found in quarterly reports for 2013-2016 and the final 2016 report. Although many trends for habitat, sample event, stocking treatment, and year were similar, this research provides a solid evidence-based foundation on which future research and management initiatives for largemouth bass can be built. Early spawned fish were larger initially and continued to be larger through time, a trend that that could have positive consequences for the survival of adult largemouth bass. Our findings of similar distribution and diet of largemouth bass in the first summer across stocking treatments are consistent with the literature that shows adult year class is most often set after the first winter (after our study period). Our data provide a scientific basis for a largemouth bass management plan. Our results also provide basic information with which to track 1, 2, 3 and older largemouth bass from each stocking treatment in future years.

Products

Presentations

Mapes. R. M., and M. E. Mather. 2015. Using the land mosaic concept to test how habitat heterogeneity alters the distribution of young-of-year largemouth bass in a Great Plains reservoir. North Central Division, American Fisheries Society, Indianapolis, IN.

Mapes, R., M. E. Mather, J. M. Smith, S. M. Hitchman, A. Earl, J. Romine. 2015. Is all heterogeneity created equal? How types of habitat heterogeneity differentially alter distribution, abundance, and diets of age-0 largemouth bass. American Fisheries Society, Portland, OR.

Mapes, R. M., and M. E. Mather. 2016. Location, location, location: Incorporating spatial context into fisheries research. 146th Annual Meeting of the American Fisheries Society, Kansas City, MO, August, 2016.

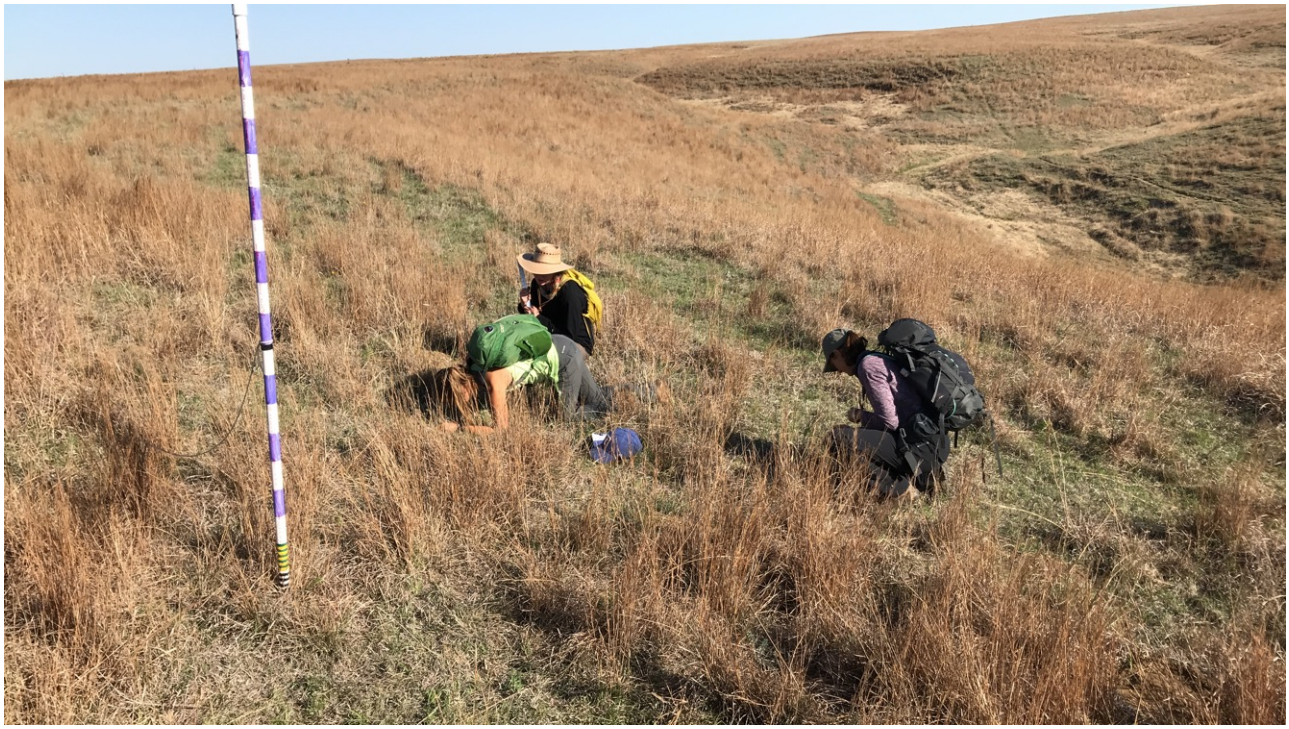
Earl*, A., R. L. Mapes, M. E. Mather. 2017. It's a fish eat fish world – or is it? Kansas Natural Resource Conference (Poster).

Thesis

Mapes, R. 2017. Young of year largemouth bass (Micropterus salmoides) relative abundance and diet: role of habitat type, spatial context, and size. Thesis, Kansas State University, Manhattan.

Wildlife Projects

Ongoing Wildlife Projects



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

Investigators
Alixandra Godar, Ph.D candidate

Project Supervisor
Dr. David Haukos

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, create an integrated population model that includes an effect of cover crops and other scenarios of landscape composition and configuration, 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 space use and forage choice, and the potential invertebrate community in the landscape

Assess selection of cover crops and other

Status
On-going, initiated August 2016

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 during 2017 and 2018, 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. We monitored hen movements and cover crop growth. Our preliminary results show pheasant use of cover crops peaks in June and continues even after termination (Fig. 1). Pheasants used GreenSpring most during 2017. Use may have been due to the close proximity of GreenSpring to the CRP fields of capture or due to the characteristics of GreenSpring, which provided the most visual obstruction, vegetative cover, and light blocked of the treatments. Pheasants select for grassland over cover crops across the entirety of the breeding season. Future research will develop an integrated population model combining spring crow counts with adult, nest, and brood survival. The model will also include how the presence of spring cover crops on the landscape influences adult and brood survival rates. Habitat selection will be combined with resource selection functions to assess what vegetative properties pheasants are selecting for and which cover crop blend provides the selected for characteristics. The final analyses will allow managers to make recommendations of the amount and type of cover crops to plant across the landscape.

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

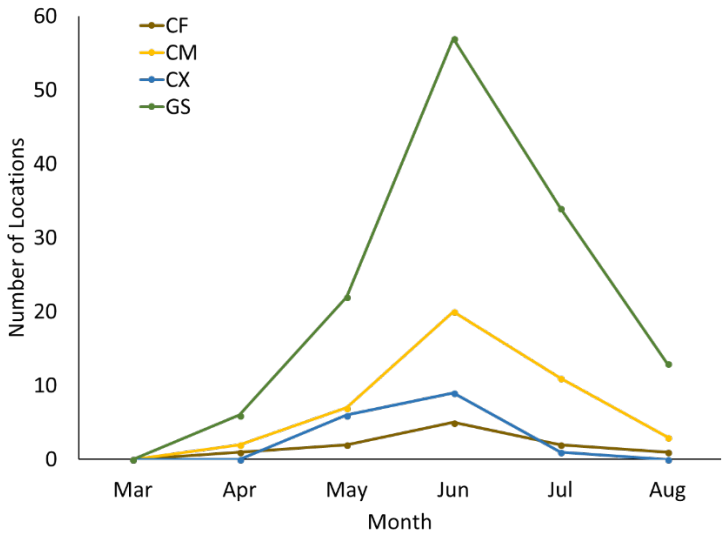


Figure 1. The number of hen locations within each treatment type (CF=Chemical Fallow, CM=Chick Magnet, CX=Custom Mix, GS=GreenSpring) across the breeding season.

Products

Presentations

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.C. Annis, D. Haukos, and J. Prendergast. 2017. Ring-necked pheasant use of spring cover crops in western Kansas. Annual conference of The Wildlife Society, Albuquerque, NM.

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

Investigators
Adela Annis, M.S. candidate

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 fallow crop treatments within Kansas

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

Measure predator occupancy in difference cover crop and fallow crop treatments

Location:
Western and mid-central Kansas

Completion
December 2019

Status
On-going

Progress and Results

Ring-necked pheasants are an economically important upland gamebird within Kansas that contribute to local and state economies. Additional management techniques are being investigated to improve regional and local populations. Spring cover crops have been suggested as a possible tool for increasing habitat on the landscape during the breeding season when traditionally agricultural fields are left fallow. Spring cover crops in Kansas are planted between March and May, and then terminated in June or July prior to the planting of a cash crop, namely winter wheat. In 2017, we evaluated use of three cover crop mixes, a custom mix, commercial mix, wildlife mix and a chemical fallow control. Female pheasants were captured in proximity to the planted spring cover crops and collared with very-high-frequency (VHF) necklace style radio transmitters to estimate survival and nest selection relative to use of spring cover crops and other types of land cover. Camera traps were placed on the edge and within the treatments to determine how cover crops may influence predator occupancy. Our research findings will provide wildlife researchers with information on cover crop benefits to wildlife and additional methods for managing upland gamebird populations in Kansas.

Results from our first year of research indicate that apparent female adult survival was lowest during spring raptor migration. Nest survival during the laying and incubation period was related to age of the nest and proportion of winter wheat surrounding nests. Nesting near or within winter wheat may positively influence nest survival. In 2017, Kansas pheasant nests were located in a variety of land-use types; however 19 of the 28 nests located in fields enrolled in the Federal Conservation Reserve Program (CRP) for native grasses. Spring cover crops can reach the vegetation densities pheasants require, but after peak nesting has occurred.

Spring cover crops provided resources for other wildlife species, including predators of pheasants. Of the seven species investigated, four were most influenced by the edge of the treatments, two by cover crop treatments, and one had constant occupancy. The interior area of cover crops may be a potential refuge for pheasants from certain predator species.

Products

Presentations

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., 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. 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. 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.

Lesser Prairie-Chicken Translocation to the Sand Sagebrush Ecoregion

Investigators
Liam Berigan, M.S. Candidate

Carly Aulicky, Ph,D Candidate

Dr. Daniel Sullins, Post-Doctoral Research Associate

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 in northwestern Kansas, release sites in southwestern Kansas and southeastern Colorado

Completion
May 2020

Status
On-going, initiated Fall 2016

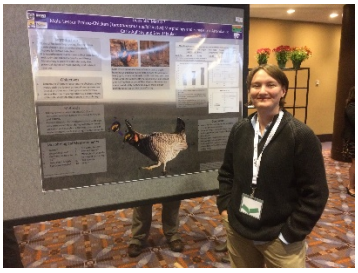
Progress and Results
The U.S. Forest Service Cimarron and Comanche National Grasslands in southwestern Kansas and southeastern Colorado was a stronghold of the lesser prairie-chicken's historic range. However, grazing practices on the grasslands, coupled with several years of intense winters and severe drought, led to their near extirpation by 2013. Since then, implementation of beneficial land management practices and amelioration of drought conditions have allowed the vegetation to recover. The area consists of high-quality habitat, although there are few leks within dispersal distance of the grasslands. Without a nearby population source, restoring lesser prairie-chickens to the Cimarron and Comanche National Grasslands will require human intervention.

In 2016, a multi-agency effort began to restore lesser prairie-chicken populations in the Sand Sagebrush Ecoregion by translocating birds to the National Grasslands. Beginning that fall, state biologists began to translocate lesser prairie-chickens from northwestern Kansas to several release sites on the Cimarron and Comanche. A total of 26 males were released in the fall of 2016 to establish and supplement leks prior to relocation of females onto the grasslands. In the spring of 2017, 45 additional males and 38 females were released onto the grasslands. All birds released in 2016 and 2017 were equipped with VHF radio transmitters to track their dispersal, survival, and fecundity.

Dispersal from release sites was variable, and often extensive (mean = 18 km, sd = 16 km). However, 75% of released birds stayed within the vicinity of the Comanche and Cimarron National Grasslands. Fall and spring released males attended 10 leks in spring 2017. Within those 10 leks, males utilized 5 novel areas to display, however, due to the ephemeral status of these areas, it is unclear if these new leks will persist into subsequent breeding seasons. Attendance at lekking sites has fluctuated widely, and will continue to be supplemented with annual releases of males.

For birds released in spring 2017, apparent survival to the next fall was 40%, reflecting the increased mortality rate which often accompanies translocation projects. Nearly all surviving females attempted to nest in 2017. Of the 16 attempted nests, 7 hens raised at least one chick past 35 days. Several hens which attempted to nest in 2017 have also returned to nest near the grasslands in 2018.

In Spring 2018, 71 males and 73 females were translocated to the grasslands. This year incorporated our first use of satellite-PTT



transmitters on the project, with 65 SAT-PTT and 64 VHF transmitters deployed on released birds. Preliminary data from satellite transmitters has shown that initial dispersal movements from the release site can exceed 100 km. Despite long distance dispersal, translocated birds frequently circle back towards the initial release site. The improved resolution of SAT-PTT transmitters will allow us to determine how landscape features influence each prairie-chicken's home range establishment on an individual scale, and may provide valuable insights for liming dispersal during future translocation projects.

Products

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.

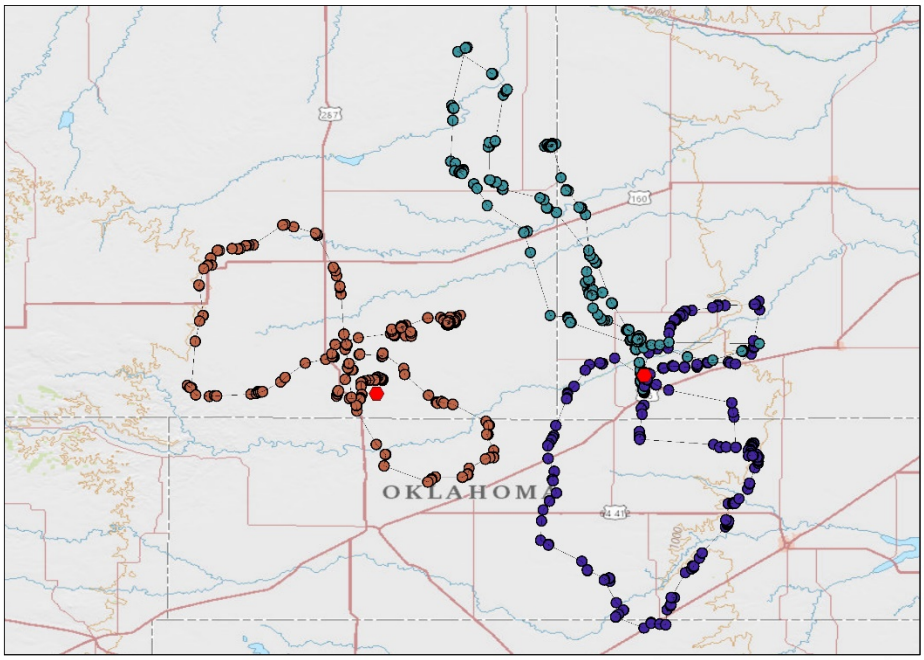
Aulicky, C., D. Haukos, and K. Fricke. 2018. Not just dusty data: what can we learn from range-wide analyses of lesser prairie-chicken morphology? Annual Meeting of The Wildlife Society, Cleveland, Ohio.

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.

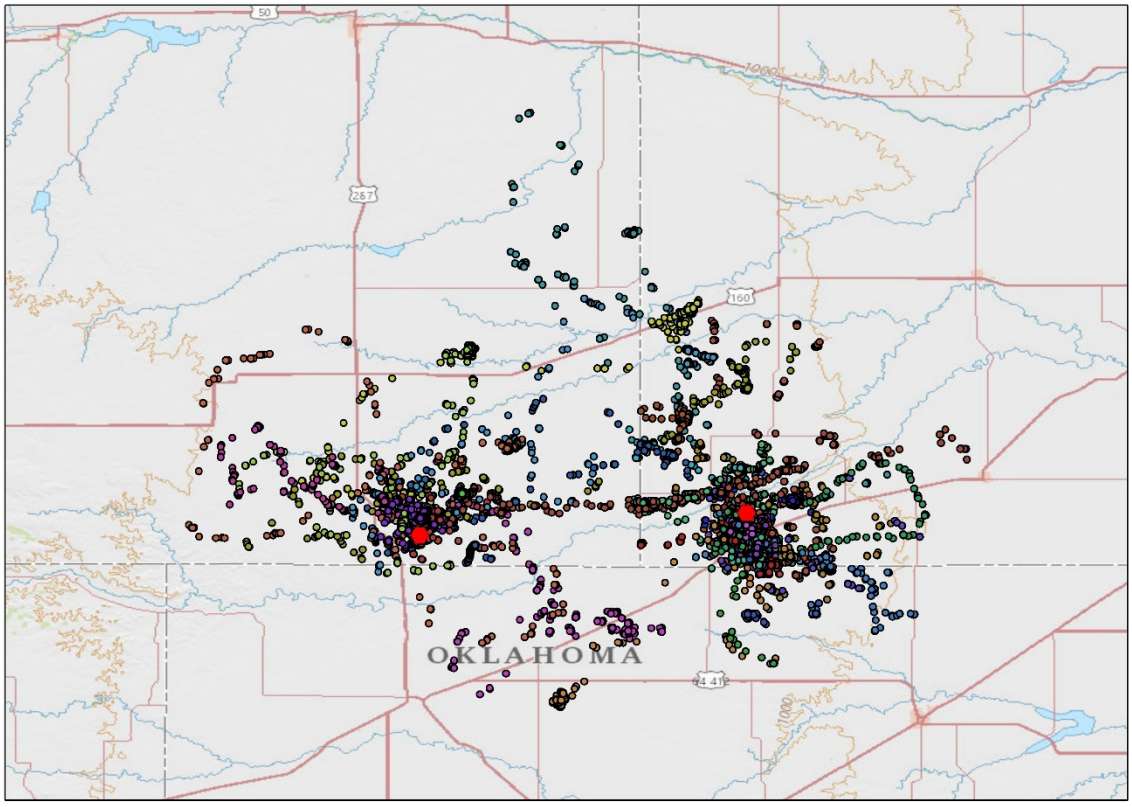
Berigan, L., D. Sullins, D. Haukos, K. Fricke, J. Reitz, L. Rossi, and K. Schultz. 2018. Role of natal habitat preference induction in prairie-grouse translocation success. International Grouse Symposium, Logan, Utah.

Notable movements as of 6/14/18



Hexagons are release sites, color represents individuals.

SAT-PTT movements as of 6/14/18 (living)



Hexagons are release sites, color represents individuals.

Lesser Prairie-Chicken Response to Patch-Burn Grazing

Investigators
Chris Gulick, M.S. Candidate

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
On-going, initiated February 2017

Progress and Results

Historically, Great Plains grasslands were shaped by a constant flux of disturbances and stochastic events such as fire, rainfall, and grazing by large herbivores. This natural continuum created a patchwork of habitat types that are used by grassland obligate species of conservation concern, such as the lesser prairie-chicken. European expansion has permanently changed and fragmented these landscapes, but modern land management strategies can mimic historical patterns to conserve habitat for lesser prairie-chickens. This project investigates the influence that landscape management and configuration have on lesser prairie-chicken movement patterns. We will determine how two contemporary management regimes, patch-burn grazing and rotational grazing, influence the spatial arrangement of GPS-collared cattle within pastures. We will then determine how GPS-marked female lesser prairie-chickens use different areas of cattle grazing intensity during different life stages, such as nesting, brooding, and non-breeding. We will also assess female lesser prairie-chicken movement at landscape scales, to determine how landscape configuration and anthropogenic features influence female dispersal. This will inform management aimed at increasing genetic connectivity between lesser prairie-chicken subpopulations.

We found that patch-burn grazed pastures have greater fob and bare ground cover than rotationally grazed pastures. Additionally, patch-burn grazed treatments have greater variation in vegetative structure and composition across gradients of high, moderate, and low cattle grazing intensity within pastures. This increased variation could correspond to a greater variety of habitat types used by lesser prairie-chickens during different seasons.

Products

Presentations

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

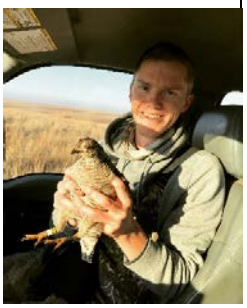
Gulick, C., and D.A. Haukos. 2018. Factors affecting habitat availability for lesser prairie-chickens across different land management regimes. Kansas Natural Resources Conference, Manhattan, Kansas.

Gulick, C., 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., 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.

Location:
Throughout southern, western, and central Kansas

Completion
May 2019



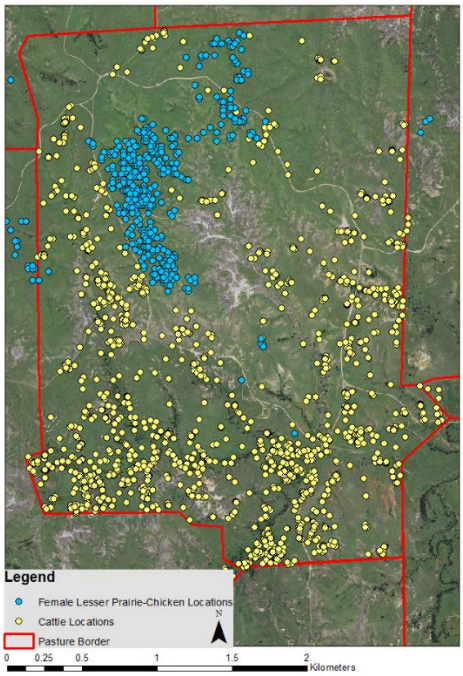


Figure 1: Cattle and female lesser prairie-chicken locations in a patch-burn grazed pasture

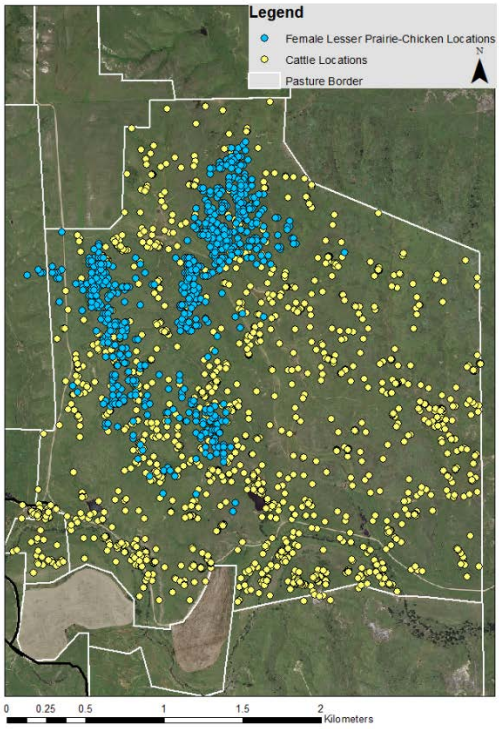


Figure 2: Cattle and female lesser prairie-chicken locations in a rotationally grazed pasture

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

Investigators
Dan Sullins, Ph.D
John Kraft, M.S.
Matthias Sirch, B.S.

Project Supervisor
Dr. David Haukos

Funding
USDA NRCS, LPCI

Pheasants Forever

Kansas Department of Wildlife, Parks, and Tourism

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

Christian Hagen, USDA, Lesser Prairie-Chicken Initiative

Objectives
Assess changes in vegetation and LEPC habitat availability

Status
In Progress

Progress and Results

Large intensive wildfires (>100,000 ha) have burned substantial portions of the lesser prairie-chicken (*Tympanuchus pallidicinctus*) range over the last three years. The Starbuck fire burned 2,521 km^2 (623,000 acres; Figures 1 and 2) of mostly grassland and encroaching woodland in Beaver and Harper counties, Oklahoma, and in Meade, Clark, and Comanche counties, Kansas, from 7 March to 12 March 2017 (inciweb.org 2017). The wildfire was the largest on record for Kansas (Kansas Forest Service) and the area burned was all within the lesser prairie-chicken distribution. Fire is an important ecological disturbance that formerly played an important role in maintaining grassland habitat for wildlife. However, response of lesser prairie-chicken populations and the habitats they occupy to extreme wildfires are unknown.

Knowledge on the effects of extreme wildfire on lesser prairie-chickens is needed because (1) lesser prairie-chickens populations are confined to a few large relict grasslands within the Great Plains where population persistence may be more susceptible to widespread stochastic events; (2) lesser prairie-chickens populations have shown long-term population declines and are a species of conservation concern; (3) effects of extreme wildfire on lesser prairie-chickens are not readily apparent (e.g., tradeoffs of burning nesting habitat or woody areas); and lastly, (4) the timing of the fire presents a unique opportunity for a Before-After-Control-Impact study design because extensive data were collected within the area burned before the fire from March 2014–March 2016.

Methods
Lek count and photo point data were collected immediately following the fire in the spring of 2017. After receiving funding from the USDA and setting up a field house in 2018, we collected more photo point and lek count data, and initiated capture of 23 lesser prairie-chickens that were marked with GPS transmitters. We also conducted vegetation surveys, raptor surveys, and monitored reproduction, resource selection, and survival of marked lesser prairie-chickens. We will continue data collection until the end of February 2020 and will capture birds in the spring of 2019.

To assess changes in vegetation and lesser prairie-chicken habitat availability, quality, and distribution, we conducted 250-m point-step surveys estimating species composition in the spring/summer of 2018 (Evans and Love 1957). Grassland structure were estimated at 50-m intervals throughout the point-step transects based on visual obstruction following Robel et al. (1970). Estimated composition was related to user-defined cover types (patches) that are greater than 5 ha in size and relatively homogenous in appearance (Plumb 2015). In addition to point-step transects,

Assess LEPC resource selection in response to extreme wildfire

Estimate the influence of extreme wildfires on LEPC population demography

Location: Clark County, KS

Completion: December 2020

vegetation composition and structure were also estimated at random locations distributed throughout patches (10 point per ~120 patches). At each point location, visual obstruction, percent horizontal cover of functional groups (grass, forbs, shrubs, bare ground, and litter), litter depth, and 3 dominant plant species within a 4 m radius of the location data were collected following Sullins (2018).

In addition to field collection of data, we also used remote sensing tools to assess burn severity and examined remote sensing options for estimating tree canopy cover change post fire.

Results

Photo Points

We took photos at identical locations (n = 16) spanning ecological sites on the study area and with the same bearing in April and October of 2017, and April 2018. An example of photo points is shown in Figure 3. At each location a phot was taken looking directly downward and facing North, East, South, and West.

Lek Counts

Table 1. Maximum number of males counted on leks before the fire in 2015 and after the fire in the spring of 2018 in Clark County, KS.

	Before	*After*
Lek	**2015**	**2018**
GAR2	20	0
GAR3	4	0
GAR4	4	5
GAR5	18	0
GAR6	11	2
GAR7	8	0
GAR8	13	3
GAR9	9	0
GAR10	20	20
GAR11	17	9
GAR12	22	4
GAR13	7	1
Seacat*		9
WIHA	11	14
TOTAL	164	67

*did not observe lek in 2015

Capture

We captured birds during 59 events and captured 43 unique lesser prairie-chickens during the lekking period in the spring of 2018. Of the 43 lesser prairie-chickens, 10 were female and 39 were male. We marked 9 females and 13 males with GPS satellite transmitters to monitor movements, reproduction, and survival. Notable recaptures included two males that were banded in 2014 and one from 2015. One of the recaptured males was at least 5 years and 10 months old.

Vegetation Surveys

During the spring and summer of 2018, we collected point vegetation data at 2 randomly selected location for each marked lesser prairie-chicken per week and at 1,172 random locations distributed throughout the burned area and on an unburned area north of the main study site in 2014–2015. We also conducted 302 250-m point-step surveys to estimate species composition within unique grassland patches and fields.

Reproduction

We monitored a total of 9 nests in spring/ summer of 2018 with attempted nests from 8 of the 9 marked female lesser prairie-chickens and 2 females re-nesting after failed first attempts. Of all the monitored nests, only 2 hatched. Of the 2 successful nests, 1 was confirmed by checking nest and flushing 7 day old chicks, the other nest was determined successful based on remote monitoring of GPS locations. We were denied permission on the nest that was monitored remotely and could not ground truth the successful nest or monitor the brood. We were able to monitor the other brood to 14 days old. Three chicks survived to 14 days old but were not detected during later brood flushes. We expect that an intense hailstorm on 6/24/18 killed the chicks.

Nests were initiated from 5 May 2018 – 10 June 2018 which was later than nest initiation in 2014 and 2015 before the wildfire. We expect that the lack of precipitation from October 2017 to mid-April of 2018 may have delayed nesting. Of the nests that failed, 5 out of 7 were depredated by snakes with the remaining depredations by mammals. The predator of the final failed nest was not confirmed. The high rate of snake depredation was not expected, however, snakes may benefit from exposed bare ground following fire and are can avoid fire by using burrows in early spring (Russell et al. 1999).

Remote Sensing of Burn Severity and Tree Canopy Cover Change

We estimated burn severity from Landsat 8 imagery using a Mid Infrared Burn Index (MIRBI) and a Normalized Burn Ratio (dNBR). We will use the burn severity classification to assess the effect of fire severity on lesser prairie-chicken use of the landscapes. We are currently working to estimate the distribution of trees on the study area remotely to assess the impact of the fire on canopy cover change.

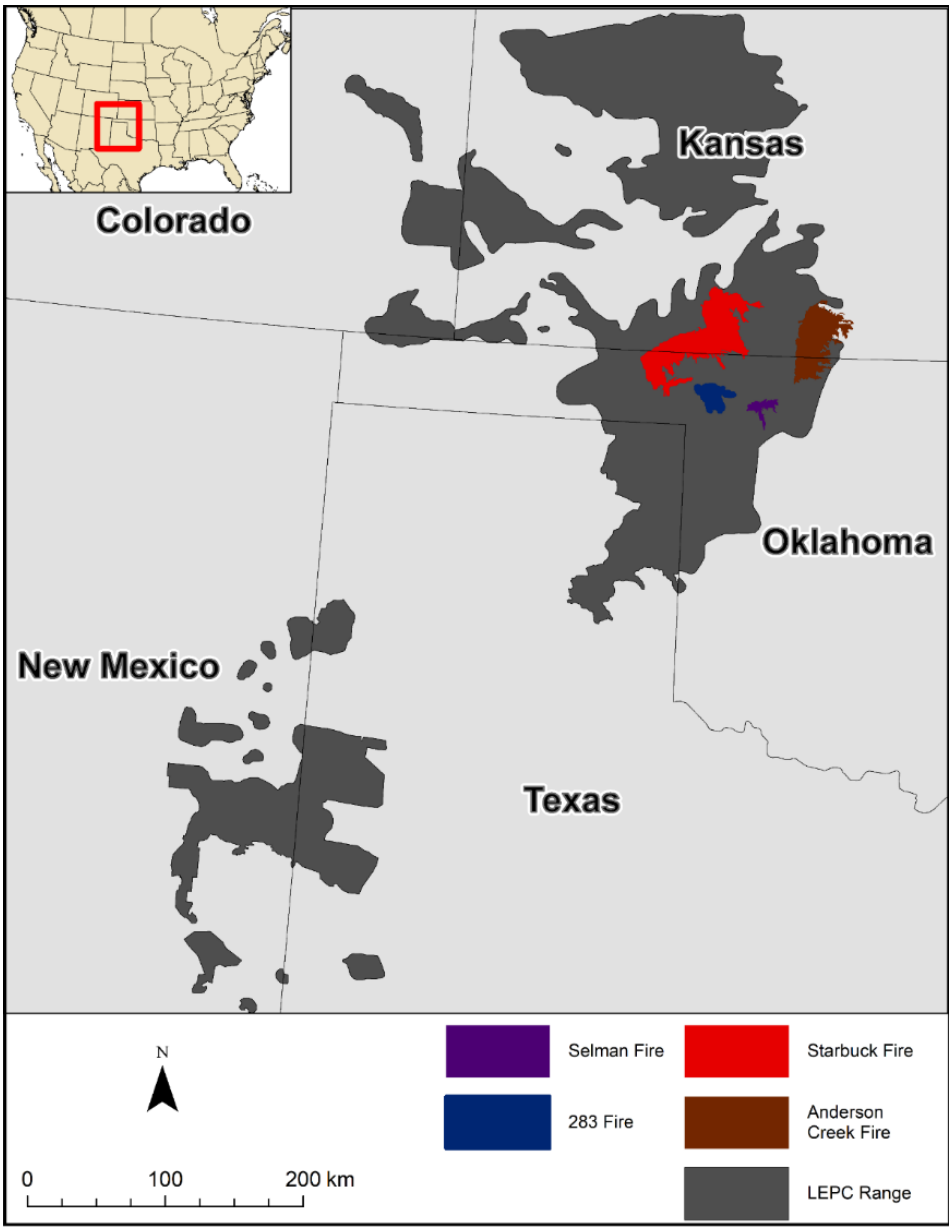


Figure 1. Notable fire perimeters in the Mixed Grass Prairie Ecoregion of Kansas and Oklahoma in 2016 (Anderson Creek) and 2017 (Starbuck, 283, and Selman; McDonald et al. 2014). The Proposed research efforts will focus on areas impacted by the Starbuck fire which burned from 7 March – 12 March 2017.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

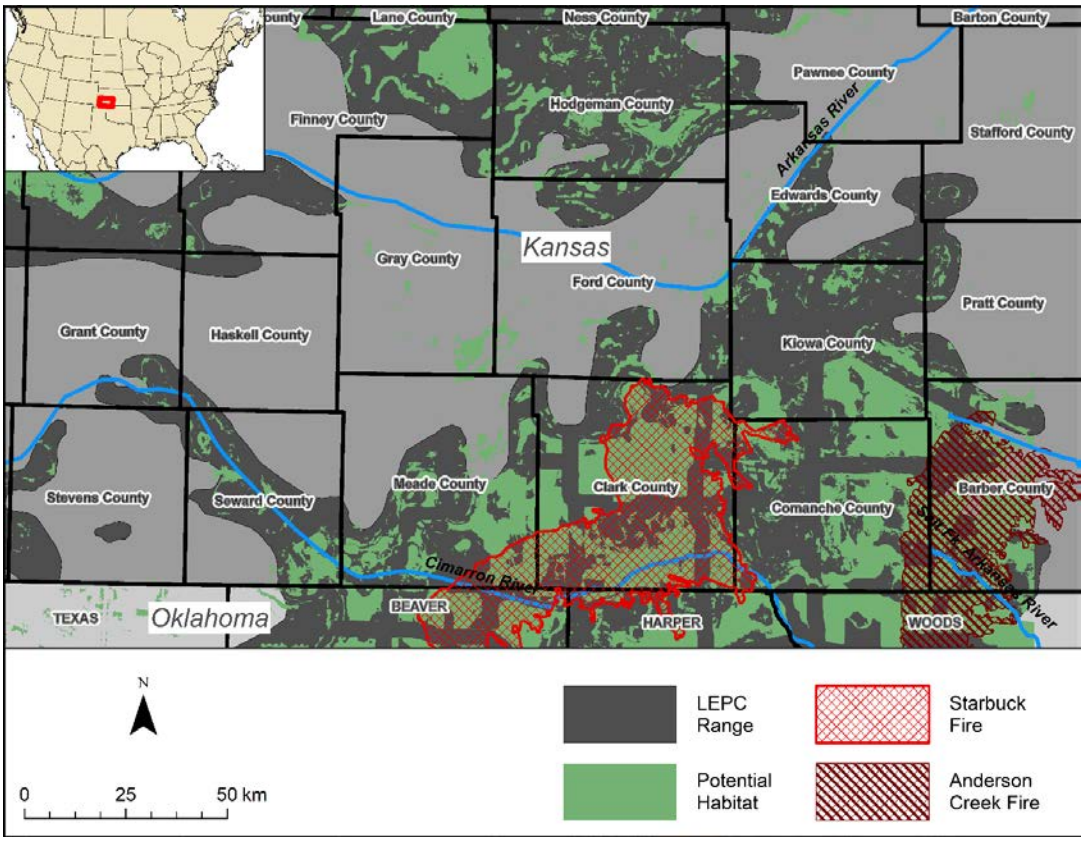


Figure 2. Perimeter of the Starbuck and Anderson Creek fire in the Mixed Grass Prairie Ecoregion of Kansas, estimated potential habitat from Sullins (2017), and the presumed range of lesser prairie-chicken from Hagen and Giesen (2005). Post fire research will focus on the Clark County portion of the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

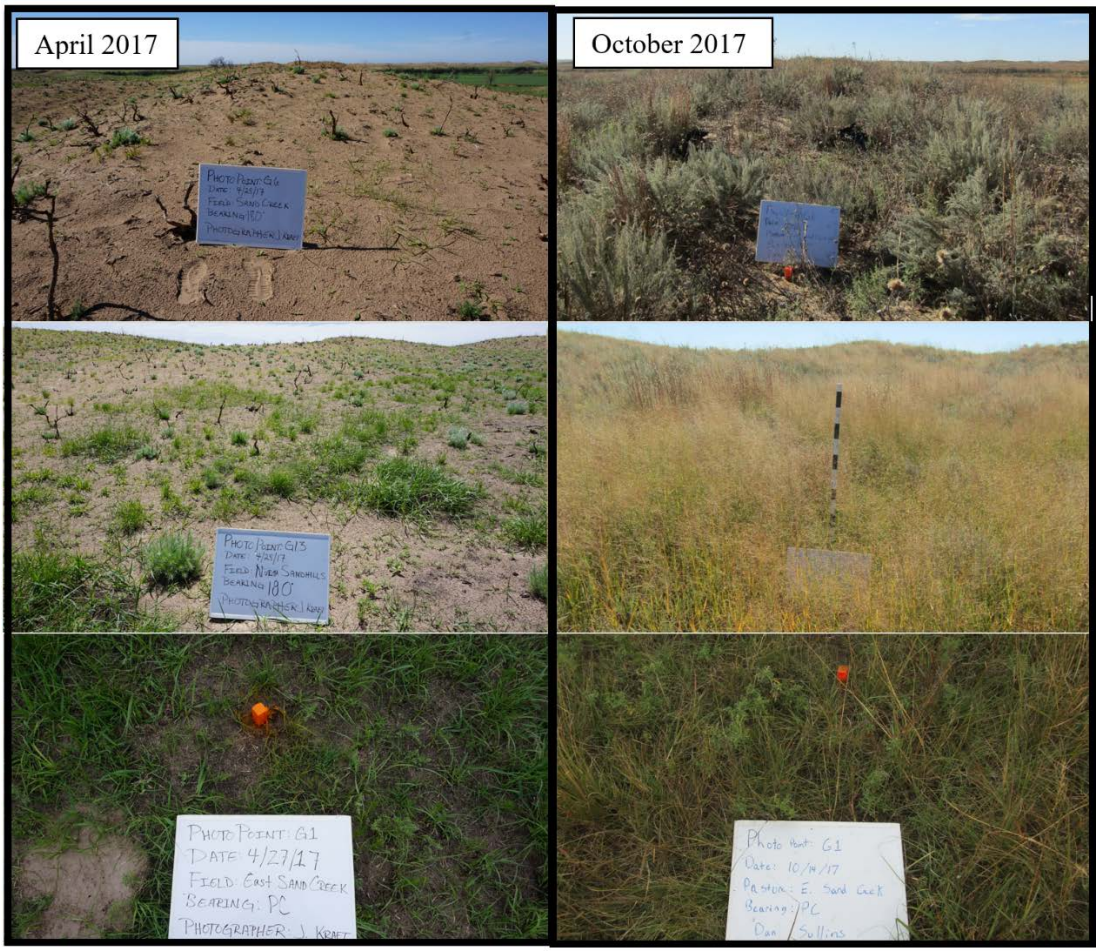


Figure 3. Photo points collected in Clark County, Kansas, on the Gardiner ranch in April 2017 (a month after the fire) and in the following October 2017. Photos on the left are from the same location and facing the same direction as photos on the right.

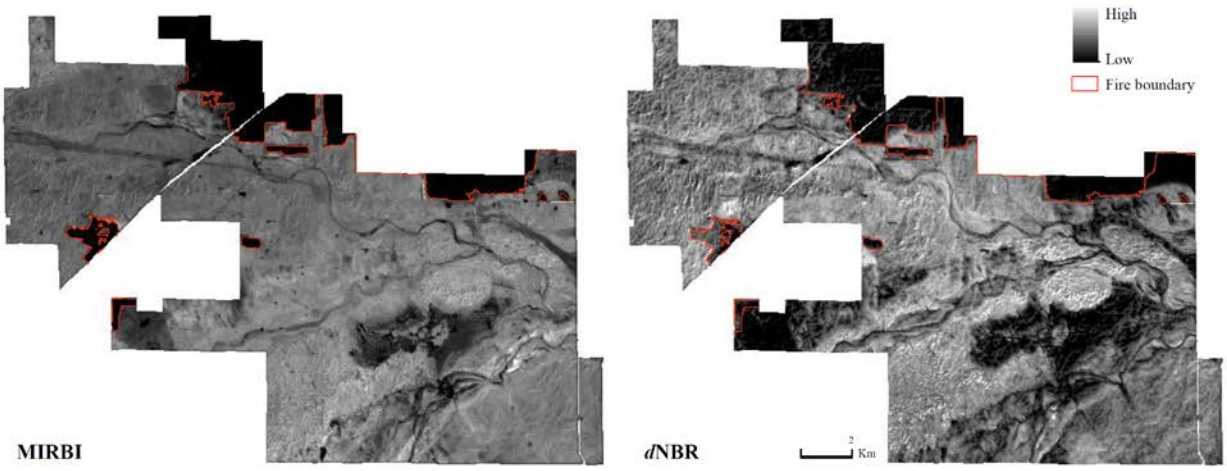


Figure 4. The Mid Infrared Burn Index (left) from March 8, 2017, and Normalized Burn Ratio (right) from March 1 and 8, 2017, calculated using Landsat 8 imagery downloaded from the USGS Earth Explorer website.

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

Investigators
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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 lek

Status
On-going, initiated January 2017

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.

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

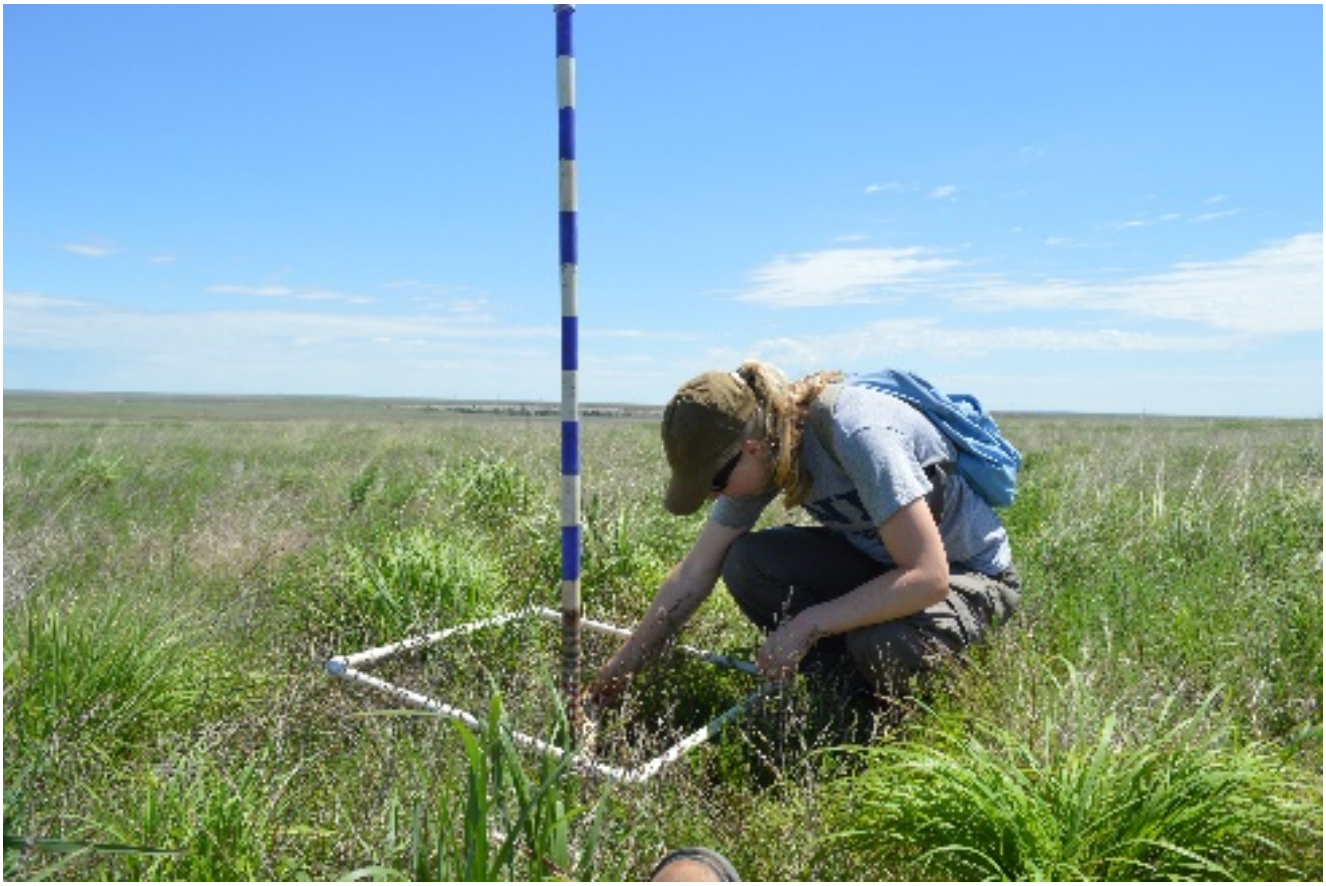
Location:
Throughout Kansas and eastern Colorado

Completion
August 2018

Products

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.



Intra-and-Interspecific Survival Rates, Cause-Specific Mortalities, and Habitat Selections of Two Sympatric Species: White-Tailed Deer and Mule Deer in Kansas

Investigators
Mitchell Kern, M.S. candidate
Maureen Kinlan, M.S. candidate
Talesha Karish, Ph.D. candidate

Project Supervisor
Dr. David Haukos
Dr. Andrew Ricketts

Cooperators
Levi Jaster, KDWPT
Kansas Bowhunters Association
Mule Deer Foundation

Funding
Kansas Department of Wildlife, Parks, and Tourism

Kansas State University

Objectives
Research population trends and movement patterns of white-tailed and mule deer in western Kansas.

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

Evaluate seasonal survival rates, cause-specific mortality, and movements of adult male mule deer and white-tailed deer in western Kansas.

Evaluate seasonal survival rates, cause-specific mortality, resource selection and movements of adult female mule deer and white-tailed deer in

Status
On-going
Start: February 2018 End: September 2021

Progress and Results:
February 2018:

- 1st adult capture season: 30 white-tailed and 30 mule deer in each study area (even sex distribution in each species) for a total of 120 adult deer.

June 2018 (current as of 6/13/18):

- North Site:
  30 bucks captured, 1 mortality.
  30 does captured, 2 failed collars
  23 fawns captured, 8 mortalities, 1 slipped collar.
  2 VITs remaining
- South Site:
  30 bucks captured.
  30 does captured, 4 mortalities, 1 failed collar.
  18 captured fawns, 13 mortalities, 1 slipped collar.
  3 VITs remaining
- Total:
  60 collared bucks, 1 mortality.
  60 collared does, 4 mortalities, 3 failed collars.
  41 collared fawns, 21 mortalities, 2 slipped collars.
  5 VITs remaining

Overall

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. Limited research has been conducted in Kansas to understand why two similar species are exhibiting vastly different population trends.

In February 2018, we processed 120 adult deer at two separate study sites over a span of 4 days utilizing helicopter net-gun capture techniques. Each study area is comprised of 60 adult deer; 30 white-tailed deer, 30 mule deer, and both species have a 50:50 sex ratio. Bucks were captured, collared, ear tagged, had blood samples drawn and released at the capture site. Does were captured and transported to a central processing location. In addition to the aforementioned procedures bucks received, 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 does.

Fawn Survival Rates, Cause Specific Mortalities, and Bed-Site Selection (Mitchell Kern)

Fawn survival rates may provide one possible explanation for the dissimilar

western Kansas.

Location
New Almelo, Kansas
Scott City, Kansas

Completion
December 2021

population trends observed between the two analogous deer species. During the summer of 2018, we captured fawns associated with the VITs implanted during the adult helicopter season. The average fawn capture rate is 1.5 fawns per VIT suggesting each study site could catch up to a maximum of 45 fawns. Unfortunately doe mortalities, premature VIT expulsions, and technology malfunctions have all hindered fawn capture potential in both study sites.

Fawns captured from VIT expulsions received VHF collars, ear tags, and had several simple morphological measurements taken resulting in a capture process time less than 10 minutes. Fawns were monitored daily for up to 10 weeks dependent upon mortality or censor events. Daily monitoring included visually locating the fawn, marking the current bed site, and conducting habitat assessment measurements on the bed-site from the previous day.

The first fawn capture associated with an expelled VIT occurred on 5/12/18 in the southern study site. Almost two weeks later, the first fawn was collared in the northern study site on 5/23/18. As of 6/15/18, 23 fawns (14 white-tailed deer and 9 mule deer) in the northern site and 18 fawns (7 white-tailed deer and 11 mule deer) in the southern site have been captured. Also as 6/15/18, there were 20 live fawn collars due to 13 mortalities and one slipped collar in the southern study site and 7 mortalities and one slipped collar in the northern site. Suspected mortality causes in order of importance include predation, malnutrition, and agricultural equipment.

Products

Presentations

Kern, M. 2018. Deer ecology project. Lenora Senior Center, Lenora, KS.

Kern, M., M. Kinlan, T. Karish, A. Ricketts, and D. Haukos.2018. Survival rates, cause-specific mortality, movement patterns, and habitat selection of white-tailed deer and mule deer in Kansas. Jubilee Parade, Lenora, KS.

Kern, M., M. Kinlan, T. Karish, A. Ricketts, D. Haukos, and L. Jaster. 2018. Survival and cause-specific mortality of white-tailed and mule deer fawns in western Kansas. TWS Annual Conference, Cleveland, OH.

Seasonal Survival and Movements of Male Mule Deer and White-tailed Deer in Western Kansas (Maureen Kinlan)

The abundance and occupied range of mule deer in Kansas have been declining for 20 years. The two predominant hypotheses for the loss of mule deer and concurrent expansion of white-tailed deer 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. Our objectives were to evaluate seasonal survival rates, cause-specific mortality, and movements of adult male mule deer and white-tailed deer in western Kansas. We aerially captured and GPS-collared 60 male mule deer and white-tailed deer at two different study sites. Dominant landcover (native grassland vs cropland) differed between the study sites. 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. Known fate models were used to evaluate landscape factors affecting survival and estimate seasonal survival rates. We used ArcGIS to measure temporal movements and Brownian Bridge Movement Models to estimate seasonal home ranges. Survival of male mule deer and white-tailed deer during spring and summer is high. Since adult capture, only one adult deer mortality has occurred; a white-tailed deer at the northern study site in April. Average daily movements and home range size are influenced by season and landscape. Inclusion of another two years of data will add to the information available to natural resource managers for management of both species in western Kansas.

Products

Presentations*:*

Kinlan, M., M. Kern, T. Karish, A. Ricketts, D. Haukos, and L. Jaster. 2018. Seasonal survival and movements of male mule deer and white-tailed deer in western Kansas. TWS Annual Conference, Cleveland, Ohio

Resource Selection and Movements of Female Mule Deer and White-tailed Deer during Parturition and Lactation in Western Kansas. (Talesha Karish)

The third part of the study focused on females; our objectives are to evaluate seasonal survival rates, cause-specific mortality, resource selection and movements of adult female mule deer and white-tailed deer in western Kansas. We used helicopters to capture and GPS-collar 30 female mule deer and 30 white-tailed deer split evenly between two study sites. Each deer was fitted with a high resolution GPS/VHF collar that recorded bi-hourly locations with an activity sensor to identify mortality events. Each collared deer also received a Vaginal Implant Transmitter digitally linked with the collar to record and send an alert for the exact time of parturition.

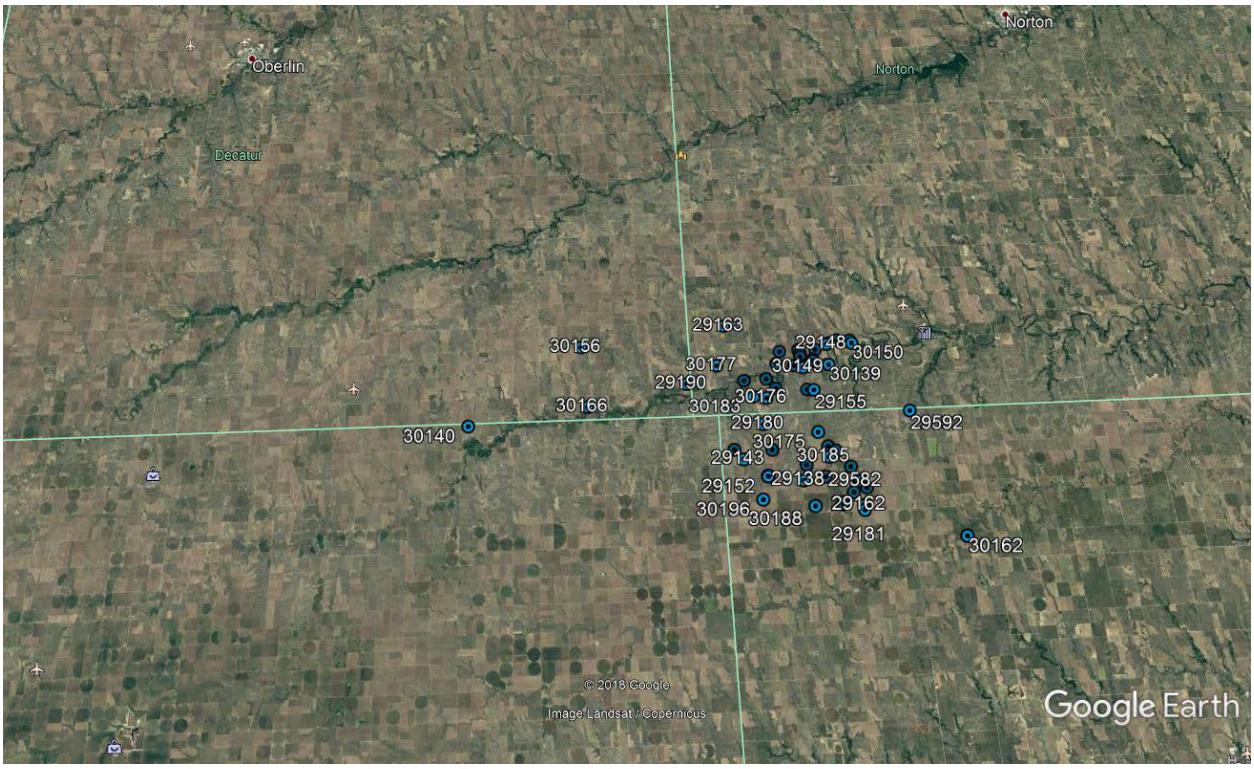
We predict that resource selection will differ between the two study sites due to difference in dominant land-cover (native grassland vs cropland). We used ArcGIS to measure temporal movements and Brownian Bridge Movement Models to estimate seasonal home ranges. Average daily movements and home range sizes of females were influenced by reproductive stage of does. Parturition and lactation are energetically demanding of females and their resource needs change. Using data gained by monitoring the captured fawns, we were able to tell what stage the females were in accurately. We used logistic regression to compare foraging locations of lactating and non-lactating females throughout the season. This information will be used to improve management of both species in Kansas.

As of 6/14/18 there are 53 live collared does. One doe has a collar in which both the GPS and VHF have failed. While she has been sighted with the collar she will likely be censored from the data. There have been 3 mortalities within 2 weeks of capture that will be considered capture myopathy. The final mortality was likely caused by predation.

Products

Presentation

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.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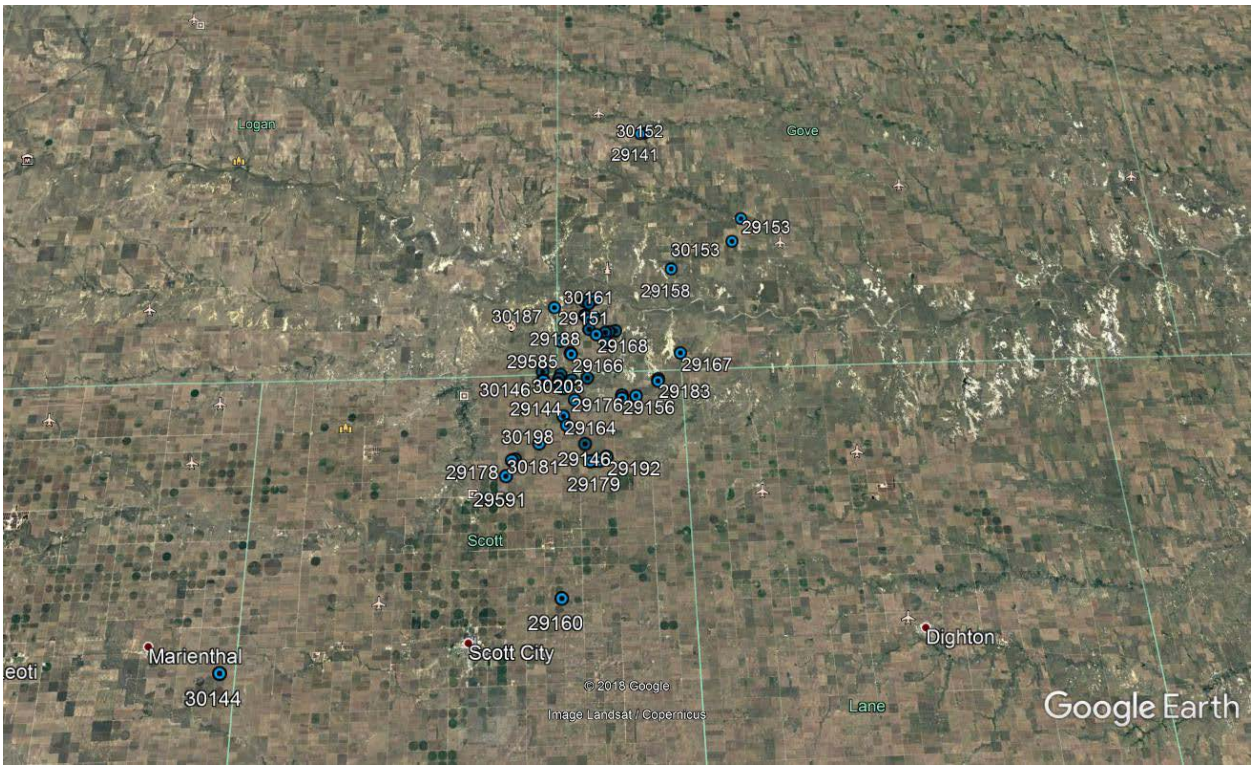
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Assessment of Temperate-breeding Canada Goose Management in Kansas

Investigator
J. Boomer Malanchuk

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Tom Bidrowski, Rich Schultheis
Kansas Department of Wildlife, Parks, and Tourism

Kansas State University

Objectives
Determine the most economical and effective survey method to estimate temperate-breeding Canada goose population abundance and distribution in Kansas.

Estimate vital rates for temperate-breeding Canada geese in Kansas.

Assess which management action(s) have the greatest effect on temperate-breeding Canada goose demography in Kansas.

Location:
Kansas and the Central Flyway

Completion
Expected June 2021

Status
On-going, initiated January 2018

Progress and Results
Temperate-breeding, resident or giant, Canada geese are all terms that have been used to describe Canada geese nesting in the lower 48 contiguous states. Current population numbers are at or above current objectives for most states in the Central Flyway; including Kansas. Over-abundant temperate-breeding Canada goose populations cause thousands of direct and non-direct human-goose conflicts each year. Nuisance problems include public health concerns from fecal coliform in urban ponds, goose-aircraft strikes, millions of dollars in crop damage, and aggressive nest defense. Increasing temperate-breeding populations, according to the current Kansas Resident Canada Goose Management Plan and the US Fish and Wildlife Canada goose environmental impact statement, must be managed for the maximum benefits to the public while minimizing goose-human conflicts.

Kansas Department of Wildlife, Parks, and Tourism would like to stabilize the current population to better manage for the benefits of Canada geese. The preferred management techniques in Kansas include oiling or addling eggs and translocating individuals from urban areas, mainly Kansas City and Wichita, to Cedar Bluff State Park in western Kansas. The long term effects of these management actions are poorly understood.

To better access management actions in Kansas, we must be able to reliably estimate change in abundance and vital rates (i.e. survival) of temperate-breeding Canada geese. We will estimate population abundance using Lincoln Petersen estimates, from hunter reported band recoveries, and aerial survey estimates from KDWPT. Hierarchical n-mixture models in a Bayesian framework will model different aerial survey stratification scenarios to help modify the current survey to be more precise while minimizing in-field effort. Brownie dead-recovery models will be used to estimate vital rates and effectiveness of management actions. We will examine site fidelity and effectiveness of translocation from urban to rural areas.

Completed Wildlife Projects

Vegetation Characteristics and Lesser Prairie-Chicken Responses to Land Cover Types and Grazing Management in Western Kansas

Investigators
John Kraft, M.S.

Project Supervisor
Dr. David Haukos
Jim Pitman
Dr. David Dahlgren
Dr. Christian Hagen

Funding
Kansas Department of Wildlife, Parks, and Tourism

USDA-NRCS

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

USDA-NRCS

U.S. Fish and Wildlife Service

Objectives

Quantify the relative vegetation differences among land cover types in western Kansas and their potential as LEPC habitat

Investigate habitat selection of land cover types in western Kansas by nesting, brooding and non-breeding LEPC

Investigate the influence of grazing management strategies on LEPC habitat selection and fitness

Location:
Western Kansas

Status
Completed December 2016

Findings and Conclusions

In the southern Great Plains, the lesser prairie-chicken (*Tympanuchus pallidicinctus;* hereafter LEPC), an obligate grassland species, has experienced significant population declines and range contractions with subsequent conservation concern. Management actions often use land cover types to make inference about habitat quality. Relatively little information is available related to grazed rangelands to guide conservation. The influences of land cover types and livestock grazing on LEPC habitat selection have not been researched extensively in western Kansas. I evaluated the influence of land cover types and grazing management on vegetation characteristics, habitat selection, and nest/adult survival of LEPC in western Kansas. Females were captured and radio-marked to monitor habitat use, nest success, and adult survival. Grazing and vegetation data were collected via producer correspondence and vegetation surveys, respectively. Vegetation composition and structure differed across land cover types, which can be used to make inferences about LEPC habitat quality. Habitat selection analyses corroborated the importance of breeding habitat in close proximity to leks (<3 km) and identified land cover types selected for nesting (Conservation Reserve Program, Limy Upland, Saline Subirrigated) and brooding (Conservation Reserve Program, Red Clay Prairie, Sands, Sandy Lowland). Conservation Reserve Program patches positioned near rangelands contributed to LEPC reproductive success in northwest Kansas. In grazed lands, LEPC selected habitat close to leks (<3 km) and large pastures (>400 ha), exhibiting low-moderate stocking densities (<0.4 AU/ha), and low-moderate levels of deferment during the grazing season (60-100 days). Nest site selection was negatively influenced by increasing distance from a lek and grazing pressure. Daily nest survival rates were negatively influenced by increasing grazing pressure and high levels of stocking density. Heterogeneity (coefficient of variation and standard deviation) of visual obstruction was decreased at stocking densities > 0.26 AU/ha. Future conservation actions should consider the potential of land cover types to create adequate vegetation structure, and manage rangelands with low-moderate stocking densities and deferment and greater pasture areas. The relationship between habitat selection and proximity of lek sites (< 5 km) should be used to identify quality LEPC habitat.

Products

Presentations

Kraft, J.D. 2015. Third-order selection of a prairie specialist lesser prairie-chicken habitat selection in varying landscapes. Division of Biology, Graduate Student Forum.

Kraft, J.D., and D.A. Haukos. 2015. Landscape level habitat selection of female lesser prairie-chickens in western Kansas and eastern Colorado. International Grouse Symposium, Reykjavík, Iceland.

Kraft, J.D., D. Haukos, J. Pitman, and C. Hagen. 2015. Identifying drivers of lesser prairie-chicken habitat selection within western Kansas grazed lands. Annual Meeting of the Kansas Ornithological Society, Emporia, KS

Kraft, J.D., J. Lautenbach, D. Haukos, J. Pitman, and C. Hagen. 2015. Female lesser prairie-chicken response to grazing in western Kansas grasslands. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Kraft, J.D., J. Lautenbach, D. Haukos, J. Pitman, and C. Hagen. 2015. Female lesser prairie-chicken response to grazing in western Kansas grasslands. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Kraft, J.D., J. Lautenbach, D.A. Haukos, and J.C. Pitman. 2015. Seasonal habitat selection by female lesser prairie-chickens in varying landscapes. Kansas Natural Resource Conference, Wichita.

Kraft, J.D., J. Lautenbach, D.A. Haukos, J.C. Pitman, and C.A. Hagen. 2015. Female lesser prairie-chicken response to grazing practices in western Kansas grasslands. Annual Meeting of the Society of Range Management, Sacramento, CA.

Kraft, J.D., S.G. Robinson, R.T. Plumb, and D.A. Haukos. 2015. Landscape characteristics of home ranges of lesser prairie-chickens. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

Kraft, J.D., D. Haukos, and C. Hagen. 2016. Implications of pasture area, grazing strategy, and region on lesser prairie-chicken habitat selection and vegetation. Annual Meeting of the Society of Range Management, Corpus Christi, TX

Kraft, J.D., D. Haukos, C. Hagen, and J. Pitman. 2016. Are larger pastures and sparser herds the way to manage grassland birds? A case-study of the lesser prairie-chicken. Annual Meeting of The Wildlife Society, Raleigh, NC. (Invited)

Kraft, J.D., D. Sullins, and D.A. Haukos. 2016. Dynamic interactions of Conservation Reserve Program, native grasslands, and lesser prairie-chicken habitat selection. Kansas Natural Resource Conference, Wichita, KS.

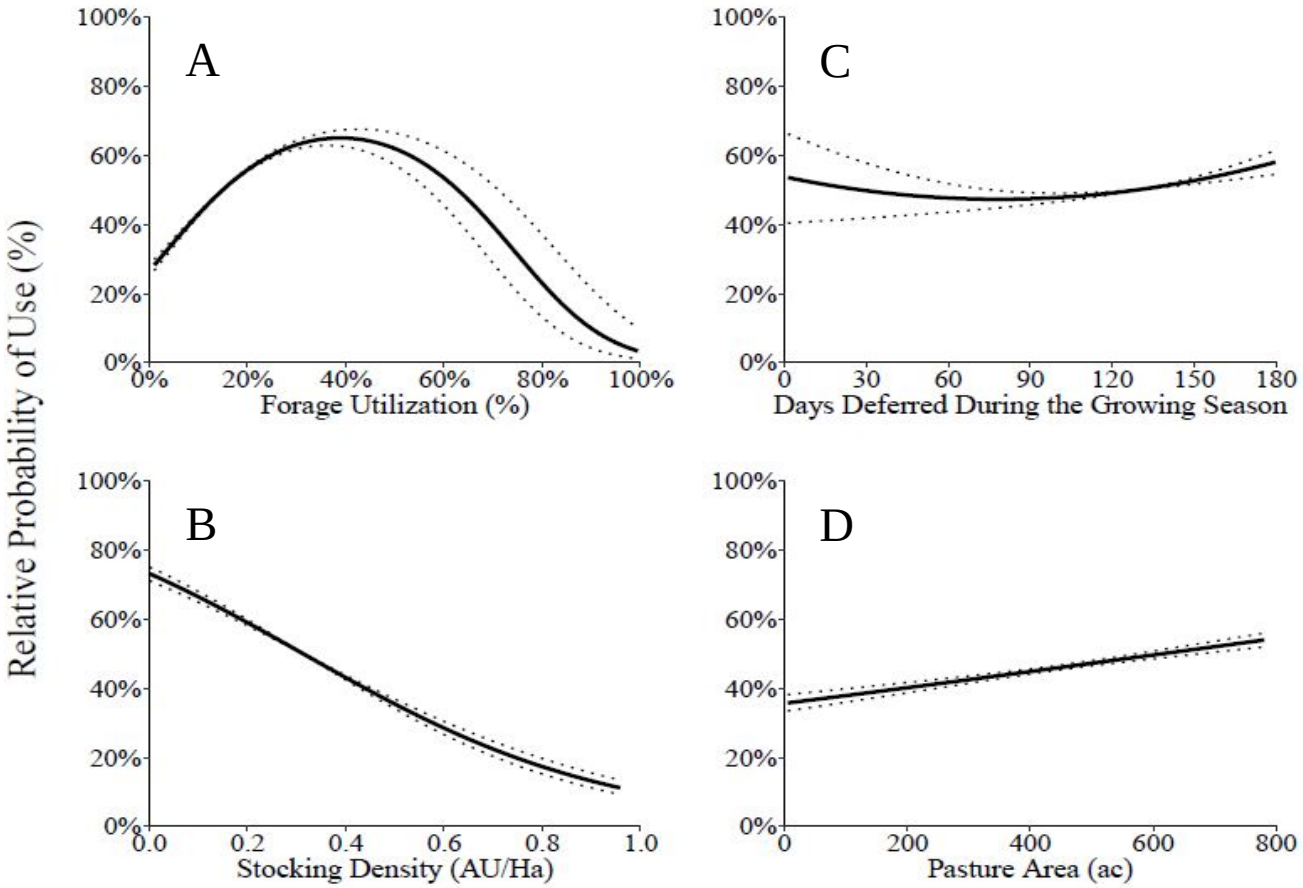
Kraft, J.D., D. Sullins, and D.A. Haukos. 2016. Evaluation of lesser prairie-chicken brood habitat selection across categorical habitats. Kansas Natural Resource Conference, Wichita, KS.

Kraft, J.D., D.A. Haukos, M.R. Bain, M. Rice, S. Robinson, D.S. Sullins, C.A. Hagen, J. Pitman, J. Lautenbach, R. Plumb, and J. Lautenbach. 2017. Sparser herds, larger pastures, and imperiled birds: heterogeneity-based grazing management is essential for a heterogeneity-dependent grassland. Prairie Grouse Technical Council, Dickinson, ND.

Thesis

Kraft, J. 2016. Vegetation characteristics and lesser prairie-chicken responses to land cover types and grazing management in western Kansas. Thesis, Kansas State University, Manhattan.

Relative probability of use response curves illustrating non-breeding habitat selection by female lesser prairie-chickens in relation to A) forage utilization (%); B) stocking density (AU/ha); C) number of days deferred during the growing season; and D) pasture area (ha) within monitored rangelands grazed by cattle from 2013-2015 in western Kansas, USA. Response curves were developed using output from resource selection functions (Table 1). Forage utilization was calculated assuming a 50% grazing efficiency (proportion of the allocated forage consumed by livestock). The prediction curves are enveloped with 95% confidence intervals.



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Regional Variation in Demography, Distribution, Foraging, and Strategic Conservation of Lesser Prairie-Chickens in Kansas and Colorado

Investigators
Dan Sullins, Ph.D

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

U.S. Fish and Wildlife Service

Great Plains LCC

USDA Forest Service

Objectives
Estimate and compare demography among regions

Predict the distribution of lesser prairie-chicken habitat

Identify the diets of lesser prairie-chickens

Status
completed

Progress and Results

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is 1 of 3 prairie-grouse species in North America. Prairie-grouse have undergone local or widespread declines due to a loss of habitat through conversion to row crop agriculture, anthropogenic development, and alteration of ecological drivers that maintain quality grasslands. For lesser prairie-chickens, habitat loss and declines were deemed significant for listing as threatened under the Endangered Species Act in 2014. Despite a judge vacating the listing decision in 2015, the lesser prairie-chicken remains a species of concern. Conservation plans are currently being implemented and developed. To maximize the effectiveness of efforts, knowledge of the distribution of lesser prairie-chickens, regional demography, foods used during critical life-stages, and where to prioritize management is needed.

To guide future conservation efforts with empirical evidence, I captured, marked with transmitters, and monitored female lesser prairie-chickens in Kansas and Colorado during 2013–2016 (n =307). I used location data to predict the distribution of habitat. Encounter data from individuals were used to estimate vital rates and integrated into a matrix population model to estimate population growth rates (λ). The matrix model was then decomposed to identify life-stages that exert the greatest influence on λ and vital rate contributions to differences in λ among sites. After assessing demography, I examined the diet of adults and chicks during critical brood rearing and winter periods using a fecal DNA metabarcoding approach.

Overall, potential habitat appears to compromise ~30% of the presumed lesser prairie-chicken range in Kansas with most habitat in the Mixed-Grass Prairie Ecoregion. Within occupied sites, populations were most sensitive to factors during the first year of life (chick and juvenile survival); however, the persistence of populations through drought may rely on adult survival. Among regional populations, breeding season, nest, and nonbreeding season survival rates contributed most to differences in λ among sites, breeding season survival contributed to differences in λ among more and less fragmented sites. During critical life-stages, diets were comprised of arthropod and plant foods. Among 80 readable fecal samples, 35% of the sequences were likely from Lepidoptera, 26% from Orthoptera, 14% from Araneae, and 13% from Hemiptera. Plant sequences from 137 fecal samples were comprised of genera similar to *Ambrosia* (27%) *Latuca* or *Taraxacum* (10%), *Medicago* (6%), and *Triticum* (5%). Among cover types, lesser prairie-chickens using native grasslands consumed a greater diversity of foods.

during brooding and winter

Evaluate the demographic consequences of Conservation Reserve Program grasslands for lesser prairie-chickens

Location: Kansas and eastern Colorado

Completion: May 2017

Last, promising conservation options include the conversion of cropland to grassland through the Conservation Reserve Program (CRP) and tree removal in mixed-grass prairie landscapes. Lesser prairie-chickens mostly used CRP during nesting and the nonbreeding season, during drier periods, and in drier portions of their distribution. Strategic CRP sign-up and tree removal could recover >60,000 ha and~100,000 ha of habitat respectively.

In summary, conservation that targets management in areas within broad scale habitat constraints predicted will be most beneficial. In areas occupied by lesser prairie-chickens, management that increases brood survival in large grasslands having optimal nesting structure will elicit the strongest influence on population growth and will likely be the most resilient to stochastic drought-related effects.

Products

Publications

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

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

Presentations

Sullins, D.S., and D.A. Haukos. 2015. Lesser prairie-chicken diets during brooding and winter. Annual Meeting of the Kansas Ornithological Society, Emporia, KS

Sullins, D.S., and D.A. Haukos. 2015. Optimal nesting substrate drives lesser prairie-chicken habitat use in Kansas and Colorado. Kansas Natural Resource Conference, Wichita.

Sullins, D.S., D.A. Haukos, and B.K. Sandercock. 2015. Population demographic sensitivity for the threatened lesser prairie-chicken. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

Sullins, D.S., D.A. Haukos, and B.K. Sandercock. 2015. Regional demographic variability for lesser prairie-chickens in Kansas and Colorado. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Sullins, D.S., D.A. Haukos, and B.K. Sandercock. 2015. Regional demographic variability for lesser prairie-chickens in Kansas and Colorado. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Sullins, D.S., and D.A. Haukos. 2016. Available foods and diets of lesser prairie-chickens in native and CRP grasslands of Kansas and Colorado. Kansas Natural Resource Conference, Wichita, KS.

Sullins, D.S., and D.A. Haukos. 2016. Lesser prairie-chicken foraging in native and CRP grasslands of Kansas and Colorado. Annual Meeting of The Wildlife Society, Raleigh, NC.

Sullins, D.S., and D.A. Haukos. 2016. Lesser prairie-chicken foraging in native and CRP grasslands of Kansas and Colorado. Annual Meeting of the

Society of Range Management, Corpus Christi, TX

Sullins, D.S., D.A. Haukos, and B.K. Sandercock. 2016. Impacts of Conservation Reserve Program grasslands on lesser prairie-chicken populations in the northern extent of their range. Kansas Natural Resource Conference, Wichita, KS.

Sullins, D.S., D.A. Haukos, J. Kraft, J. Lautenbach, J. Lautenbach, R. Plumb, S. Robinson, and B. Ross. 2016. Conservation planning for lesser prairie-chickens among reproductive and survivorship landscapes of varying anthropogenic influence. North American Congress for Conservation Biology, Madison, WI. (Invited)

Sullins, D.S., D.A. Haukos, J. Kraft, J. Lautenbach, J. Lautenbach, R. Plumb, S. Robinson, B. Ross, and B.K. Sandercock. 2017. Strategic regional conservation for lesser prairie-chickens among landscapes adjacent to western Kansas rivers. Kansas Natural Resource Conference, Wichita, KS.

Sullins, D.S., J. Kraft, D.A. Haukos, and B.K. Sandercock, 2017. Selection and demographic consequences of Conservation Reserve Program grasslands for lesser prairie-chickens. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

Sullins, D.S., J.M. Lautenbach, and D.A. Haukos. 2017. Tradeoffs of nest and brood habitat availability for lesser prairie-chickens. Annual conference of The Wildlife Society, Albuquerque, NM.

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., 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.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.

Dissertation

Sullins D. 2017 Regional variation in demography, distribution, foraging, and strategic conservation of lesser prairie-chickens in Kansas and Colorado. Dissertation, Kansas State University, Manhattan

Lesser Prairie-Chicken Habitat Selection Based on Prescribed Fire, Microclimate, and Vegetation Characteristics

Investigators:
Jonathan Lautenbach, M.S.

Project Supervisor:
Dr. David A. Haukos

Funding:

Natural Resources Conservation Service
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Jim Pitman, Kent Fricke
Kansas Department of Wildlife, Parks and Tourism
Dr. Christian Hagen
Natural Resources Conservation Service
Kansas State University
Greg Kramos, Aron Flanders
U.S. Fish and Wildlife Service

Objectives:

Assess the response of lesser prairie-chickens to prescribed fire.

Characterize vegetation comprising lesser prairie-chicken habitat across the species' range in Kansas.

Determine the role of microclimate for fine scale habitat selection by

Status
Completed

Progress and Results
The lesser prairie-chicken is a prairie grouse native to the southwestern Great Plains that has experienced significant population and habitat declines since European settlement. Ongoing declines prompted the U.S. Fish and Wildlife Service to list lesser prairie-chickens as threatened under the Endangered Species Act in spring of 2014. In fall of 2015, the listing was vacated on procedural grounds and the lesser prairie-chicken was removed from listing in summer 2016. Despite the legislative change, considerable conservation efforts emerged with the initial listing and have continued following the removal of the species from the threatened and endangered species list. Understanding how lesser prairie-chickens use landscapes and how management actions can influence their space use is important for long-term strategies to meet conservation goals.

I modeled lesser prairie-chicken habitat selection relative to landscape mosaics of vegetation patches generated through patch-burn grazing, microclimate, and vegetation characteristics across their range. I captured, attached GPS satellite or VHF radio transmitters to, tracked, and measured vegetation characteristics used by and available to female lesser prairie-chickens across the northern portion of their range in Kansas and Colorado. Female lesser prairie-chickens use all patch types created in a patch-burn grazing mosaic, with female selecting greater time-since-fire patches (>2-years post-fire) for nesting, 2-year post-fire patches during the spring lekking season, 1- and 2-year post-fire patches during the summer brooding period, and 1-year post-fire units during the nonbreeding season. Available vegetation structure and composition in selected patches during each life-cycle stage was similar to the needs of female lesser prairie-chickens during that life-cycle stage. To assess their selected microclimate conditions, I deployed Maxim Integrated Semiconductor data loggers (iButtons) at female flush locations and across a landscape inhabited by lesser prairie-chickens.

Females selected locations that minimized thermal stress at microsite, patch, and landscape scales during peak midday temperatures during summer. Females selected midday locations based on vegetation characteristics; where selected sites had >60% forb cover and <25% grass cover, or >75% grass cover and <10% forb cover. In addition, females selected sites with greater visual obstruction. I measured vegetation composition and structure at use and available sites at four study areas located along the precipitation gradient characterizing the full extent of the lesser prairie-chicken range. Vegetation structure

lesser prairie-chickens.

Location:
Kansas

Completion:
Fall 2016

use by females varied in relation to long-term precipitation patterns. Females used sites with lower visual obstruction than available during the fall and spring. However, they used vegetation composition that was similar to available within each study area. Overall, my findings indicate that lesser prairie-chickens require structural and compositional heterogeneity to support a suite of habitat needs throughout the year. Therefore, management should focus on providing structural and compositional heterogeneity across landscapes. Greater heterogeneity in vegetation conditions can be achieved through management practices that allow domestic grazers to select grazing locations, such as patch-burn grazing or increased pasture area.

Products

Presentations

Lautenbach, J. D. Haukos, J. Lautenbach, J. Kraft, and D. Sullins. 2016. Satisfying the quilt work of habitat needs of the lesser prairie-chicken: the role of patch-burn grazing. Annual Meeting of The Wildlife Society, Raleigh, NC. (Invited)

Lautenbach, J., and D. Haukos. 2015. Effect of patch-burn grazing on vegetation composition in the eastern portion of the lesser prairie-chicken range. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Lautenbach, J., and D. Haukos. 2017. Quantifying landscape and vegetation characteristics of lesser prairie-chicken habitat during extreme temperature events. Annual meeting of the Society of Range Management, St. George, UT.

Lautenbach, J., D. Haukos, and B.A. Grisham. 2017. Fried Chicken: Identifying areas of thermal refugia for lesser prairie-chickens in a changing climate. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

Lautenbach, J., D. Haukos, and B.A. Grisham. 2017. Quantifying landscape and vegetative characteristics of lesser prairie-chicken habitat during extreme temperature events. Annual meeting of The Wildlife Society, Albuquerque, NM.

Lautenbach, J., D. Haukos, and C. Hagen. 2016. Satisfying the quilt work of habitat needs of the lesser prairie-chicken: the role of patch-burn grazing. Annual meeting of The Wildlife Society, Raleigh, NC.

Lautenbach, J., D. Haukos, and C. Hagen. 2017. Influence of patch-burn grazing on lesser prairie-chicken habitat selection in Kansas. Prairie Grouse Technical Council, Dickinson, ND.

Lautenbach, J., J. Lautenbach, and D. Haukos. 2016. Response of lesser prairie-chicken habitat and habitat use to patch-burn grazing. Annual Meeting of the Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Lautenbach, J., J. Lautenbach, and D. Haukos. 2016. Using patch-burn grazing to maintain prairie for lesser prairie-chickens. Kansas Natural Resource Conference, Wichita, KS.

Thesis

Lautenbach, J.D. 2017. The role of fire, microclimate, and vegetation in lesser prairie-chicken habitat selection. Thesis, Kansas State University, Manhattan.

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

Investigators
Beth Ross, Ph.D

Project Supervisor
Dr. David Haukos

Funding
USDA NRCS

Cooperators
Dr. Christian Hagen
Jim Pitman
Dr. David Dahlgren
Kansas Department of Wildlife, Parks, and Tourism

Objectives

Quantify the relative importance of changes in CRP and climate on LEPC abundance and demographic parameters

Quantify the spatial extent, juxtaposition, and habitat composition/structure of CRP grasslands and native prairie habitat that yield high likelihood of LEPC occurrence

Link abundance of the "best" landscapes to fitness parameters for populations

Examine abundance and population demographics to quantify the relative values of various management strategies for CRP and other USDA conservation programs.

Location:
Throughout Kansas and Eastern Colorado

Status
Completed

Progress and Results
Significant numbers of lesser prairie-chickens of Kansas and Colorado are associated with former croplands that have been enrolled in a U.S. Department of Agriculture conservation programs/practices, principally the Conservation Reserve Program (CRP) and Environmental Quality Incentive Program (EQIP). At a broad-scale CRP has reduced habitat fragmentation and assisted in connecting extant and expanding populations. Additionally, conservation practices with CRP fields that may be affecting these populations include vegetation species composition, development of supplemental water areas, mid-term management practices, and emergency haying/grazing declarations. Use of CRP may also be related to juxtaposition of CRP, cropland, and other land uses. In addition, the overall population response by lesser prairie-chickens to conservation programs needs to be assessed in regard to demography of the population to model future population trends. Concurrent with CRP and land use practices, more information is needed on the response of lesser prairie-chickens to changes in climate. The Great Plains region is predicted to experience increasing drought conditions, which could negatively affect lesser prairie-chickens in the future. A better understanding of the interaction between land use and climate change on lesser prairie-chicken population demographics is important for future management practices. Our results thus far indicate that extreme values of Palmer Drought Severity Index (both low and high, or dry and wet conditions) during the spring breeding season were the best predictors of changes in lesser prairie-chicken abundance, though neither had a significant effect on male lesser prairie-chicken abundance on leks. Abundance on leks was highest during the mid-1980s, followed by low population abundance in the 1990s. The population has remained relatively stable since the late 1990s. Additionally, increasing the ratio of cropland to grassland in a given area (i.e., moving towards more cropland) reduces the resilience of lesser prairie-chickens to extreme drought conditions. Using an integrated population model, we found that juvenile survival is likely most impacted by extreme drought causing the shifts in population abundance that are observed.

Products

Publications

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

Ross, B.E., D. Haukos, C. Hagen, and J. Pitman. 2016. The relative contribution of variation in climate to changes in lesser prairie-chicken abundance. Ecosphere 7:e01323.

Completion
June 2016

Ross, B.E., D. Haukos, C. Hagen, and J. Pitman. 2016. Landscape composition creates a threshold influencing Lesser Prairie-Chicken population resilience to extreme drought. Global Ecology and Conservation 6:179-188.

Presentations

Ross, B., D. Haukos, C. Hagen, and J. Pitman. 2014. Changes in lesser prairie-chicken abundance in Kansas. Kansas Natural Resource Conference, Wichita, Kansas.

Ross, B., D. Haukos, C. Hagen, and J. Pitman. 2014. Combining multiple data sources to determine climate and land-use impacts on lesser prairie-chickens. Annual Meeting of The Wildlife Society, Pittsburg, Pennsylvania.

Ross, B., D. Haukos, C. Hagen, and J. Pitman. 2014. The relative influence of drought and habitat on lesser prairie-chickens. Society for Conservation Biology, Missoula, Montana.

Ross, B., D. Haukos, C. Hagen, and J. Pitman. 2015. Combining multiple data sources to determine drought and land-use impacts on lesser prairie-chickens. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

Ross, B., D. Haukos, C. Hagen, and J. Pitman. 2015. Extreme drought events and changes in land cover interact to reduce resilience of the lesser prairie-chicken. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Ross, B., D. Haukos, C. Hagen, and J. Pitman. 2015. The relative influence of climate variability and landscape change on lesser prairie-chicken populations. Annual Meeting of The Wildlife Society, Winnipeg, Manitoba

Ross, B., D. Haukos, C. Hagen, and J. Pitman. 2016. Combining multiple data sources to determine drought and land-use impacts on lesser prairie-chickens. North American Ornithological Congress, Washington, D.C.

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.

A Multi-scale Examination of the Distribution and Habitat Use Patterns of the Regal Fritillary

Investigators:
Kelsey McCullough, M.S.
Caroline Skidmore, B.S.

Dr. Gene Albanese, Postdoctoral Research Associate

Project Supervisor:
Dr. David A. Haukos

Funding:
Department of Defense

Cooperators:
Department of Defense:
Jeff Keating
Shawn Stratton
Mike Houck

Konza Prairie Biological Station

Kansas State University
Division of Biology

Objectives:

Generate probabilistic maps of the predicted distribution of the regal fritillary larval host plant species and identify the habitat features and management practices associated with its occurrence, distribution and density

Construct descriptive models that identify the management regimes, vegetative, and environmental features associated with the occurrence, distribution,

Status
Complete

Progress and Results

The regal fritillary (*Speyeria idalia*) was once an abundant butterfly species of North American prairie communities. Despite its once broad geographic distribution, populations have declined by ~99% in the prairie region for reasons that are poorly understood. The rapid, range-wide declines and persistent threats to extant populations from habitat loss and mismanagement prompted the U.S. Fish and Wildlife Service to initiate a species status review of the regal fritillary as a potential candidate for listing under the endangered species act in September 2015. Due to the uncertain status and contention regarding the effects of management practices (i.e., burning, grazing, and haying) on regal fritillary, my research objectives were to assess the effects of management practices and habitat features on the distribution and density of regal fritillary and their preferred larval host plant for the Midwest, prairie violet (Viola pedatifida).

I generated species distribution models (SDM) of prairie violet to readily identify potential areas across the landscape containing patches of host plants and subsequently facilitate the location of regal fritillary larvae. The SDM produced maps of the probabilistic occurrence distribution of prairie violet throughout my study area and highlighted habitat features and management practices important to the occurrence of prairie violet. The seven final variables used to create the SDM and identified as important to the occurrence of prairie violet were elevation, slope, hill shade, slope position, land cover type, soil type, and average fire frequency. Using the SDM for prairie violet, I located eight areas to conduct surveys for regal fritillary larvae that were managed using various management (grazing and haying) regimes and fire-return intervals (low $\geq$ 10 years, moderate 3-5 years, and high 1-2 years). I used a binomial generalized linear model to determine the effects of management, host plant density, months since burn, and the interaction between months since burn and management on the occurrence distribution of regal fritillary larvae.

My results indicate that greater host plant density and short fire-return intervals are important to the occurrence of regal fritillary larvae and, despite current management recommendations, larvae may be negatively impacted by a lack of fire. Finally, I surveyed tracts of prairie with my study area using a distance sampling approach along line transects stratified by overall management (burned, grazed, and hayed) and fire-return interval (low $\geq$10 years, moderate 3-5 years, and high 1-2 years) for adult regal fritillary. My results indicated that

and abundance of late-instar regal fritillary larvae

Construct a descriptive model that identifies the habitat features and management practices that influence the occurrence, distribution, and abundance of adult regal fritillary

Construct a descriptive model that identifies the habitat features and management practices that influence the occurrence, distribution and abundance of post-reproductive diapause adult female regal fritillary

Location:
Fort Riley Military Reserve and Konza Prairie Biological Station

Completion:
Fall 2016

adult density was at least 84% greater in areas that received moderate fire-return intervals and greatest in areas that were grazed and burned on a moderate fire-return interval. However, density estimates of adult regal fritillary did not differ among overall management practices (i.e., burned grazed, hayed). Additionally, adult density increased as percent cover of grass, litter, and prairie violets increased. In contrast, adult density decreased as percent cover of woody vegetation and forbs increased. These results

Products

Publications

McCullough, K., G. Albanese, and D.A. Haukos. 2017. Novel observations of larval fire survival, feeding behavior, and host plant use in the regal fritillary, Speyeria idalia (Drury) (Nymphalidae). Journal of the Lepidopterists' Society 71:146–152

Presentations

McCullough, K. 2015. Gradient habitat modeling of Regal Fritillary and larval host plant using a distribution modeling approach with notes on life history attributes. Annual Graduate Research Forum, Division of Biology.

McCullough, K., and G. Albanese. 2015. Gradient habitat modeling of Regal Fritillary (Speyeria idalia) and larval host plant using a distribution modeling approach with notes on life history attributes. National Military Fish & Wildlife Association Conference. Omaha, NE.

McCullough, K., and G. Albanese. 2015. Gradient habitat modeling of Regal Fritillary (Speyeria idalia) and larval host plant using a distribution modeling approach with notes on life history attributes. Kansas Natural Resources Annual Conference. Wichita, KS.

McCullough, K., G. Albanese, and D.A. Haukos. 2015. Gradient habitat modeling of regal fritillary (*Speyeria idalia*) and larval host plant using distribution modeling approach with notes on life history sttributes. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

McCullough, K., G. Albanese, and D.A. Haukos. 2016. Habitat characteristics and the impact of disturbance regime on an imperiled grassland butterfly: re-thinking regal fritillary (Speyeria idalia) conservation and management. Kansas Natural Resource Conference, Wichita, KS.

McCullough, K.E., G. Albanese, and D.A. Haukos. 2016. Re-thinking regal fritillary conservation and management: habitat characteristics and the impact of disturbance regime on an imperiled grassland butterfly. Annual meeting of The Wildlife Society, Raleigh, NC.

McCullough, K.E, D. A. Haukos, G. Albanese, and A. Ricketts. 2017. Re-thinking regal fritillary conservation and management: the impact of disturbance regime and habitat characteristics on an imperiled grassland butterfly. 7th International Fire Ecology and Management Congress, Orlando, FL.

Skidmore, C., K.E., McCullough, G. Albanese, and D.A. Haukos. 2016. A distribution modeling approach to monarch butterfly density, host plant occurrence, and preferred habitat in the Flint Hills. Annual meeting of The Wildlife Society, Raleigh, NC.

Skidmore, C., K. McCullough, and D. Haukos. 2017. Ecology of the Monarch butterfly relative to density, host plant occurrence, and habitat use in the Flint Hills. Annual meeting of The Wildlife Society, Albuquerque, NM.

Skidmore, C., K. McCullough, and D. Haukos. 2017. The ecology of the monarch butterfly relative to density, host plant occurrence and habitat use in the Flint Hills. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

Thesis

McCullough, K. 2016. A multi-scale examination of the distribution and habitat use patterns of the regal fritillary. Thesis, Kansas State University, Manhattan

Grassland Nesting Passerine and Prairie Butterfly Response to Prescribed Fire and Livestock Grazing Used to Control Sericea Lespedeza

Investigators
Sarah Ogden, M.S.

Project Supervisor
Dr. David Haukos

Funding
National Fish and Wildlife Foundation

Cooperators
Dr. KC Olson
Jack Lemmon, M.S.
Jonathan Alexander, M.S.

Objectives
Measure abundance grassland nesting passerines in grassland patches subjected to fire or grazing treatments

Measure diversity and density of the butterfly community in patches subjected to fire or grazing treatments

Location:
Geary County and Woodson County, KS

Completion
December 2016

Status Complete

Progress and Results
Sericea lespedeza (Lespedeza cuneata) is an invasive forb that reduces native grass and forb abundance in tall-grass prairie by up to 92%. Controlling invasions is difficult because traditional land management tools used in the Flint Hills, broad spectrum herbicides, spring prescribed fire, and cattle grazing, are ineffective against sericea. Recent research has demonstrated, however, that mid- and late summer prescribed fire and spring fire with early season grazing by steers followed by late season grazing by sheep are effective at reducing sericea whole plant mass, number of seeds produced, and seed mass.

Field results were from two separate experiments conducted in tall-grass prairie study sites in the Flint Hills. On a Geary County, Kansas, study site, the utility of 1) spring fire (control), 2) mid-summer fire, and 3) late summer fire on sericea control were compared. On a Woodson County, Kansas, study site, the utility of 1) spring fire with early season steer grazing followed by rest (control) and 2) spring fire with early season steer grazing and late season sheep grazing on sericea control were compared. At the same study sites, I measured responses by the native wildlife community to use of summer fire and sheep grazing, relative to their controls, to manage sericea lespedeza. Specifically, my objectives were to compare grassland songbird density, grassland songbird nest survival, and grassland butterfly species composition and density among treatments at both study sites. I also related patterns in the vegetation community of each treatment for each study site to respective patterns in grassland bird and butterfly communities.

Within study sites, density, nest density, and nest success of grassland bird communities responded similarly to treatments and controls, with the exception that densities of Grasshopper Sparrows (*Ammodramus savanarrum*) were 3.4- and 2.2-fold greater in mid- and late summer fire plots than spring fire plots, respectively, in the Geary County study site. Species compositions of butterfly communities were similar across treatments within experiments, but grassland specialist species comprised only 8.6 and 1.2% of all butterfly observations in the Geary County and Woodson County experiments, respectively. Grassland specialist butterfly species may benefit from summer fire, as their nectar sources were more abundant in Summer Fire plots than Spring Fire plots. Overall, within each experiment, grassland bird and butterfly communities were similar

across treatments, suggesting that treatments did not negatively affect grassland songbird and butterfly communities.

I additionally demonstrated that Dickcissel (*Spiza americana*) nest sites contain a lower proportion of sericea than random points, the first evidence that the invasion is detrimental to grassland songbird species. Lacking control, the continued sericea invasion will out compete cumulatively more forb plants resulting in declining quality of grassland bird nesting habitat on the landscape. Controlling sericea lespedeza invasions will allow native forb species to increase in abundance and improve the condition of grasslands for native wildlife and livestock producers. Therefore, I advocate use of summer fire or spring fire with a combination of cattle and sheep grazing to control sericea lespedeza with the long-term goal of tall-grass prairie restoration.

Products

Presentations

Ogden, S., D. Haukos, K. Olson, and J. Lemmon. 2015. Response of grassland passerine communities to tall-grass prairie restoration using summer fire and sheep grazing. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Ogden, S., D. Haukos, K.C. Olson, and J. Lemmon. 2015. Response of grassland passerine communities to tall-grass prairie restoration with summer fire and sheep grazing. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

Ogden, S., D. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2015. Grassland nesting bird community response to Sericea Lespedeza using fire and grazing. Annual Meeting of the Kansas Ornithological Society, Emporia, KS

Ogden, S., D. Haukos, K. Olson, J. Alexander, and J. Lemmon. 2016. Patterns of butterfly community composition in response to sericea lespedeza control using fire and grazing. Kansas Natural Resource Conference, Wichita, KS.

Ogden, S., D. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2016. Grassland bird community response to sericea lespedeza control using fire and grazing. Annual Meeting of the Midwest Fish and Wildlife Conference, Grand Rapids, MI

Ogden, S., D. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2016. Grassland bird community response to sericea lespedeza control using fire and grazing. Annual Meeting of the Society of Range Management, Corpus Christi, TX

Ogden, S., D.A. Haukos, K.C. Olson, and J. Alexander. 2016. Birds, butterflies, and burning: wildlife response to summer fire used for invasive plant control in tall-grass prairie. Annual Meeting of The Wildlife Society, Raleigh, NC

Ogden, S., D.A. Haukos, K.C. Olson, and J. Alexander. 2016. Grassland birds and season of burn: grassland nesting

songbird response to Sericea Lespedeza control. Annual meeting of the Kansas Ornithological Society, Great Bend.

Ogden, S., D.A. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2017. Influence of season of burn on butterfly diversity in tall-grass prairie. 7th International Fire Ecology and Management Congress, Orlando, FL. (Invited)

Ogden, S., D.A. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2017. Grassland bird response to season of burn and grazing intensity. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

Thesis

Ogden, S. 2016. Responses of grassland birds and butterflies to control of sericea lespedeza with fire and grazing. Thesis, Kansas State University, Manhattan

Occurrence and Prediction of Avian Disease Outbreaks in Kansas

Investigators
Thomas Becker, M.S.

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks, and Tourism

U.S. Fish and Wildlife Service

Cooperators
Shane Hesting

Objectives
Compile all known records of avian disease outbreaks in Kansas.

Associate each record with available environmental data (e.g., precipitation index, temperature) and, if possible, estimated population at risk during each outbreak.

Create a historical data base and a web-based reporting form for avian disease outbreaks in Kansas.

Construct predictive models for environmental conditions that may support a disease outbreak

Location:
Throughout Kansas

Completion: July 2016

Status Complete

Results
There is a wide variety of diseases that affect wild migratory birds. Occurrence, causes, and impacts of disease outbreaks in wild bird populations are rarely studied beyond documentation of large epizootic events. Interfaces among wildlife, livestock, and humans are rapidly developing closer together. Global interests in avian diseases increased around 1990 as a result of the prevalence of zoonosis and potential threat to domestic livestock. A central disease reporting protocol does not exist in many states, which has led to a lack of available historical knowledge of disease occurrence that could be used to predict and manage future outbreaks. Due to changes of abundance and distribution of the migrant population of Ross's goose (*Chen rossii*) and Snow goose (*C. caerulescens*), geese are increasing their residence time in Kansas potentially increasing risk of disease outbreaks. We compiled historic records of avian disease events in Kansas from 1967-2014 establishing a Kansas disease outbreak database and related the frequency of events with increased waterfowl populations from 1970-2014. We found 32 reports spanning 16 counties consisting of the diseases avian cholera, avian botulism, aspergillosis, renal coccidiosis, west Nile, aflatoxicosis, and mycotoxicosis. Using a retrospective survey, we found there was a significant relationship between population densities of light geese in Kansas during the Mid-Winter Waterfowl Inventory and occurrence of avian cholera. Efforts to increase the understanding of relationships between disease outbreaks and host species will improve management of future disease outbreaks. Factors known to cause avian disease (e.g., environmental, species, and individual) assist in disease identification and disease management course of action. Actions taken are predetermined in a disease management plan developed at the state and station level. Surveillance and monitoring schemes are developed within these plans build on the centralized disease database and to promote future disease understanding.

Products

Publications

Becker, T.A., A.A. Ahlers, S. Hesting, and D.A. Haukos. 2018. Spatiotemporal distribution of waterfowl disease outbreaks in Kansas, USA. Prairie Naturalist *In Press*

Presentations

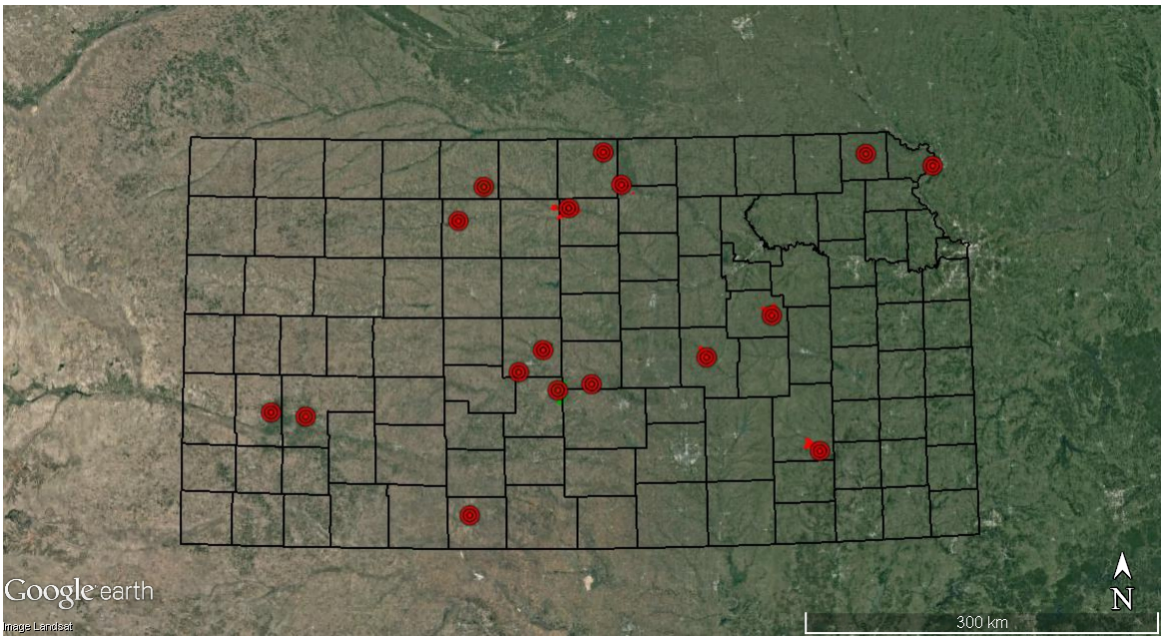
Becker, T., P. McBee, and D. Haukos. 2015. Occurrence and predictions of avian disease outbreaks in Kansas. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Becker, T., P. McBee, and D. Haukos. 2015. Occurrence and prediction of avian disease outbreaks in Kansas. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

Becker, T., A. Ahlers, and D. Haukos. 2016. A retrospective surveillance study of avian disease outbreaks in Kansas. Kansas Natural Resource Conference, Wichita, Kansas.

Thesis

Becker, T. 2016. Retrospective review of avian diseases in Kansas. Thesis, Kansas State University, Manhattan.



Spatial distribution of reported disease outbreaks in Kansas during 1967-2014.

Effects of Large-Scale Wetland Loss on Network Connectivity of the Rainwater Basin, Nebraska

Investigators
Dr. Bram Verheijen, Postdoctoral Research Associate

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

Location
The Rainwater Basin Region, southcentral Nebraska.

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 affects connectivity and structure of the Rainwater Basin, and whether the persistence of remaining wetlands that are important in maintaining network connectivity is threatened by future sediment accumulation.

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. Conservation efforts should therefore 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.

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

Completion
July 2018

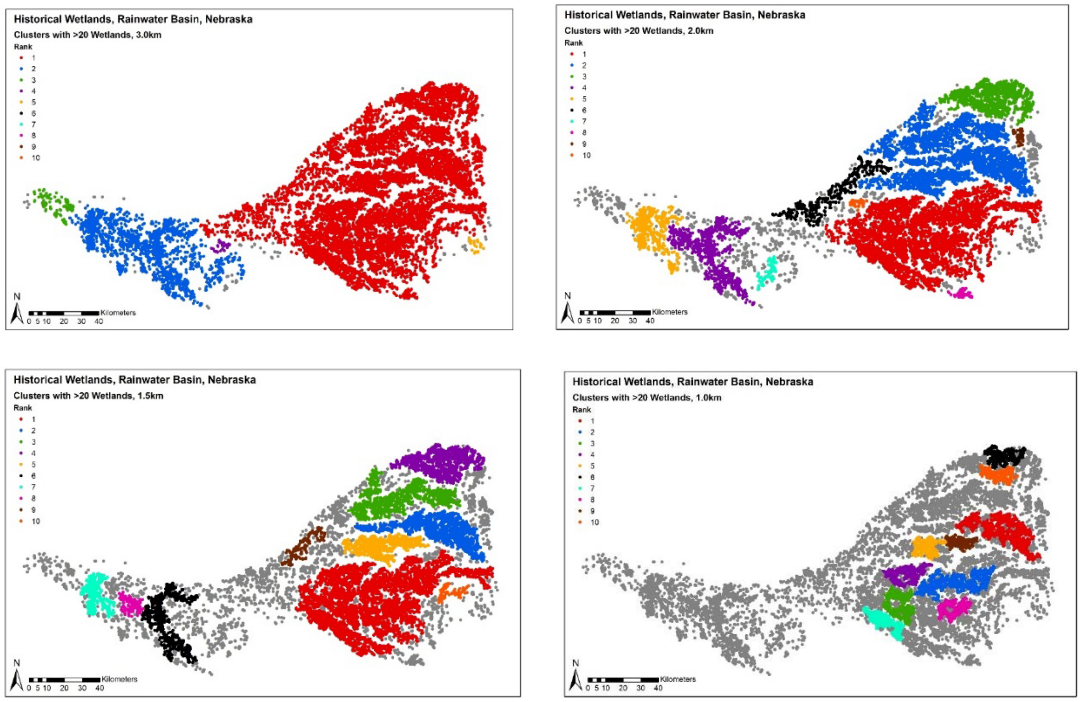
Presentations

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.

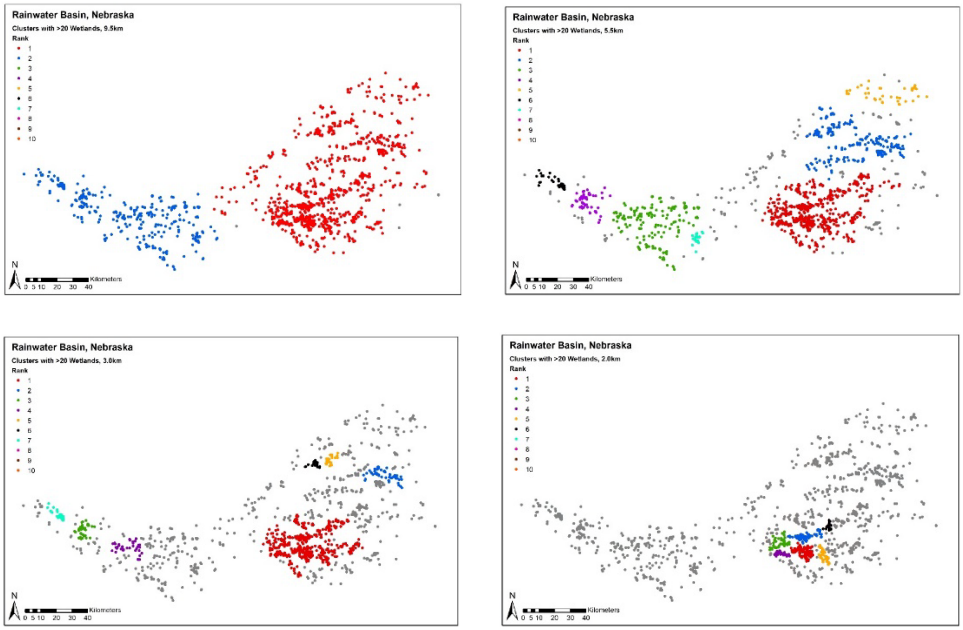
Verheijen, B.H.F., D. M. Varner, and D.A. Haukos. 2018. Effects of large-scale wetland loss on network connectivity of the Rainwater Basin. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Kearney, Nebraska.

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.



The ten largest clusters with at least 20 wetlands for four dispersal distances (3.0, 2.0, 1.5, and 1.0 km) for the historical extent of wetlands in the Rainwater Basin region of south-central Nebraska. Depicted dispersal distances coincide with significant drops in maximum network cluster size (see Figure 2).



The ten largest clusters with at least 20 wetlands for four dispersal distances (9.5, 5.5, 3.0, and 2.0 km) for the current extent of wetland in the Rainwater Basin region of south-central Nebraska. Depicted dispersal distances coincide with significant drops in maximum network cluster size.

Occurrence and Function of Playa Wetlands in the Smoky Hill River Watershed

Investigators
Willow Malone, M.S.

Project Supervisor
Dr. David Haukos

Funding
National Science Foundation

Cooperators
Dr. Melinda Daniels
Dr. Martha Mather
Dr. Marcellus Caldas
Dr. J. Heier Stamm
Dr. Jason Bergtold
Dr. Aleksey Sheshukov
Dr. Matthew Sanderson

Objectives

Identify the classification type, occurrence, and size of the wetlands in the Smoky Hill River Watershed

Test the relationship between land use and playa hydrology through biotic variables of the playa wetland

Develop a framework to predict the effects of environmental variation on playa hydrology and the effects it will have on the biodiversity

Location:
Smoky Hill River watershed

Completion
December 2016

Status
Completed

Progress and Results
Playa wetlands are unique ecological systems crucial to the ecology of the western Great Plains of North America. Playas offer a variety of ecological goods and services: flood water retention; water quality improvement; habitat for a distinctive assemblage of resident and migratory biota; and primary recharge points for the Ogallala Aquifer. The major threat to the function of playas is caused by watershed disturbance and habitat loss, primarily through sediment accumulation that decreases playa hydroperiod, density, and size. Previous research focused on playas in the Southern High Plains in Texas and the Rainwater Basin of Nebraska, with little playa studies located in the Central Great Plains. My objectives were to (1) identify the number and level of functionality of existing playas in the Smoky Hill River watershed, (2) determine the relative contribution of playas to the biodiversity of the landscape and influences from watershed disturbance levels, and (3) assess relationships among avian community composition and environmental variables through a canonical correlation analysis (CCA).

To assess playa functionality, I randomly selected 20% of the 3,310 historical playas in the watershed and confirmed playa presence and anthropogenic modifications through imagery analysis (n = 608). To achieve the last two objectives, I conducted breeding bird surveys using point counts in >25 playas with paired, nonplaya sites. I recorded avian relative abundance and species richness. Plant species occurrence was detected using step-point methods along transects. Species diversity was derived using Simpson's index. Approximately 22% of playas have been lost from the landscape. Of the remaining playas, only 3.15% were not affected by anthropogenic influences. Playas contribute greater than 40% and 16% greater avian species richness and diversity to the surrounding landscape, respectively. Playas located in grassland watersheds had a 63% and 35% greater avian species richness and diversity, as well as 57% and 66% greater floral species richness and diversity than playas located in croplands, respectively. CCA results identify playa soil moisture and watershed disturbance as significant influences to the playa avian community. It is important to reduce watershed disturbance and anthropogenic influence on playas to maintain biodiversity at local, regional, and continental scales.

Products

Presentations

Malone, W.E.A., and D.A. Haukos. 2015. The influence of watershed condition on avian use of dry playa wetlands. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

Malone, W., and D.A. Haukos. 2015. The influence of watershed condition on avian use and diversity of playa wetlands in western Kansas. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas. (poster)

Malone, W.E.A., D.A. Haukos, and M.D. Daniels. 2015. Our essential freshwater source: estimating the occurrence and function of playa wetlands in western Kansas. Governor's Water Conference, Manhattan, Kansas.

Malone, W.E.A., and D.A. Haukos. 2016. The influence of watershed condition on avian use of dry playa wetlands. Kansas Natural Resource Conference, Wichita, KS.

Malone, W., and D.A. Haukos. 2017. How playa wetlands influence landscape biodiversity: small depressions with a big benefit. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE. (Invited)

Thesis

Malone, W.E.A. 2016. Biodiversity in playa wetlands in relation to watershed disturbance. Thesis, Kansas State University, Manhattan.

Use of Moist-Soil Management for Waterfowl on the Texas Coast

Investigators
Mike Whitson, M.S.
Texas Tech University

Project Supervisor
Dr. Warren Conway
Dr. David Haukos

Funding
U.S. Fish and Wildlife Service
U.S. Geological Survey
Stephen F. Austin State University

Cooperators
Texas Chenier Plain NWR Complex
Dr. Dan Collins
Patrick Walther

Objectives
Assess biomass production in response to moist-soil management treatments

Determine species response to moist-soil management treatments

Measure waterfowl response to moist-soil management on the upper Texas Gulf Coast.

Location:
Anahuac NWR

Completion: December 2016

Status
Completed

Progress and Results

The Gulf Coast lies at the southern terminus of the Central Flyway and historically has provided winter habitat for millions of wintering waterfowl. Texas coastal associated wetlands provide critical winter habitats for wintering waterfowl, crucial stopover sites for migrating shorebirds, summer breeding and brood rearing habitats for a variety of species, for species, and vital year-round habitats for mottled ducks (*Anas fulvigula*). Reductions in wetland quality and quantity, from both natural and anthropogenic causes, increased human oriented demands on water use and allocation, and rising management implementation costs increase the need for efficient and effective management actions. Moist-soil management has been effectively used to improve habitats and promote seed producing plants, by varying hydrology, such as inundation seasonality, depth, duration, and drawdown lengths. This research focused upon examining the use of moist-soil management techniques in fallow rice fields on the upper Texas coast, by (1) examining seed-bank potential, (2) estimating plant community response to variations in inundation and drawdown events (3) estimate vegetation biomass and visual obstruction to variations in inundation seasonality, drawdown treatments, and disking events (4) examine inundation and drawdown effects on soil nutrient levels (5) quantify seed production of three focal species to calculate Duck-Use-Days, and develop seed production models using phytomorphology, and (6) quantify winter invertebrate biomass to incorporate into Duck Use Day estimates.

Seed-bank expression was estimated from 105 soil samples collected and subjected to moist or flooded treatments in a greenhouse. Seedlings (n = 9471) identified were 74 species, from 21 families, of which nearly 87% were considered either moderately or highly desirable for waterfowl. Greatest expression of highly desirable species was in moist treatments (n = 2212), while the greatest moderately desirable species expression occurred under flooded treatments (n = 3072). Greatest highly desirable species expression occurred 31-60 days after initial watering, while moderately desirable species expression was greatest 61-90 days after initial watering.

Plant community response to various inundation and drawdown treatments was estimated from (n =15,987) point-step survey locations, where 80% of all hits were plants, representing 53 species from 20 families. Highly desirable species (65%) and moderately desirable species (12%) were most frequently encountered in early season inundated fields, while highly desirable species cover was greatest in fields subjected to fast drawdown treatments (50 %) and

moderately desirable species cover was greatest in fields subjected to slow drawdowns (61 %). Plant biomass was estimated from 105 samples and visual obstruction was measured at 210 locations concurrently with biomass clipping. Dry vegetative biomass ranged from 987.93 kg/ha to 5777.40 kg/ha, and was positively correlated with visual obstruction measures. Greatest plant biomass occurred in fields that were not subjected to pre-inundation disking treatments ($\overline{x}$ = 4153 kg/ha) as compared to fields that were disked ($\overline{x}$ = 1517). Soil nutrient levels were estimated using 150 soil samples collected at three time periods in relation to inundation and growing season. While there was high variability in soil nutrient level between fields, variation due to moist-soil management regime was not detected.

Seed production was estimated from samples collected at 420 sample points for each of three focal species. Seed production was estimated from (n = 1,339) collected barnyard grass (*Echinochloa* spp.) inflorescence, (n = 2845) sprangletop (*Leptochloa fusca*) inflorescence and from (n = 3,277) jungle rice (*Echinochloa colona*) inflorescence. Estimated seed biomass produced by barnyard grass was ($\overline{x}$ = 38.32 kg/ha), sprangletop ($\overline{x}$ = 27.27 kg/ha), and ($\overline{x}$ = 56.42 kg/ha) for jungle rice, produced available metabolizable energy sufficient for nearly 20,000 Duck-Use-Days. Winter macroinvertebrate abundance and dry biomass was estimated from 75 sweep net samples collected during November and December 2012 and February and March 2013. Nearly 64,000 invertebrates were collected from 14 orders, with Diplostraca accounting for the greatest number of individuals (n = 44,723), while Physidae made up nearly 50% of sampled dry biomass. Winter macroinvertebrate biomass was sufficient to provide enough metabolizable energy for nearly 45,000 Duck-Use-Days. Combined seed and macro invertebrate biomass could provide metabolizable energy for 63,977 Duck-Use-Days.

Moist-soil management techniques are a viable management option to improve seed production and waterfowl habitats. These approaches can be incorporated into existing land management strategies for waterfowl, and other wetland associated species. In comparison to other research, Duck Use Day estimates were somewhat lower in this study but should be expanded to include other forage producing species beyond the three used in this research. The long growing season and ability to manage water movements provides managers with a variety implementation options using moist-soil management strategies that will be useful in regional waterfowl management in the

Products

Presentations

Whitson, M., W. Conway, C. Comer, and J. Moon. 2013. Vegetation and waterfowl response to temporal inundation variation in moist-soil managed fallow rice fields on the upper Texas Coast. Annual Meeting of The Texas Chapter of The Wildlife Society, Houston, Texas. Poster.

Whitson, M.D., T.V. Riecke, W.C. Conway, D.A. Haukos, J.A. Moon, and P. Walther. 2016. Waterfowl identification skills by duck hunters on the upper Texas coast. 7th North American Duck Symposium, Annapolis, MD.

Whitson, M.D., T.V. Riecke, W.C. Conway, D.A. Haukos, J.A. Moon, and P. Walther. 2016. Waterfowl identification skills by duck hunters on the upper Texas coast. Annual meeting of the Texas Chapter of The Wildlife Society, San Antonio, Texas

Whitson, M.D., W.C. Conway, D.A. Haukos, and D. Collins. 2016. Seed bank potential of moist-soil managed fallow rice fields on the upper Texas coast. 7th North American Duck Symposium, Annapolis, MD.

Thesis

Whitson, M. 2017. Use of moist-soil management techniques for wintering waterfowl in fallow rice fields on the upper Texas coast. Thesis, Texas Tech University

List of Scientific, Peer Reviewed Publications: 2016-present

Book

Haukos, D.A., and C.W. Boal (editors). 2016. Ecology and Conservation of Lesser Prairie-Chickens. Studies in Avian Biology, CRC Press.

Book Chapters

Albanese, G., and D. Haukos. 2018. Toward a theory of connectivity among depressional wetlands of the Great Plains: resiliency to natural and anthropogenic disturbance within a wetland network. In Press in E. Beever, S. Prange, and J. Franklin (editors). Disturbance Ecology and Biological Diversity: Context, Nature, and Scale. CRC Press/Taylor and Francis Group.

Haukos, D.A., and J.C. Zavaleta. 2016. Habitat. Pages 99-132 in D.A. Haukos, and C.W. Boal (editors). Ecology and Conservation of Lesser Prairie-Chickens. Studies in Avian Biology (no. 48), CRC Press, Boca Raton, FL.

Haukos, D.A., J.C. Pitman, G.M. Beauprez, and D.D Schoeling. 2016. Harvest. Pages 133-158 in D.A. Haukos, and C.W. Boal (editors). Studies in Avian Biology (no. 48), CRC Press, Boca Raton, FL.

Haukos, D.A., A. Flanders, C.A. Hagen, and J.C. Pitman. 2016. Lesser Prairie-Chickens of the Sand Sagebrush Prairie. Pages 281-298 in D.A. Haukos, and C.W. Boal (editors). Ecology and Conservation of Lesser Prairie-Chickens. Studies in Avian Biology (no. 48), CRC Press, Boca Raton, FL.

Boal, C.W., and Haukos, D.A. 2016. The Lesser Prairie-Chicken: a brief introduction to the grouse of the Southern Great Plains. Pages 1-12 in D.A. Haukos, and C.W. Boal (editors). Ecology and Conservation of Lesser Prairie-Chickens. Studies in Avian Biology (no. 48), CRC Press, Boca Raton, FL.

Grisham, B.A., J.C. Zavaleta, A.C. Behney, P.K. Borsdorf, D.R. Lucia, C.W. Boal, and D.A. Haukos. 2016. Ecology and Conservation of Lesser Prairie-Chickens in Sand Shinnery Oak Prairies. Pages 315-344 in D.A. Haukos, and C.W. Boal (editors). Ecology and Conservation of Lesser Prairie-Chickens. Studies in Avian Biology (no. 48), CRC Press, Boca Raton, FL.

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Peer Reviewed Journal Articles

Albanese, G., and D.A. Haukos. 2017. A network model framework for prioritizing wetland conservation in the Great Plains. Landscape Ecology 32:115-130.

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 In Press

Earl, J.E., S.D. Fuhlendorf, D. Haukos, A.M. Tanner, D. Elmore, and S.A. Carleton. 2016. Characteristics of lesser prairie-chicken (Tympanuchus pallidicinctus) long-distance movements across their distribution. Ecosphere 7(8):e01441. 10.1002/ecs2.1441

Fencl, J. S., M. E. Mather, J. M. Smith, and S. M. Hitchman. 2017. The blind men and the elephant examinebiodiversity at low-head dams: Are we all dealing with the same dam reality? Ecosphere 8(11):e01973.

Fritts, S.R., B.A. Grisham, R.D. Cox, C.W. Boal, C.A. Hagen, D.A. Haukos, P. McDaniel, and A.N. Erickson. 2018. Influence of vegetation structure and composition on lesser prairie-chicken demographics following an intense drought. Rangeland Ecology and Management *In Press.*

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 *In Press*.

Fritts, S.F., B.A. Grisham, D.A. Haukos, C.W. Boal, M.A. Patten, D.H. Wolfe, C.E. Dixon, R.D. Cox, and W.R. Heck. 2016. Long-term evaluation of lesser prairie-chicken nest ecology in response to grassland restoration at two spatial scales. Journal of Wildlife Management 80:527-539.

Gerber, K. M., M. E. Mather, and J. M. Smith. 2017. A suite of standard post-tagging evaluation metrics can help assess tag retention for field-based fish telemetry research. Reviews in Fisheries and Fish Biology 27:651–664

Grisham, B.A., A.J. Godar, C.W. Boal, and D.A. Haukos. 2016. Interactive effects between nest microclimate and nest vegetation structure confirm microclimate thresholds for lesser prairie-chicken nest survival. Condor 118:728-746.

Haukos, D.A., C.W. Boal, S. Carleton, and B. Grisham. 2016. Roles of Cooperative Research Units in contemporary conservation of natural resources. Transactions of the North American Wildlife and Natural Resources Conference 80: *In Press*

Haukos, D.A., L.A. Johnson, L.M. Smith, and S.T. McMurry. 2016. Effectiveness of vegetation buffers surrounding playa wetlands at contaminant and sediment amelioration. Journal of Environmental Management 181:552-562.

Hellgren, E.C, D.J. Austen, D.A. Haukos, J.R. Mawdsley, J.F. Organ, and B.K. Williams. 2016. 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: *In Press*

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.

Kennedy, C. G., M. E. Mather, J. M. Smith, J. T. Finn, L. A. Deegan. 2016. Discontinuities concentrate mobile predators: Quantifying organism-environment interactions at a seascape scale. Ecosphere 7(2):e01226.

Kennedy. C. G., M. E, Mather, and J. M. Smith. 2017. Quantifying integrated, spatially-explicit, ecologically-relevant, physical heterogeneity within an estuarine seascape. Estuaries and Coasts, 40:1385-1397.

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. 2018. Northern exposure: factors influencing nesting ecology of lesser prairie-chickens in Kansas and Colorado. Journal of Wildlife Management *In Press*

Lautenbach, J.M., R.T. Plumb, S.G. Robinson, D.A. Haukos, J.C. Pitman, and C.A. Hagen. 2017. Lesser prairie-chicken avoidance of trees in a grassland landscape. Rangeland Ecology and Management 70:78-86.

McCullough, K., G. Albanese, and D.A. Haukos. 2017. Novel observations of larval fire survival, feeding behavior, and host plant use in the regal fritillary, Speyeria idalia (Drury) (Nymphalidae). Journal of the Lepidopterists' Society 71:146–152.

McMullin, S. L, V. DiCenzo, R. Essig, C. Bonds, R. DeBruyne, M. Kaemingk, M. Mather, C. Myrick, Q. Phelps, T. Sutton, J. Triplett. 2016. Are we preparing the next generation of fisheries professionals to succeed in their careers? A survey of AFS members. Fisheries 41:448-461

Moon, J.A. D.A. Haukos, and W.C. Conway. 2017. Seasonal survival of adult female mottled ducks in the Texas Chenier Plain Region. Journal of Wildlife Management 81:461-469.

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. 2018. Lesser prairie-chicken space use among landscapes in response to anthropogenic structures. Journal of Wildlife Management *In Press*

Riecke, T.V., W.C. Conway, D.A. Haukos, J.A. Moon, and C.E. Comer. 2018. Nest survival of black-necked stilts, Himantopus mexicanus, on the upper Texas Coast. Waterbirds *In Press*

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.

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, D.S. Sullins, and R.T. Plumb. 2016. Use of free water by nesting lesser prairie-chickens. Southwestern Naturalist 61:187-193.

Robinson, S.G., D.A. Haukos, R.T. Plumb, C.A. Hagen, J.C. Pitman, J.M. Lautenbach, D.S. Sullins, J.D. Kraft, and J.D. Lautenbach. 2016. Lack of lesser prairie-chicken mortality due to fence collisions in Kansas and Colorado. Journal of Wildlife Management 80:906-915.

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. Haukos, C. Hagen, and J. Pitman. 2016. The relative contribution of climate to changes in lesser prairie-chicken abundance. Ecosphere 7(6):e01323. 10.1002/ecs2.1323

Ross, B.E., D.A. Haukos, C.A. Hagen, and J.C. Pitman. 2016. Landscape composition creates a threshold influencing lesser prairie-chicken population resilience to extreme drought. Global Ecology and Conservation 6:179-188.

Spencer, D., D. Haukos, C. Hagen, M. Daniels, and D. Goodin. 2017. Conservation Reserve Program mitigates grassland loss in the lesser prairie-chicken range of Kansas. Global Ecology and Conservation 9:21-38.

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 *In Press*

Sullins, D.S., D. A. Haukos, J. M. Lautenbach, S. G. Robinson, J. D. Lautenbach1, 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., W.C. Conway, D.A. Haukos, and C.E. Comer. 2018. Using pointing dogs and hierarchical models to evaluate American woodcock winter habitat. Proceedings of 11th American Woodcock Symposium *In Press*

Sullins, D.S., W.C. Conway, D.A. Haukos, K.A. Hobson, L.I. Wassenaar, C.E. Comer, and I.K. Hung. 2016. American woodcock migratory connectivity and post-juvenile dispersal as indicated by hydrogen isotopes. Journal of Wildlife Management 80:510-526.

Vanni, M.J., M. E. Mather et al. 2017. A global database of nitrogen and phosphorus excretion rates of aquatic animals. Ecology 98:1475

Waldman, J., K. Wilson, M. E. Mather, and N. P. Snyder. 2016. Can resilience theory help guide restoration of anadromous fishes? Fisheries 41:116-126.

Zavaleta, J.C., D.A. Haukos, B. Grisham, C. Boal, and C. Dixon. 2016. Restoring sand shinnery oak prairies with herbicide and grazing in New Mexico. Southwestern Naturalist 61:225-232.

Technical Publications

Krausman, P.R., D.A. Haukos, A.S. Cox, A.S.C. Knipps, J.L. Wallace, and T.E. Boal. 2016. Journal of Wildlife Management and Wildlife Society Bulletin: Author Guidelines.

Theses and Dissertations

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.

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

Ryland Taylor (M.S. 2017; advisor Mather) – Using geomorphology and animal “individuality” to understand ‘scape-scale predator distributions.

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.

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

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

Mike Whitson (M.S., 2017; advisor Conway/Haukos, Texas Tech University) – Use of moist-soil management techniques for wintering waterfowl in fallow rice fields on the upper Texas coast.

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

Willow Malone (M.S. 2016; advisor Haukos) – Biodiversity in playa wetlands in relation to watershed disturbance.

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

Sarah Ogden (M.S. 2016; advisor Haukos) – Responses of grassland birds and butterflies to control of sericea lespedeza with fire and grazing.

Thomas Becker (M.S. 2016; advisor Haukos, Horticulture and Natural Resources) – Retrospective review of wild waterfowl diseases in Kansas.

Hannah Ashbaugh (M.S. 2016; advisor Conway/Haukos Texas Tech University). Effects of heavy metals on snowy plovers nesting in saline lakes of the Southern High Plains.

Alix Godar (M.S. 2016; advisor Grisham/Boal/Haukos Texas Tech University) – Influence of climate change and land use on lesser prairie-chicken (*Tympanuchus pallidicinctus*) population persistence in the sand sagebrush and short-grass prairies

Cody Griffin (M.S. 2016; Grisham/Boal/Haukos Texas Tech University) – The influence of environmental and landscape variables on lesser prairie-chickens in the Sand Shinnery Oak Prairie Ecoregion of Texas and New Mexico and the Mixed-Grass Prairie Ecoregion of Oklahoma and Kansas

Research Experience for Undergraduates (REU)

- **2016/2017 – Jennie Grill (Martha Mather, Ryland Taylor)**

  Spatial Variation in Diets of Striped Bass

Undergraduate Student Research Mentorships

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

Austin, Earl. 2016-2017. Kansas State University. Project: Young of year largemouth bass (Micropterus salmoides) relative abundance and diet during the first summer. (Mather)

Miller, Kenna. 2016-2017. Project: Young of year largemouth bass (*Micropterus salmoides*) relative abundance and diet during the first summer (Mather)

Heit, Destiny. 2017. Kansas State University. Project: Estimating hydrological patterns in saline lakes of the Southern High Plains using LandSat imagery. (Haukos)

Welti, Laura. 2017. Kansas State University. Project: Land cover influence on movements by ring-necked pheasants. (Haukos)

Sink, Chelsea. 2016. Kansas State University. Project: Do lesser prairie-chickens perceive predation risk during the breeding season. McNair Scholar (Haukos)

Skidmore, Caroline. 2015-2016. Kansas State University. Project: A distribution modeling approach to monarch butterfly density, host plant occurrence, and preferred habitat in the Flint Hills. (Haukos)

List of Presentations 2016-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., 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. 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. 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.

Ashbaugh, H.M., W.C. Conway, D.P. Collins, D.A. Haukos, and C.E. Comer. 2016. Heavy metal concentrations within breeding snowy plovers in saline lakes of the Southern Great Plains of Texas, New Mexico, and Oklahoma. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, TX.

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., 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.

Austin E., R. L. Mapes, and M. E. Mather. 2017. It's a fish eat fish world – or is it? Kansas Natural Resource Conference, Wichita, KS (Poster).

Becker, T., A. Ahlers, and D. Haukos. 2016. A retrospective surveillance study of avian disease outbreaks in Kansas. Kansas Natural Resource Conference, Wichita, KS.

Bergtold, J.S., M.R. Sanderson, J.L. Heier Stamm, M.M. Caldas, G. Granco, S.M. Ramsey, M. Mather, D.A. Haukos, and M. Daniels. 2017. Perceived vulnerability of the Ogallala aquifer, wetlands and aquatic biodiversity: the gap between the public and scientific experts. Kansas Governor's Water Conference, Manhattan, Kansas.

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.

de la Piedra, S., C. Portillo-Quintero, B. Grisham, C. Boal, D. Haukos, and W. Heck. 2016. Time series analysis of remote sensing data as a management tool for the conservation of the lesser prairie-chicken (Tympanuchus pallidicinctus). Student Conference on Conservation Science - New York.

Duffie, L.E., C.E. Comer, W.C. Conway, D.A. Haukos, D.P. Collins, K.W. Farrish, R.J. Taylor, and H.M. Ashbaugh. 2017. Conservation implications and toxicological risk for declining snowy plovers breeding in the Southern Great Plains. Annual meeting of the Society of Wetland Scientists, San Juan, Puerto Rico.

Duffie, L.E., C.E. Comer, W.C. Conway, D.A. Haukos, D.P. Collins, K.W. Farrish, R.J. Masse, and R.J. Taylor. 2016. Potential mercury exposure through wetland sediments and blood of snowy plovers breeding in the Southern Great Plains. Joint meeting of the Gulf Estuarine Research Society and Society of Wetland Scientists, Pensacola Beach, FL.

Duffie, L.E., C.E. Comer, W.C. Conway, D.A. Haukos, D.P. Collins, K.W. Farrish, R.J. Masse, and R.J. Taylor. 2016. Environmental mercury availability and accumulation in wetland sediments and blood of snowy plovers in the Southern Great Plains. Annual Meeting of the Society of Wetland Scientists, Corpus Christi, TX.

Duffie, L.E., C.E. Comer, W.C. Conway, D.A. Haukos, D.P. Collins, K.W. Farrish, R.J. Masse, and R.J. Taylor. 2016. Mercury concentrations in wetland sediments and blood of snowy plovers in the Southern Great Plains. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, TX.

Fritts, S.R., B. A. Grisham, R. D. Cox, C. W. Boal, D. A. Haukos, P. McDaniel. 2016. Hierarchical modeling of lesser prairie-chicken demographic response to weather and grazing. Society of Range Management Annual Conference. Corpus Christi, TX.

Fritts, S.R., B.A. Grisham, R.D. Cox, C.W. Boal, D.A. Haukos, and P. McDaniel. 2016. Assessing potential synergies between drought and grazing on lesser prairie-chicken demography. Annual Meeting of The Wildlife Society, Raleigh, North Carolina.

Fritts, S.R., B.A. Grisham, R.D. Cox, C.W. Boal, D.A. Haukos, and P. McDaniel. 2016. Influence of vegetation structure and composition on lesser prairie-chicken abundance, survival, and recruitment following an intense drought. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, TX.

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.

Gerber, K. M., M. E. Mather, J. M. Smith, and Z. Peterson. 2016. Identifying overall, seasonal, and diel patterns for reservoir-wide distribution of Blue Catfish: filling critical gaps for fish ecology and fisheries management. American Fisheries Society. Kansas City, MO.

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.C. Annis, D. Haukos, and J. Prendergast. 2017. Ring-necked pheasant use of spring cover crops in western Kansas. Annual conference of The Wildlife Society, Albuquerque, NM.

Godar, A., B. Grisham, C. Griffin, S. Fritts, C. Boal, D. Haukos, J. Pitman, C. Hagen, and M. Patten. 2016. Influence of weather parameters on lesser prairie-chicken rangewide nest survival. Texas Tech Annual Biological Sciences Symposium, Lubbock.

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.

Godar, A.J., B.A. Grisham, B.E. Ross, C.W. Boal, C.P. Griffen, C.A. Hagen, D.A. Haukos, M.A. Patten, and J.C. Pitman. 2016. Incorporating contemporary statistical methods into long-term ecological data: a case study on lesser prairie-chickens. Kansas Natural Resource Conference, Wichita, KS.

Godar, A.J., B.A. Grisham, B.E. Ross, C.W. Boal, S.R. Fritts, C.P. Griffin, C.A. Hagen, D.A. Haukos, M.A. Patten, and J.C. Pitman. 2016. Rangewide assessment of the influence of climate change on lesser prairie-chicken population persistence. North American Ornithological Congress, Washington, D.C.

Godar, A.J., B.A. Grisham, C.P. Griffin, S.R. Fritts, C.W. Boal, D.A. Haukos, J.C. Pitman, M.A. Patten, and C.A. Hagen. 2016. The influence of weather parameters on lesser prairie-chicken rangewide nest survival. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, TX.

Godar, A.J., C.P. Griffin, B.A. Grisham, D.A. Haukos, S.R. Fritts, B.E. Ross, C.W. Boal, C.A. Hagen, M.A. Patten, and J.C. Pitman. 2017. Combining weather data and climate projections: a case study with Lesser Prairie-Chickens. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

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.

Greene, D.U., B.A. Grisham, C.W. Boal, D.A. Haukos, and R.D. Cox. 2017. Brood survival of lesser prairie-chickens in the sand shinnery oak ecoregion of Texas and New Mexico. Annual Meeting of The Wildlife Society, Albuquerque, NM.

Greene, D.U., B.A. Grisham, C.W. Boal, D.A. Haukos, and R.D. Cox. 2017. Brood survival of lesser prairie-chickens in the sand shinnery oak ecoregion of Texas and New Mexico. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, Tcxas.

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.

Griffin, C.P., A.J. Godar, S.R. Fritts, B.A. Grisham, C.W. Boal, D.A. Haukos, J.C. Pitman, G.M. Beauprez, M.A. Patten, and C.A. Hagen. 2016. A range-wide assessment of the influence of anthropogenic features and landcover patterns on lesser prairie-chicken lek attendance. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, TX.

Griffin, C.P., A.J. Godar, S.R. Fritts, D.U. Greene, B.A. Grisham, C.W. Boal, D.A. Haukos, J.C. Pitman, G.M. Beauprez, M.A. Patten, and C.A. Hagen. 2016. A range-wide assessment on the influence of anthropogenic structure dispersion and land cover patch size on lesser prairie-chicken lek attendance. NAOC, Washington, D.C.

Grill, J., R. Taylor, and M. Mather. 2017. Where and how predators feed: migratory striped bass can provide general insights into sportfish foraging. Kansas Natural Resource Conference, Wichita, Kansas (Poster).

Grisham, B., D. Greene, R.T. Cox, S. Fritts, C. Boal, D. Haukos, and W. H. 2017. Lesser prairie-chicken brood ecology in the sand shinnery oak ecoregion. Prairie Grouse Technical Council, Dickinson, ND.

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., 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., 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.

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.A. 2017. 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. 2017. Playa buffers. Playa Lakes Workshop and Tour, Kansas Alliance of Wetlands and Streams, Garden City, Kansas (Invited)

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

Haukos, D.A., and G. Albanese. 2017. Use of network analysis to prioritize conservation of playa wetlands based on landscape connectivity. Annual Meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE. (Invited)

Haukos, D.A., and J. Prendergast. 2016. Lesser prairie-chickens – a case study in cooperative conservation. North American Wildlife and Natural Resources Conference, Pittsburg, PA. (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)

Haukos, D.A., J.A. Moon, and W.C. Conway. 2016. At what scale should mottled ducks be managed? Special Session: Evolution, Ecology, and Conservation of Monotypic Ducks, 7th North American Duck Symposium, Annapolis, MD. (Invited)

Haukos, D.A., W.C. Conway, D. Hett, and B. Weihs. 2017. Ecological state change of saline lakes on the Southern High Plains. Annual conference of The Wildlife Society, Albuquerque, NM.

Hitchman, S.M., M.E. Mather, J.M. Smith and J.S. Fencl. 2016. Viewing streams as a habitat mosaic; implications for riverscape ecology and stream conservation. American Fisheries Society. Kansas City, MO.

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.

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.

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.

Kraft, J.D., D. Haukos, and C. Hagen. 2016. Implications of pasture area, grazing strategy, and region on lesser prairie-chicken habitat selection and vegetation. Annual Meeting of the Society of Range Management, Corpus Christi, TX

Kraft, J.D., D. Haukos, C. Hagen, and J. Pitman. 2016. Are larger pastures and sparser herds the way to manage grassland birds? A case-study of the lesser prairie-chicken. Annual Meeting of The Wildlife Society, Raleigh, NC. (Invited)

Kraft, J.D., D. Sullins, and D.A. Haukos. 2016. Dynamic interactions of Conservation Reserve Program, native grasslands, and lesser prairie-chicken habitat selection. Kansas Natural Resource Conference, Wichita, KS.

Kraft, J.D., D. Sullins, and D.A. Haukos. 2016. Evaluation of lesser prairie-chicken brood habitat selection across categorical habitats. Kansas Natural Resource Conference, Wichita, KS.

Kraft, J.D., D.A. Haukos, M.R. Bain, M. Rice, S. Robinson, D.S. Sullins, C.A. Hagen, J. Pitman, J. Lautenbach, R. Plumb, and J. Lautenbach. 2017. Sparser herds, larger pastures, and imperiled birds: heterogeneity-based grazing management is essential for a heterogeneity-dependent grassland. Prairie Grouse Technical Council, Dickinson, ND.

Lane, T. C., J. A. Moon, B. A. Grisham, D. M. Head, D. A. Haukos, W. C. Conway. 2016. Habitat selection by waterfowl wintering at Anahuac National Wildlife Refuge. Annual meeting of the Texas Chapter of The Wildlife Society, San Antonio, Texas.

Lane, T.C., B.A. Grisham, J.A. Moon, D.M. Head, D.A. Haukos, and W.C. Conway. 2017. Habitat selection of wintering waterfowl communities on Anahuac National Wildlife Refuge. Annual Meeting of The Wildlife Society, Albuquerque, NM.

Lane, T.C., B.A. Grisham, J.A. Moon, D.M. Head, D.A. Haukos, and W.C. Conway. 2017. Habitat selection of wintering waterfowl communities on the upper Texas Coast. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, Texas.

Lautenbach, J. D. Haukos, J. Lautenbach, J. Kraft, and D. Sullins. 2016. Satisfying the quilt work of habitat needs of the lesser prairie-chicken: the role of patch-burn grazing. Annual Meeting of The Wildlife Society, Raleigh, NC. (Invited)

Lautenbach, J., and D. Haukos. 2017. Quantifying landscape and vegetation characteristics of lesser prairie-chicken habitat during extreme temperature events. Annual meeting of the Society of Range Management, St. George, UT.

Lautenbach, J., D. Haukos, and B.A. Grisham. 2017. Fried Chicken: Identifying areas of thermal refugia for lesser prairie-chickens in a changing climate. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

Lautenbach, J., D. Haukos, and B.A. Grisham. 2017. Quantifying landscape and vegetative characteristics of lesser prairie-chicken habitat during extreme temperature events. Annual meeting of The Wildlife Society, Albuquerque, NM.

Lautenbach, J., D. Haukos, and C. Hagen. 2016. Satisfying the quilt work of habitat needs of the lesser prairie-chicken: the role of patch-burn grazing. Annual meeting of The Wildlife Society, Raleigh, NC.

Lautenbach, J., D. Haukos, and C. Hagen. 2017. Influence of patch-burn grazing on lesser prairie-chicken habitat selection in Kansas. Prairie Grouse Technical Council, Dickinson, ND.

Lautenbach, J., D. Haukos, R. Plumb, J. Pitman, and C. Hagen. 2016. Effects of tree encroachment on lesser prairie-chickens. Annual Meeting of the Midwest Fish and Wildlife Conference, Grand Rapids, MI

Lautenbach, J., J. Lautenbach, and D. Haukos. 2016. Effects of tree encroachment and prescribed fire on lesser prairie-chicken space use. Annual meeting of the Kansas Ornithological Society, Great Bend.

Lautenbach, J., J. Lautenbach, and D. Haukos. 2016. Killing trees and maintaining prairie for lesser prairie-chickens through patch-burn grazing. Annual Meeting of the Society of Range Management, Corpus Christi, TX

Lautenbach, J., J. Lautenbach, and D. Haukos. 2016. Response of lesser prairie-chicken habitat and habitat use to patch-burn grazing. Annual Meeting of the Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Lautenbach, J., J. Lautenbach, and D. Haukos. 2016. Using patch-burn grazing to maintain prairie for lesser prairie-chickens. Kansas Natural Resource Conference, Wichita, KS.

Lautenbach, J., J. Lautenbach, D. Sullins, R. Plumb, D. Haukos, C. Hagen, and J. Pitman. 2017. Lesser prairie-chicken avoidance of trees in a grassland landscape. Annual Meeting of the Society of Range Management, St. George, Utah. (Invited)

Lehrter, R., and M. E. Mather. 2017. Land Use, Flow, and Discontinuities Influence Fish Biodiversity across Regions in the Smoky Hill River, a Great Plains Watershed. Kansas Natural Resource Conference, Wichita, Kansas (Poster).

Lipp, T., A. Gregory, and D. Haukos. 2016. Influence of sound on nesting ecology and home range characteristics of the lesser prairie-chicken. Annual Meeting of the Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Luginbill, J., E. Johnson, S.M. Hitchman and M.E. Mather. 2016. Effective aquatic conservation requires fisheries research for the "scape". American Fisheries Society. Kansas City, MO.

Malone, W., and D.A. Haukos. 2017. How playa wetlands influence landscape biodiversity: small depressions with a big benefit. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE. (Invited)

Malone, W.E.A., and D.A. Haukos. 2016. The influence of watershed condition on avian use of dry playa wetlands. Kansas Natural Resource Conference, Wichita, KS.

Mapes, R.L., and M.E. Mather. 2016. Location, Location, Location: Incorporating spatial context into fisheries research. American Fisheries Society Meeting, Kansas City, MO

Mather, M. E., J. M. Smith, K. Gerber, and R. Taylor. 2017. Resmo: Patterns in residence and movement across sites can provide novel insights into field distribution of mobile consumers in pelagic ecosystems. Invited Paper, Symposium, American Fisheries Society, Tampa, FL

Mather, M.E., J. M. Smith. C. G. Kennedy, and R. T. Taylor. 2016. Mobile organisms in the 'scape': patterns, consequences, and challenges. American Fisheries Society. Kansas City, MO

Mather, M. E., and R. Lehrter. 2017. Fish biodiversity as an interdisciplinary link for sustainability. American Fisheries Society, Tampa, FL

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., 2018. Implicit gender bias limits workplace diversity in the scientific profession: evidence, consequences, and remedies.

McCullough, K., G. Albanese, and D.A. Haukos. 2016. Habitat characteristics and the impact of disturbance regime on an imperiled grassland butterfly: re-thinking regal fritillary (Speyeria idalia) conservation and management. Kansas Natural Resource Conference, Wichita, KS.

McCullough, K.E, D. A. Haukos, G. Albanese, and A. Ricketts. 2017. Re-thinking regal fritillary conservation and management: the impact of disturbance regime and habitat characteristics on an imperiled grassland butterfly. 7th International Fire Ecology and Management Congress, Orlando, FL.

McCullough, K.E., G. Albanese, and D.A. Haukos. 2016. Re-thinking regal fritillary conservation and management: habitat characteristics and the impact of disturbance regime on an imperiled grassland butterfly. Annual meeting of The Wildlife Society, Raleigh, NC.

Moon, J., S. DeMaso, M. Brasher, W. Conway, and D. Haukos. 2016. A stochastic model to simulate mottled duck population dynamics. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, TX.

Moon, J., S. DeMaso, M. Brasher, W. Conway, and D. Haukos. 2016. A stochastic model to simulate mottled duck population dynamics. 7th North American Duck Symposium, Annapolis, MD.

Moon, J., S. Lehnen, K. Metzger, S. Sesnie, D. Haukos, and W. Conway. 2016. Integrating sea-level rise and anthropogenic change into mottled duck conservation. 7th North American Duck Symposium, Annapolis, MD.

Ogden, S., D. Haukos, K. Olson, J. Alexander, and J. Lemmon. 2016. Patterns of butterfly community composition in response to sericea lespedeza control using fire and grazing. Kansas Natural Resource Conference, Wichita, KS.

Ogden, S., D. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2016. Grassland bird community response to sericea lespedeza control using fire and grazing. Annual Meeting of the Midwest Fish and Wildlife Conference, Grand Rapids, MI

Ogden, S., D. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2016. Grassland bird community response to sericea lespedeza control using fire and grazing. Annual Meeting of the Society of Range Management, Corpus Christi, TX

Ogden, S., D.A. Haukos, K.C. Olson, and J. Alexander. 2016. Birds, butterflies, and burning: wildlife response to summer fire used for invasive plant control in tall-grass prairie. Annual Meeting of The Wildlife Society, Raleigh, NC

Ogden, S., D.A. Haukos, K.C. Olson, and J. Alexander. 2016. Grassland birds and season of burn: grassland nesting songbird response to Sericea Lespedeza control. Annual meeting of the Kansas Ornithological Society, Great Bend.

Ogden, S., D.A. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2017. Influence of season of burn on butterfly diversity in tall-grass prairie. 7th International Fire Ecology and Management Congress, Orlando, FL. (Invited)

Ogden, S., D.A. Haukos, K.C. Olson, J. Alexander, and J. Lemmon. 2017. Grassland bird response to season of burn and grazing intensity. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

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.

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.

Peterson, Z., M. E. Mather, J. M. Smith, and K. M. Gerber. 2016. Correlates of the whole-system distribution of a reservoir predator (Blue Catfish, Ictalurus Furcatus). American Fisheries Society. Kansas City, MO.

Plumb, R.T., J.M. Lautenbach, S.G. Robinson, J.D. Kraft, D. Sullins, J. Lautenbach, D.A. Haukos, J.L. Winder, J.C. Pitman, C.A. Hagen, and D. Dahlgren. 2016. Lesser prairie-chicken space use response to anthropogenic structures among landscapes. North American Congress for Conservation Biology, Madison, WI. (Invited)

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.

Robinson, S., R. Plumb, D. Haukos, C. Hagen, J. Pitman, and B. Sandercock. 2016. Come rain or no water, I will survive: nonbreeding lesser prairie-chicken survival and space use. North American Ornithological Congress, Washington, D.C.

Ross, B., D. Haukos, C. Hagen, and J. Pitman. 2016. Combining multiple data sources to determine drought and land-use impacts on lesser prairie-chickens. North American Ornithological Congress, Washington, D.C.

Ross, B.E., D. Haukos, and P. Walther. 2016. Drivers of mottled duck pairs on the upper Texas Gulf Coast. 7th North American Duck Symposium, Annapolis, MD.

Ross, B.E., D.A. Haukos, and P. Walther. 2017. Quantifying changes and drivers of mottled duck density in Texas. Annual conference of The Wildlife Society, Albuquerque, NM.

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.

Silva, M., D.U. Greene, S.R. Fritts, B.A. Grisham, C.W. Boal, D.A. Haukos, J. Lautenbach, C.A. Hagen, and W.R. Heck. 2017. Assessing fine-scale microclimate conditions in an intensively managed landscape. Annual Meeting of the Texas Chapter of The Wildlife Society, San Antonio, Texas.

Sink, C. and D. Haukos. 2016. Influence of raptor abundance on lesser prairie-chicken habitat selection. McNair Heartland Conference, Kansas City, MO.

Sink, C., and D. Haukos. 2017. Influence of raptor abundance on female lesser prairie-chicken habitat selection. Kansas Natural Resource Conference, Wichita, KS.

Sink, C., and D. Haukos. 2017. Influence of raptor abundance on female lesser prairie-chicken habitat selection. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

Skidmore, C., K. McCullough, and D. Haukos. 2017. Ecology of the Monarch butterfly relative to density, host plant occurrence, and habitat use in the Flint Hills. Annual meeting of The Wildlife Society, Albuquerque, NM.

Skidmore, C., K. McCullough, and D. Haukos. 2017. The ecology of the monarch butterfly relative to density, host plant occurrence and habitat use in the Flint Hills. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

Skidmore, C., K.E., McCullough, G. Albanese, and D.A. Haukos. 2016. A distribution modeling approach to monarch butterfly density, host plant occurrence, and preferred habitat in the Flint Hills. Annual meeting of The Wildlife Society, Raleigh, NC.

Smith, J. M., M. E. Mather, and K. M. Gerber. 2016. Seasonal and diel patterns of depth and temperature distribution of Blue Catfish in Milford Reservoir, Ks. American Fisheries Society. Kansas City, MO.

Smith, J.M., M.E. Mather and Hitchman, S.M. 2016. Operationalizing riverscapes. American Fisheries Society. Kansas City, MO.

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.S., and D.A. Haukos. 2016. Available foods and diets of lesser prairie-chickens in native and CRP grasslands of Kansas and Colorado. Kansas Natural Resource Conference, Wichita, KS.

Sullins, D.S., and D.A. Haukos. 2016. Lesser prairie-chicken foraging in native and CRP grasslands of Kansas and Colorado. Annual Meeting of The Wildlife Society, Raleigh, NC.

Sullins, D.S., and D.A. Haukos. 2016. Lesser prairie-chicken foraging in native and CRP grasslands of Kansas and Colorado. Annual Meeting of the Society of Range Management, Corpus Christi, TX

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, and B.K. Sandercock. 2016. Impacts of Conservation Reserve Program grasslands on lesser prairie-chicken populations in the northern extent of their range. Kansas Natural Resource Conference, Wichita, KS.

Sullins, D.S., D.A. Haukos, J. Kraft, J. Lautenbach, J. Lautenbach, R. Plumb, S. Robinson, B. Ross, and B.K. Sandercock. 2017. Strategic regional conservation for lesser prairie-chickens among landscapes adjacent to western Kansas rivers. Kansas Natural Resource Conference, Wichita, KS.

Sullins, D.S., D.A. Haukos, J. Kraft, J. Lautenbach, J. Lautenbach, R. Plumb, S. Robinson, and B. Ross. 2016. Conservation planning for lesser prairie-chickens among reproductive and survivorship landscapes of varying anthropogenic influence. North American Congress for Conservation Biology, Madison, WI. (Invited)

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., J. Kraft, D.A. Haukos, and B.K. Sandercock, 2017. Selection and demographic consequences of Conservation Reserve Program grasslands for lesser prairie-chickens. Annual meeting of the Midwest Fish and Wildlife Agencies, Lincoln, NE.

Sullins, D.S., J.M. Lautenbach, and D.A. Haukos. 2017. Tradeoffs of nest and brood habitat availability for lesser prairie-chickens. Annual conference of The Wildlife Society, Albuquerque, NM.

Sullins, D.S., W.C. Conway, D.A. Haukos, and C.E. Comer. 2017. Using pointing dogs and hierarchical models to estimate American woodcock winter habitat availability. 11th Woodcock Symposium, Roscommon, MI.

Taylor, R. T., M. E. Mather, J. Smith, K. Gerber. 2017. Examining the concept of site fidelity for a mobile fish predator in an estuarine seascape. Contributed Paper, Ecological Society of America, Portland, OR

Taylor, R.B. and M.E. Mather. 2017. Examining the concept of site fidelity for a mobile fish predator in an estuarine seascape. Plum Island All Scientists Meeting, Woods Hole, MA, March 2017

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.

Whitson, M.D., T.V. Riecke, W.C. Conway, D.A. Haukos, J.A. Moon, and P. Walther. 2016. Waterfowl identification skills by duck hunters on the upper Texas coast. 7th North American Duck Symposium, Annapolis, MD.

Whitson, M.D., W.C. Conway, D.A. Haukos, and D. Collins. 2016. Seed bank potential of moist-soil managed fallow rice fields on the upper Texas coast. 7th North American Duck Symposium, Annapolis, MD.

Committees and Other Professional Assignments
2016-present

Addie Annis (GRA)

- Teaching Assistant, Mammalogy (Fall 2016), Principals of Biology (Fall 2017, Fall 2018)
- Hill City, Kansas Chamber of Commerce Monthly Meeting. Ring-necked Pheasant Project Update Presentation, 2018.

Carly Aulicky (GTA)

- Teaching Assistant, Principals of Biology (2 sections Fall 2017, 2 sections Fall 2018)
- 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
- Biology Graduate Student Association T-shirt Committee, 2016-2017

Liam Berigan (GRA)

- Teaching Assistant, Principles of Biology BIOL 198 (Fall 2017, 2 sections Fall 2018)

Alix Godar (GRA)

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

Chris Gulick (GTA)

- 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.

David Haukos

- KSU Representative for North Central Science Center
- Member, Great Plains LCC Science Team
- Member, Playa Lakes Joint Venture Science Advisory Team
- 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
- Facilitate KSU volunteers for semi-annual black-footed ferret surveys in western Kansas 2012-2016
- Member of the KDWPT Threatened and Endangered Task Committee 2013-current
- Adjunct Professor, Texas Tech University
- Adjunct Professor, Stephen F. Austin State University
- Western Association of Fish and Wildlife Agencies – Lesser Prairie-Chicken Science Work Group 2014-Current
- Editor-in-Chief, Wildlife Society Bulletin 2016-2020
- Served on NSF Review Panel – Macrosystems and Early NEON 2016
- Board Member At Large – Kansas Chapter of The Wildlife Society (2017-2018)

- Member, USFWS Lesser Prairie-Chicken Species Status Assessment Team (2016-2017)
- Science Team, STG and GPC Interstate Working Groups (2016 – current)
- Served as peer-reviewer for USFWS Species Status Assessment for the American Burying Beetle 2017.
- Served on panel to review and provide input for the Sault Ste. Marie Tribe of Chippewa Indians - Inland Fish and Wildlife Department, climate change vulnerability assessment project on the upland game bird panel.
- Provided pintail satellite locations to Max Planck Institute for Ornithology in Germany (2017).
- Provided data on amphibian diets to Federal University of Mato Grosso do Sul, in Brazil (2017).
- External Reviewer, P/T Application, University of Wyoming (2017)
- Kansas Alliance of Wetlands and Streams – Board Member 2018-Current
- Abstract Reviewer, The Wildlife Society 2018 Annual Meeting

Sean Hitchman (GRA, Graduated May 2018)

- Teaching Assistant, Organismal Biology BIOL 201 (Spring 2012, Fall 2012, Spring 2013, Fall 2013, Spring 2014, Fall 2014, Spring 2015, Fall 2015, Spring 2016)
- Vice President: Kansas State Biology Graduate Student Association (2014)
- Transactions of the American Fisheries Society Publication Awards Committee (2014-2017)
- Symposium organizer, Fish Research and Conservation in the 'Scapes: Needs, Progress, Challenges and Opportunities, American Fisheries Society, Kansas City (2016)
- Moderator for national American Fisheries Society Conference (2014-2016)
- Golden Key International Honor Society (2014-2017)

Talesha Karish (GRA)

- Teaching Assistant, Organismic Biology (Fall 2018)

Mitchell Kern (GRA, WOEM)

- Teaching Assistant, Advanced Habitat Management, WOEM (Fall 2018)
- Booth, Summer Festival and Jubilee Parade, Lenora, KS.

Maureen Kinlan (GRA)

- Teaching Assistant, Principles of Biology (Fall 2018)

John Kraft (GRA, Graduated December 2016)

- Teaching Assistant, Principles of Biology (Fall 2014 [2 sections], Spring 2015, Spring 2016)
- Teaching Assistant, Organismic Biology (Fall 2015)

Jonathan Lautenbach (GRA, Graduated May 2017)

- Teaching Assistant, Principles of Biology (Fall 2015 [2 sections]), Grader (Fall 2016)

Richard Lehrter (GRA, Graduated May 2018)

- Teaching Assistant, Principles of Biology (Fall 2014, Spring 2015, Fall 2015, Spring 2016, Fall 2016); Grader (Spring 2017)
- Biology Graduate Student Association – Seminar Representative 2014-2015

- Invited panel speaker at Flint Hill Discovery Center for screening of "*When the Well Runs Dry: Film Screening and Panel Discussion"* 2017

John Malanchuk (GRA)

- Teaching Assistant, Wildlife Management and Techniques Lab (Spring 2018), Mammalogy (Fall 2018)

Willow Malone (GRA, Graduated Dec 2016)

- Teaching Assistant, Principles of Biology (Fall 2014, Spring 2015)
- Teaching Assistant, Adaptations of Animals Lab (Fall 2015)
- Teaching Assistant, Wildlife Management and Techniques Lab (Spring 2016)
- Teaching Assistant, Plant Taxonomy (Fall 2016)
- Biology Graduate Student Association – T-shirt Committee 2014-2016
- Biology Graduate Student Association – Welcoming Committee

Robert Mapes (GRA, Graduated May 2017)

- Teaching Assistant, Principles of Biology (Spring 2014, Fall 2014. Fall 2015);
- Teaching Assistant, Organismic Biology (Spring 2015 [2 sections], Spring 2016 [2 sections])
- President – KSU Student Subunit of the American Fisheries Society 2016

Martha Mather

- Subject Editor, Wetlands Ecology and Management 2008-current
- President's Committee on Improving Fisheries Education, American Fisheries Society 2013-2016
- Co-Chair, Kansas Chapter, American Fisheries Society, Membership Committee 2012-2016
- Organizer, KSU Workshop on best practices in species distribution modeling (SDMs). Participants originated from Kansas State University and Kansas Department of Wildlife, Parks, and Tourism, 2016
- National Science Foundation proposal review panel (Population and community ecology) 2016, 2017
- USGS Research Grade Evaluation Panelist, Jackson, WY, 2017
- Most Promising Undergraduate Student Selection Committee, KSU, May 2017
- Invited Speaker WSFR Field Trip. Kansas Division of Fisheries, Wildlife, and Parks, May 2018

Kelsey McCullough (GRA, Graduated Dec 2016)

- Teaching Assistant, Principles of Biology (Spring 2015, Fall 2015, Spring 2016)

Sarah Ogden (GRA, Graduated May 2017)

- Teaching Assistant, Principles of Biology (Fall 2014, Spring 2015, Fall 2015, Spring 2016)
- Biology Graduate Student Association Welcoming Committee 2014—2016
- Biology Graduate Student Association Secretary 2016

Dan Sullins (GTA, Graduated Dec 2017)

- Teaching Assistant, Principles of Biology (Summer 2014, Fall 2014 [2 sections], Spring 2015, Fall 2015, Summer 2016)
- Teaching Assistant, Wildlife Management and Techniques Lab (Spring 2016, Spring 2017)
- Teaching Assistant, Mammalogy (Fall 2016)
- BGSA Graduate Affairs Committee Representative 2016

Ryland Taylor (GRA, Graduated Dec 2017)

- Teaching Assistant Principals of Biology (Fall 2014, Spring 2015 [2 sections], Spring 2016, Spring 2017)
- Biology Graduate Student Association – Welcoming Committee 2014-2016.
- Moderator, Symposium entitled "Fish Research and Conservation in the 'Scapes: Needs, Progress, Challenges and Opportunities." American Fisheries Society 2016.
- Organizer, Kansas State University Biology Graduate Student Association, "Professional Social Media and Communications" 2017
- Organizer, GROWing Green. Animal mobility & how understanding it can help conservation." Earth Day Workshop for Middle School Students, Manhattan, KS 2017

Awards and Recognition
2016-present

Addie Annis

- Student Travel Grant from the Kansas Chapter of The Wildlife Society, Fall 2017 $500
- Student Travel Grant from the Biology Graduate Student Association, Fall 2017 $500
- Wayne Sandfort Student Travel grant from the Central Mountains and Plains Section of The Wildlife Society $500
- 3rd Place in Student Poster Contest at Central Mountains and Plains Section of The Wildlife Society Annual Meeting. Kearney, NE.

Carly Aulicky

- 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
- Kansas Natural Resources Conference Student Registration Scholarship, 2017 $50
- Biology Graduate Student Association Research Grant, 2017 $500
- Best Presentation Style in Kansas State University Division of Biology Graduate Students on Parade Forum, 2017

Liam Berigan

- 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
- Best Slides in Kansas State University Division of Biology Graduate Students on Parade Forum, 2017
-

Alix Godar

- First Place in the Student Poster competition at the Central Mountains and Plains Section of The Wildlife Society, 2018
- Travel grant from Kansas Chapter of the Wildlife Society, 2017 $500
- Travel grant from the Central Mountains and Plains Section of the Wildlife Society, 2017 $500

David Haukos

- The Wildlife Society – Wildlife Publications Award-Outstanding Article 2016
  Winder, V.L., K.M. Carrlson, A.J. Gregory, C.A. Hagen, D.A. Haukos, D.C. Kesler, L.C. Larsson, T.W. Matthews, L.B. McNew, M.A. Patten, J. C. Pitman, L.A. Powell, J.A. Smith, T. Thompson, D.H. Wolfe, and B.K. Sandercock. 2015. Ecological correlates of female space use in ten populations of prairie chickens. Ecosphere 6(9):166. http://dx.doi.org/10.1890/ES14-00536.1
- Elected Fellow – The Wildlife Society, 2016
- 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.

Sean Hitchman

- Kansas State University College of Arts and Sciences Travel Award- 2016 ($1000)
- Kansas State University Graduate Student Council Travel Award- 2016 ($500)

Jonathan Lautenbach

- Kansas State University Biology Graduate Student Association Travel Grant- 2016 ($500)
- Kansas State University Graduate Student Council Travel Grant- 2016 ($500)
- Kansas State University Arts and Science Travel Grant- 2016 ($400)
- Kansas State University Arts and Science Travel Grant- 2016 ($400)

Richard Lehrter

- Kansas State University Travel grant for KNRC- 2016 $400

Robert Mapes

- College of Arts and Sciences Graduate Research Travel Award, Kansas State University, 2016 $1000

Kelsey McCollough

- Kansas State University Arts and Sciences Travel Grant- 2016 ($400)
- Kansas State University Arts and Sciences Travel Grant, 2016 ($800)
- K-State Graduate Student Council, 2016 ($500)
- Kansas Natural Resources Conference Student Scholarship, 2016

Sarah Ogden

- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2016 $400
-

Caroline Skidmore

- Kansas State University Arts and Science Travel Grant- 2016 ($400)
- Robert Robel Memorial Scholarship, Kansas Chapter of The Wildlife Society (2017)

Dan Sullins

- Robert J. Robel Award for Outstanding Graduate Student Research in Wildlife Biology and Ecology, 2017 Division of Biology, Kansas State University $500
- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2016 $800
- K-State Graduate Student Council, 2016 $500
- Biology Graduate Student Association, 2017 $300

Ryland Taylor

- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2016 $1000
- Kansas State University BGSA Travel Grant, 2016 $500
- Kansas State University BGSA Workshop Grant, 2017 $500
- EEB Graduate Students on Parade Award for Best Science 2017

University Courses Taught by Unit Faculty 2010-2016

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
River Regimes	Co-Instructor: 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

Kansas State University Degrees Completed 1996 – 2018

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.

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

2017

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

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.

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

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

2016

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

Willow Malone (M.S. 2016; advisor Haukos) – Biodiversity in playa wetlands in relation to watershed disturbance.

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

Sarah Ogden (M.S. 2016; advisor Haukos) – Responses of grassland birds and butterflies to control of sericea lespedeza with fire and grazing.

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

2015

Samantha Robinson (M.S.2015; advisor Haukos). Landscape conservation design, movements, and survival of lesser prairie-chickens in Kansas and Colorado.

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.

Kayla Gerber (M.S. 2015; advisor Mather), Tracking blue catfish: quantifying system-wide distribution of a mobile fish predator throughout a large heterogeneous reservoir.

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.

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.

Joseph Lautenbach (M.S. 2015; advisor Haukos). Lesser prairie-chicken reproductive success, habitat selection, and response to trees. Kansas State University

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

2014

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

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

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.