Biennial Report

August 2014 - August 2016

Kansas Cooperative
Fish and Wildlife Research Unit

Biennial Report

Kansas Cooperative
Fish and Wildlife Research Unit

August 2014 - August 2016

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

Unit Cooperators

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

TABLE OF CONTENTS

Preface

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

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

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

The Kansas Unit opened in October 1991 at Kansas State University in Manhattan. Dr. Timothy R. Modde was appointed as the first Unit Leader. Ms. Joyce Brite was hired as support staff. 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.

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, 12 projects were ongoing, and 11 projects were completed. Thirteen students finished Master's degrees and 4 finished Ph.D. degrees.

New Projects:

Ring-necked pheasant use of cover crops in western Kansas

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

On-going Projects:

Developing and Testing a Spatially-Explicit, Science-Based, Decision-Support Tool for Making Riverscape-Scale Management Decisions: How Dams Affect Fish Communities, a Threatened Native Stream Fish (the Neosho Madtom), and Select Tributary Fish Species

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

Plum Island Ecosystems LTER

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.

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

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

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

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

Completed Projects:

Reproductive Success of and Response to Shrub Removal by Lesser Prairie-Chickens in Western Kansas and Eastern Colorado

Risk Assessment of Exposure to Lead for Mottled Ducks on National Wildlife Refuge of the Texas Gulf Coast

Estimating Inundation Frequency of Playa Wetlands Using 1970s LandSat MSS Data: Did Irrigation Practices Artificially Increase Frequency and Longevity of Landscape Wetness?

Occurrence and Prediction of Avian Disease Outbreaks in Kansas

A Historical Record of Land Cover Change of the Lesser Prairie-Chicken Range in Kansas

Development of Conservation and Climate Adaptation Strategies for Wetlands in the Great Plains LCC Region

Assessing Distribution and Movement of Blue Catfish in Kansas Reservoirs

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

Mottled Duck (*Anas fulvigula*) Ecology in the Texas Chenier Plain Region

Environmental Availability and Lead Exposure to Mottled Ducks (*Anas fulvigula*) in the Texas Chenier Plains region

Parasitemia, Health, and Reproduction in Lesser Scaup at Red Rock Lakes National Wildlife Refuge

Master's Theses Completed:

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

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 batfish, 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.

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.

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

Stephen McDowell (M.S. 2014; Conway/Haukos) – Environmental availability and lead exposure to mottled ducks (Anas fulvigula) in the Texas Chenier Plains region. Stephen F. Austin State University

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. Kansas State University

Ph.D. Dissertations Completed:

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

Jena Moon (Ph.D. 2014; advisor Conway/Haukos) –Mottled Duck (*Anas fulvigula*) ecology in the Texas Chenier Plain Region. Stephen F. Austin State University

Rachel Pigg (Ph.D. 2014; advisor Cully) – A multi-scale investigation of movement patterns among black-tailed prairie dog colonies. Kansas State University.

KANSAS COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

Mission Statement

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

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

Personnel and Cooperators

Coordinating Committee Members

U.S. Geological Survey
Dr. Kevin Whalen
USGS CRU
PO Box 185
Round Hill, VA 20142

Wildlife Management Institute
Patrick Ruble
12748 West Bank Dr.
Millersport, OH 43046

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

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

U.S. Fish and Wildlife Service
Dr. Steve Torbit
Assistant Regional Director
Region 6, U.S. Fish and Wildlife Service
134 Union Blvd
Lakewood, CO 80228

Cooperative Unit Staff

David A. Haukos, Ph.D.
Unit Leader, Wildlife and Adjunct Associate Professor, Division of Biology
Martha Mather, Ph.D.
Assistant Unit Leader, Fisheries and Adjunct Associate Professor, Division of Biology
Joyce Brite, Administrative Manager
Gene Albanese, Ph.D
Research Associate – Wildlife, Division of Biology

Faculty Cooperators at Kansas State University

Division of Biology

Dr. Alice Boyle	Dr. Walter Dodds
Dr. Keith Gido	Dr. Andrew Hope
Dr. Tony Joern	Dr. Jessie Nippert
Dr. Brett Sandercock	Dr. Lydia Zaglin

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

Additional Universities

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

South Dakota State University
Dr. Carter Johnson

Stephen F. Austin State University
Dr. Chris Comer
Dr. Monty Whiting

Emporia State University
Dr. William Jensen

Texas Tech University
Dr. Warren Conway
Dr. Philip Gipson
Dr. Blake Grisham
Dr. Katharine Hayhoe
Dr. Nancy McIntyre
Dr. Samantha Kuhl
Dr. Mark Wallace

University of Minnesota – Duluth
Dr. Lucinda Johnson
Dr. Christopher Wright

State of Kansas

Kansas Department of Wildlife, Parks, and Tourism

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

Federal Government

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

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

U.S. Fish and Wildlife Service, Montana
Jeff Warren

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

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

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

U.S. Department of Agriculture,
Natural Resources Conservation Service
Dr. Christian Hagen
David Kraft
Jon Unger
Farm Services Agency
Skip Hyberg

U.S. Army, Fort Riley
Shawn Stratton

Other State Agencies

Colorado Wildlife and Parks
Brian Dreher
Dr. Jim Gammonly
Dr. David Klute
Dr. Mindy Rice
Jonathan Reitz

Texas Parks and Wildlife Department
Kevin Kraai

Private Organizations and NGOs

Stroud Water Research Center
Dr. Melinda Daniels
Ducks Unlimited
Joe Kramer
Grasslands Charitable Trust
Charles Dixon
Willard Heck
Jim Weaver

The Nature Conservancy
Matt Bain
Rob Manes
CEHMM
Patricia McDaniel
Kansas Alliance for Wetlands & Streams
Jeff Neel
Playa Lakes Joint Venture
Dr. Anne Bartuszevige

Graduate Students Supported by Unit Projects, 2014-present
Kansas State University

Student and Degree Sought	Thesis Project	Previous Education	Advisor
*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
*Jane Fencl, M.S.	Developing and Testing a Spatially-Explicit, Science-Based, Decision-Support Tool for Making Riverscape-Scale Management Decisions: How Dams Affect Fish Communities, a Threatened Native Stream Fish (the Neosho Madtom), and Select Tributary Fish Species	B.S., University of New Mexico	Dr. Mather
*Kayla Gerber, M.S.	Assessing Distribution and Movement of Blue Catfish in Kansas Reservoirs	B.S., Winona State University	Dr. Mather
Sean Hitchman, Ph.D.	Developing and Testing a Spatially-Explicit, Science-Based, Decision-Support Tool for Making Riverscape-Scale Management Decisions: How Dams Affect Fish Communities, a Threatened Native Stream Fish (the Neosho Madtom), and Select Tributary Fish Species	B.S., Univ. of South Carolina M.S., Univ. of San Diego	Dr. Mather
John Kraft, M.S	Lesser Prairie-Chicken Adult Female Seasonal Habitat Selection, Use of Grazed Range, and Predation Risk in Kansas and Eastern Colorado	B.S. Emporia State University	Dr. Haukos
*Brian Kearns, Ph.D	Risk Assessment of Exposure to Lead for Mottled Ducks on National Wildlife Refuge of the Texas Gulf Coast	B.S., Whitman College M.S., Univ. of Southern California	Dr. Haukos
Jonathan Lautenbach	Lesser prairie-chicken habitat selection based on prescribed fire, microclimate, and vegetation characteristics.	B.S. Fort Wayne State University	Dr. Haukos
*Joseph Lautenbach M.S.	Reproductive Success of and Response to Shrub Removal by Lesser Prairie-Chickens in Western Kansas and Eastern Colorado	B.S. Fort Wayne State University	Dr. Haukos

Willow Malone, M.S.	Climate Variation and human-landscape interactions affect functional capacity of the Central Great Plains Wetlands	B.S. Kansas State University	Dr. Haukos
Robert Mapes, M.S.	A field manipulation that evaluates size through time, habitat-specific diet, isotope values, and distribution of early spawn and natural spawn age-0 largemouth bass	B.S. University of Toledo	Dr. Mather
Kelsey McCullough, M.S.	Re-Thinking Regal Fritillary Conservation and Management: Habitat Characteristics and the Impact of Disturbance Regime on an Imperiled Grassland Butterfly	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
*Zach Peterson, M.S.	Assessing Distribution and Movement of Blue Catfish in Kansas Reservoirs	B.S., Texas A&M University	Dr. Mather
*Rachel Pigg, Ph.D.	A multiscale investigation of movement patterns to infer the metapopulation dynamics of a grassland mammal	B.S., Rhodes College (Tennessee)	Dr. Cully
*Reid Plumb, M.S.	Breeding Season Survival, Space Use, Movement, and Habitat Use of Female Lesser Prairie-Chickens (*Tympanuchus pallidicinctus*) in Kansas and Colorado	B.S. Rio Grande University, Ohio	Dr. Haukos
*Samantha Robinson, M.S.	Landscape Demography and Spatial Use of Lesser Prairie-Chickens in Kansas and Colorado	B.S., University of Connecticut	Dr. Haukos
*David Spencer, M.S.	A Historical Record of Land Cover Change of the Lesser Prairie-Chicken Range in Kansas	B.S. University of Minnesota	Dr. Haukos
*Andrew Stetter, M.S.	Parasitemia, Health, and Reproduction in Lesser Scaup at Red Rock Lakes National Wildlife Refuge	B.S., Univ. of Wisconsin, Stevens Point	Dr. Haukos
Dan Sullins, Ph.D	Landscape Conservation Design, Movements, and Survival of Lesser Prairie-Chickens in Kansas and Colorado.	B.S. Texas A&M University M.S. Stephen F. Austin State University	Dr. Haukos

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

*Graduated

Fisheries Projects

Ongoing Fisheries Projects

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.

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

Professional Colleagues
Dr. Joseph Smith
Jason Luginbill, USFWS
Jordan Hofmeier, KDWPT

Project Supervisor
Dr. Martha Mather

Funding
Kansas Department of Wildlife, Parks, and Tourism

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

Kansas State University

Objectives
Quantify how dams and habitat affect fish communities

Identify the role of heterogeneity in stream networks

Location
Neosho River, KS
Smoky Hill River

Completion
February 2018

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; and Dr. Martha Mather, Principal Investigator) are sampling fish communities and instream habitat at dammed and undammed sites within the upper Neosho River, KS. Ultimately, this research can be used to develop and test a spatially-explicit, science-based decision support tool for managing 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, 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. Jane has one paper published and a second paper in review. Sean Hitchman's Ph.D. research examines patterns, drivers, and consequences of habitat heterogeneity in stream networks. His dissertation will include three chapters of which one is almost ready for review. These research products are described in more 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.

Jane S. Fencl, Martha E. Mather, Katie H. Costigan, Melinda D. Daniels. ***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.***

Longitudinal connectivity is a fundamental characteristic of rivers that can be disrupted by natural and anthropogenic processes. Dams are significant disruptions to streams. Over 2,000,000 low-head dams (<7.6 m high) fragment United States rivers. Despite potential adverse impacts of these ubiquitous disturbances, the spatial impacts of low-head dams on geomorphology and ecology are largely untested. Progress for research and conservation is impaired by not knowing the magnitude of low-head dam impacts. Based on the geomorphic literature, we refined a methodology that allowed us to quantify the spatial extent of low-head dam impacts (herein dam footprint), assessed variation in dam footprints across low-head dams within a river network, and identified select aspects of the context of this variation. Wetted width, depth, and substrate size distributions upstream and downstream of six low-head dams within the Upper Neosho River, Kansas, United States of America were measured. Total dam footprints averaged 7.9 km (3.0-15.3 km) or 287 wetted widths (136-437 wetted widths). Estimates included both upstream (mean: 6.7 km or 243 wetted widths) and downstream footprints (mean: 1.2 km or 44 wetted widths). Altogether the six low-head dams impacted 47.3 km (about 17%) of the mainstem in the river network. Despite differences in age, size, location, and primary function, the sizes of geomorphic footprints of individual low-head dams in the Upper Neosho river network were relatively similar. The number of upstream dams and distance to upstream dams, but not dam height, affected the spatial extent of dam footprints. In summary, ubiquitous low-head dams individually

and cumulatively altered lotic ecosystems. Both characteristics of individual dams and the context of neighboring dams affected low-head dam impacts within the river network. For these reasons, low-head dams require a different, more integrative, approach for research and management than the individualistic approach that has been applied to larger dams.

Jane S. Fencl, Martha E. Mather, Joseph M. Smith, Sean M. Hitchman. ***The Blind Men Meet The Elephant at the Dam: Alternative Perspectives Obscure Low-Head Dam – Biodiversity Relationships.*** Dams are ubiquitous environmental impacts. The ability to provide science-based generalizations across dam sites and research studies is critical for sustainable management of these disturbances because empirical data can only be collected at a few of the existing 2 million U.S. low-head dams that will require future repair or removal. Just as individual blind men disagree about the structure of an elephant based on an examination of isolated body parts, uncoordinated, individualized dam research can lead to conflicting results and unnecessary disagreements about ecological dam impacts unless alternative research perspectives are explicitly integrated. To initiate this essential synthesis of how dams impact biodiversity, we concurrently quantified two categories of dam effects (spatial and taxonomic) using two spatial components (1-above vs below dams, 2-undammed vs dammed comparisons) and 11 taxonomic components (3 assemblage summaries, 8 guild metrics for fish biodiversity). At six low-head dams and five undammed sites in the Upper Neosho subbasin, KS, USA, sites below dams had dramatically more diverse fish assemblages than sites above dams for all taxonomic components. These upstream biodiversity deserts link low-head dams to environmental degradation. Sites below dams were subtly different from undammed sites. When dam impacts were strong (above vs below dams), all taxonomic metrics detected differences. When the dam impacts were subtle (undammed vs dammed sites), guild metrics were needed to evaluate ecological function. Because research perspective influenced conclusions about strength and type of ecological dam effects, here we propose a framework to integrate the entire elephant (e.g., multiple ecological research perspectives about dam-biodiversity relationships) that can provide scientifically sound generalizations across dam sites and research studies when placed within a broader interdisciplinary (ecological, physical, social science) context.

Sean M. Hitchman, Martha E. Mather, Joseph M. Smith, Jane S. Fencl. ***A Mosaic-Based Approach to Biodiversity in Freshwater Ecosystems.*** 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.

Products

Thesis

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.

Publications

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

Professional Presentations

Fencl J.S., Mather M.E., Smith J.M., and S.M. Hitchman. 2015. Quantifying river fragmentation: impacts of low-head dams on geomorphology and fish biodiversity in the Neosho River, Kansas. 75th Midwest Fish and Wildlife Conference; Indianapolis, Indiana.

Fencl, J.S., K.H. Costigan, M.E. Mather and S.M. Hitchman. 2014. How long is a dam footprint?: Applying methodology that quantifies the geomorphic extent of low-head dams in the Neosho River Basin, KS, 7th Kansas Natural Resources Conference, Wichita, KS (poster)

Fencl, J.S., M.E. Mather, S.M. Hitchman and J.M. Smith. 2014. Quantifying impacts of river fragmentation: How low-head dams alter geomorphology, fish biodiversity, and habitat in the Neosho River, Kansas, American Fisheries Society Meeting, Quebec, Canada

Hitchman, S.M., M.E. Mather, J.M. Smith and J.S. Fencl. 2014. Do FRAGSTATS sink or swim? Calculating metrics of heterogeneity for aquatic macrohabitat within the Neosho River, KS. Kansas Natural Resource Conference. Wichita, KS.

Hitchman, S.M., M.E. Mather, J.M. Smith and J.S. Fencl. 2014. Does heterogeneity in habitat type, size, and arrangement influence patterns of fish biodiversity in the Neosho River, Kansas? American Fisheries Society. Quebec City, Quebec, Canada.

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, Oregon.

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.

A field manipulation that evaluates size through time, habitat-specific diet, isotope values, and distribution of early spawn and natural spawn age-0 largemouth bass

Student Investigators:
Robert Mapes, M.S.

Undergraduates:
Austin Earl
Jarrett Romine
McKenna Miller

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:
1. Characterize the diet and stable isotope values of age-0 LMB in Hillsdale Reservoir

2. Determine if early spawn LMB and natural spawned LMB occupy the same habitats

3. Assess habitat utilization by age-0 LMB and fish and invertebrate prey species across seasons

4. Determine if early spawn age-0 LMB are larger than natural spawned age-0 LMB by the end of their growing season

Status On-going

Progress and Results

Largemouth bass (*Micropterus salmoides*) is an important predator and a popular sportfish. However, adult survival is often poor because of size-structured interactions in the first year of life. For example, a link has been observed between poor first year survival and small size during the first summer. Many fish grow faster when they consume fish prey instead of invertebrate prey. If young largemouth bass can switch to fish prey during their first summer, they may grow faster, overwinter at a larger size, and possibly survive better as adults. However, young largemouth bass are gape-limited predators (i.e., the size of prey eaten is limited by mouth size). Consequently, naturally spawned age-0 largemouth bass often are not large enough to consume young-of-year fish prey.

To test the role of size-structured interactions among age-0 largemouth bass, fish prey, invertebrate prey, fish competitors, and fish predators, we compared habitat-specific size through time, diet, stable isotope values, and distribution among three groups of age-0 largemouth bass [(1) naturally spawned or wild bass, (2) stocked phase 1 early-spawned bass, (3) stocked phase 2 early-spawned bass,] in Hillsdale Reservoir. The results of this whole-system manipulation will provide useful guidance for fisheries management and advance basic ecological knowledge about controls on first-year survival of this important predator.

During the initial sampling in 2014, we created effective, standardized, science-based sampling protocols that allowed us to sample the same sites with the same gear in the same way each other week (except when water levels or weather prevented standardized sampling). Sites within Hillsdale Reservoir were chosen to (a) provide a logistically-feasible but broad spatial coverage of the lake, (b) represent a range of habitat types (e.g., vegetation, beach, rock, wood, offshore - > 3 m deep), and (c) utilize sites with the highest catches from previous KDWPT largemouth bass sampling (Andy Jansen, personal communication). Although multiple habitats were present at some sites, all habitats were not present at any site. Backpack electrofishing and minnow traps did not catch many fish, but beach seine was very effective in catching largemouth bass such that seine was our primary collection gear.

We retained largemouth bass $\leq$ 150 mm TL for laboratory analysis in 2014 and $\leq$ 120 mm TL in 2015 because all fish $\leq$ 150 mm in midsummer and fall were age-0. Numbers of small largemouth bass in each square meter of habitat were summarized as catch per unit effort (CPUE). Following sampling, fins from largemouth bass were sent to KDWPT for genetic sampling to identify stocking

Location
Hillsdale Reservoir, KS

Completion
December, 2016

treatment (wild, phase 1, and phase 2). In the laboratory, 1-2 muscle fillet samples were dried for 24 h at 60^{o}C, then ground into a fine powder for stable isotope analysis of carbon and nitrogen. Stomach contents from young largemouth bass were analyzed using a standard diet protocol in which alimentary canals were removed and the contents were immediately fixed in 95% ethanol. Diet items were grouped into five functional groups: (1) benthic invertebrates, (2) zooplankton, (3) terrestrial invertebrates, (4) fish prey, and (5) unidentified prey. Diets were analyzed by three metrics: number of prey eaten, weight of prey eaten, and frequency of occurrence (i.e., number of individual largemouth bass within a sample that contained at least one individual of a prey type). For fish prey, we identified species by counting vertebrate of prey fish backbones. Potential prey and potential fish competitors [pelagic invertebrate prey (zooplankton), benthic invertebrate prey, potential fish prey (< 50% sampled largemouth bass length), and potential fish competitors (> 50% sampled largemouth bass)] were sampled monthly.

In 2014 at Hillsdale Reservoir, we captured 823 largemouth bass $\leq$ 150 mm TL in 11 biweekly samples at 9 sample sites. In addition, we collected 190 CPUE samples, 657 largemouth bass isotope samples, 99 zooplankton prey samples, 99 benthic prey samples, and 190 prey fish samples. In 2015 at Hillsdale Reservoir, we captured 251 largemouth bass $\leq$ 120 mm TL during 9 biweekly samples at 12 sample sites. In addition, we collected 130 CPUE samples, 216 largemouth bass isotope samples, 81 zooplankton prey samples, 81 benthic prey samples, and 130 prey fish samples. Based on preliminary data analysis, in both years the highest mean catch per unit effort (largemouth bass per m^2) (CPUE) for all three treatment groups (wild, phase 1, phase 2) occurred in vegetated (2014), beach (2014), and rock habitats (2015). No small largemouth bass were ever caught in wood or offshore habitats (2014, 2015). Wild largemouth bass were smaller than hatchery fish (phase 1, phase 2) throughout the field season for both years. For all young largemouth bass (wild, phase 1, phase 2), benthic invertebrates were an important diet item by number, terrestrial invertebrates were consistently eaten, and, by weight, fish prey was the most important diet item. Fish prey increased in importance later in the summer and in fall. Diets for all young largemouth bass (wild, phase 1 hatchery, phase 2 hatchery) were complex and varied across years and habitats for all measures (numbers, weight, frequency of occurrence) and all taxonomic categories (benthic invertebrates, terrestrial invertebrates, zooplankton, fish).

Robert Mapes' MS thesis is entitled "***How Multiple Approaches to Type, Size, and Arrangement of Habitat Patches Increase the Understanding of Space Use by Young Largemouth Bass: Using the Land Mosaic Concept to Inform Fisheries Management."***

The justification for this research synthesis is that although fisheries field research samples spatial variation within or across systems, fisheries biologists (especially those studying

reservoirs) characterize space and its effect on reservoir fisheries in different ways. For example, researchers variably refer to different locations as replicates, patches, microhabitats, sites, and regions. This inconsistent use of space may impede progress for reservoir fisheries biology and management. Because different perspectives could provide alternative views of these systems, comparing, evaluating, and standardizing spatial approaches is important for fish ecology, fisheries biology, and fisheries management.

Products

Professional Presentations

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

Mapes, R.L. and M.E. Mather. 2015. Habitat and resource use of age-0 largemouth bass in a Great Plains reservoir. Lake Erie Center Brown Bag Seminar. University of Toledo – Lake Erie Center.

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

Mapes. R. L., 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. Midwest Fish and Wildlife Meeting, Indianapolis, IN.

Plum Island Ecosystems LTER

Student Investigator:
Ryland Taylor

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

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

Project Supervisor:
Dr. Martha Mather

Funding
National Science Foundation

Cooperators
Kansas State University
Division of Biology

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

Continue ecological studies of mobile fish predators

Location
Plum Island Estuary

Completion
December 2017

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 build 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 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 is entitled ***"Can confluence network dynamics create a functionally-important spatial mosaic of predator interactions?"*** The goal of this research is to better understand the link between the spatial configuration of land and seaforms (specifically confluences or river /creek mouths) and the distribution, abundance, habitat use, and impact of top fish predators (e.g., striped bass) in Plum Island estuary. The overarching question of this research is *"How does the geomorphology of river network confluences influence local trophic ecology through mobile top predators?* The three specific objectives of this research are to (1) identify and measure variation in confluence morphology, (2) track striped bass to determine how they are using confluences with different characteristics, and finally (3) determine if trophic ecology is different across confluences with different striped bass use. This research will advance basic ecology about how these top predators affect local trophic interactions across the estuarine seascape and consequently facilitate effective science-based conservation. The scientific questions and methods used are very similar to those asked in the blue catfish project, and this research should complement fish research in Kansas.

In 2015, over 125 days were spent in the field at Plum Island Estuary, 26 stationary acoustic receivers were deployed, 59 striped bass were acoustically tagged, stationary receiver arrays were downloaded regularly, 400,000 fish detections were recorded, a manual tracking survey that paired 12 confluence sites with 12 non confluence sites was completed, and standard 50 ft quarter circle

seines were conducted at select manual receiver tracking location to identify prey available to foraging striped bass.

Products

Professional Presentations

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

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
April 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, and fish distribution, movement, and survival. Although previously this research has focused 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. This work is especially relevant to river systems in Kansas that are fragmented by dams.

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 for different species in different river systems. 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

Recruitment of Fishes in the Kansas River

Investigators
Joe Gerken, Ph.D.
Dr. Craig Paukert

Project Supervisor
Dr. Craig Paukert

Funding
Kansas State University

Kansas Department of Wildlife, Parks and Tourism

Cooperators
Kansas Department of Wildlife, Parks, and Tourism

Objectives
Identify the biological and environmental factors that influence recruitment in the Kansas River.

Determine if year class strength of selected fishes is related to river flows, and if year class strength is consistent throughout the Kansas River.

Make recommendations of the conditions (flows) suitable for recruitment of large river fish.

Location
Kansas River in eastern Kansas

Completion
May 2013

Status Completed

Results
River discharge influences fish and invertebrate communities and understanding how hydrologic variables contribute to fish and invertebrate composition can provide information for restoration and management. This study examines the relationship between several flow regime metrics that may influence fish and invertebrate community structure in large river systems such as the Kansas River. First, I examined how hydrology influences macroinvertebrate (drifting and benthic) density and fish communities before, during, and after flooding in both main and secondary channels. I found that drifting invertebrate density increased during flooding potentially providing increased prey opportunities for fishes. I also found that fluvial dependent and generalist fish species use inundated habitats more than fluvial specialists. My results suggest that the flux of water into inundated habitats supports a unique subset of invertebrate and fish communities of the main channel. Next, I examined the importance of lateral connectivity on fish and invertebrate composition by examining differences in seasonally and permanently inundated secondary channels in relation to main channel reaches. I found that drifting and benthic invertebrate assemblages and fish assemblages differed between seasonally inundated and permanently connected secondary channels. These results suggest that maintenance of diverse secondary channel connections is useful in preserving native biota in the Kansas River. Finally, I tested if hydrologic variables influenced recruitment of four native Kansas River fishes. I found that recruitment for two of the four fish species (flathead catfish, *Pylodictis olivaris*, and shovelnose sturgeon, *Scaphirhynchus platorynchus*) increased in high flow years. These results indicate that a natural and variable flow regime may be important for maintaining fish community structure in the Kansas River. The results of this study have implications for management strategies that include the use of high flows to provide a pulse of insect prey to the main channel for fishes, restoration of natural high and low flow variability as important to fish recruitment, and diversity in secondary channel connectivity (seasonal and permanently connected) that promotes unique fish and invertebrate communities.

Products
Dissertation
Gerken, J.E. 2015. Fish and invertebrate community response to flow magnitude in the Kansas River. Ph.D. Dissertation. Division of Biology, Kansas State University.

Publications

Gerken, J., and C. Paukert. 2013. Fish community and habitat factors associated with the distribution of Topeka shiner (*Notropis topeka*) in Kansas streams. Journal of Freshwater Ecology 28: 503-516 DOI: 10.1080/02705060.2013.792754

White, K., J. Gerken, C. Paukert, and A. Makinster. 2010. Fish community structure in natural and engineered habitats in the Kansas River. River Research and Applications 26:797-805.

Professional Presentations

Gerken, J., and C. Paukert. 2011. Age-specific demography of silver carp: implications for management and control. American Fisheries Society Annual Meeting, Seattle, WA.

Gerken, J., and C. Paukert. 2011. Can silver carp be controlled? Population level response to various management regimes. Midwest Fish and Wildlife Conference, Des Moines, IA.

Gerken, J., and C. Paukert. 2011. The importance of high flows and floodplain inundation for fish and invertebrates of the Kansas River. Kansas Natural Resources Conference, Wichita, KS.

Mammoliti, K., J. Gerken, and C. Paukert. 2010. Population characteristics of channel catfish in the Kansas River. Kansas Natural Resources Conference, Wichita, KS.

Gerken, J. E., and C. P. Paukert. 2010. Fish recruitment in the Kansas River: the role of flow, habitat, and urbanization. Kansas Natural Resources Conference, Wichita, KS.

White, K., J. Gerken, C. Paukert, and A. Makinster. 2010. Fish community structure in natural and engineered habitats in the Kansas River. Kansas Natural Resources Conference, Wichita, KS. Poster

Paukert, C. and J. Gerken. 2010. The Importance of secondary channels to mainchannel fishes in the Kansas River. Big River Confab, Jefferson City, MO.

Gerken, J., and C. Paukert. 2010. Floods and fishes: examining the role of high flows on fish and invertebrates in a large Great Plains River. Midwest Fish and Wildlife Conference, St. Paul, MN.

Gerken, J., and C. Paukert. 2010. Testing the flood pulse concept: The importance of floodplain inundation on fish and invertebrates of a Great Plains river. American Fisheries Society Annual Meeting, Pittsburgh, PA.

Gerken, J. E., and C. P. Paukert. 2009. Effects of urbanization on recruitment of Riverine fishes. 70th Midwest Fish and Wildlife Conference, Springfield, IL.

Gerken, J. E., and C. P. Paukert. 2009. Topeka shiners status and trends in Kansas. 70th Midwest Fish and Wildlife Conference, Springfield, IL.

Gerken, J., and C. Paukert. 2009. Spatial variation in the recruitment patterns of three riverine fishes in the Kansas River. American Fisheries Society Annual Meeting, Nashville, TN.

Gerken, J., and C. Paukert. 2009. Spatial variation in the recruitment patterns of three riverine fishes in the Kansas River. KSU Biology Student Research Forum, Manhattan, KS.

Gerken, J., W. Bouska, and C. Paukert. 2009. Effects of instream habitat and fish communities on the endangered Topeka shiner in Kansas streams. Kansas Natural Resources Conference, Wichita, KS.

Gerken, J.E., and C.P. Paukert. 2009. Impacts of a low-head dam on fish communities in the Kansas River. Kansas Natural Resources Conference, Wichita, KS.

Gerken, J.E., and C.P. Paukert. 2009. Factors impacting Topeka shiner distribution in Kansas. American Fisheries Society Midwest Student Colloquium, Annual Meeting, Ames, IA.

Gerken, J.E., and C.P. Paukert. 2009. Impacts of a low-head dam on a Great Plains River Fish Community. American Fisheries Society Midwest Student Colloquium, Annual Meeting, Ames, IA.

Gerken, J. E., and C. P. Paukert. 2008. Fish recruitment in the Kansas River: the role of flow, habitat, and urbanization. Kansas Natural Resources Conference, Wichita, KS.

Gerken, J., and C. P. Paukert. 2008. Effects of a low-head dam on the fish community of a large Great Plains river. Southwestern Association of Naturalists, Memphis, TN.

Gerken, J., and C. Paukert. 2008. Effects of a low-head dam on the fish community of a large Great Plains River. American Fisheries Society Annual Meeting, Ottawa, Canada.

Gerken, J., and C. Paukert. 2008. Fish community changes associated with a low-head dam in a large Great Plains river. Midwest Fish and Wildlife Conference, Columbus, OH.

Assessing Distribution and Movement of Blue Catfish in Kansas Reservoirs

Student Investigators:
Kayla Gerber, M.S. Student
Zach Peterson, M.S. Student

Professional Colleagues:
Dr. Joe Smith, Post-doctoral Fellow

Project Supervisor
Dr. Martha Mather

Funding
Kansas Department of Wildlife, Parks, and Tourism (KDWPT)

Cooperators
Kansas Department of Wildlife, Parks, and Tourism (KDWPT)

Kansas State University (KSU)

Objectives
Determine distribution and seasonal movements of the Blue Catfish in a large reservoir.

Assess correlates of this distribution.

Location
Milford Reservoir, KS

Completion
August 2015

Status
Completed

Progress and Results

Overall
The objectives of this project were to (a) develop methods that can be used to monitor and understand sport fish movement, (b) document distribution and egress patterns of multiple sizes of Blue Catfish in Milford Reservoir, KS, and (c) collect related data that will help explain reasons for distribution and egress of this important, popular, and highly mobile sport fish.
Many Kansas anglers target catfish through specialized clubs (e.g., KC Catfish, Catfish Chasers, US Cats, and U.S. Catfish Association). For example, in 2001, 216,000 Kansas anglers spent $40.1 million fishing for catfish. Blue Catfish, in particular, provide trophy catches (i.e., KS state record, 102.8 lbs). Thus, the results from this research can provide basic scientific, management, and outreach information.
In 2012, Team Blue Catfish developed and tested tagging protocols at the KDWPT hatchery at Milford Reservoir. On June 26-28, 2012, Team Blue Catfish surgically implanted 48 Blue Catfish captured at three different locations in Milford Reservoir with VEMCO V9 acoustic tags. In 2012, mean size of Blue Catfish was 487 mm total length (TL) (range = 383-1020 mm TL; SE = 14.5; 88% of tagged fish were 400-600 mm TL, the most common sized fish in Milford Reservoir). Twenty VEMCO receivers, placed throughout Milford Reservoir, recorded the date, time, and location of fish distribution when tagged fish moved within 300 m of the stationary receivers. Two of these receivers detected if any tagged fish egressed Milford Reservoir either through the upstream Republican River or downstream over the dam. On June 3-6, 2013, an additional 75 Blue Catfish were tagged with V9 and V13 acoustic tags. In 2013, we tagged smaller and larger Blue Catfish as they became available, resulting in an average size of 517 mm TL (range = 343-1090 mm TL; SE = 17.8; 71% of the tagged fish were 400-600 mm TL). Data were retrieved regularly.
In both years, all Blue Catfish survived the tagging and were detected over a million times each year. No tagged catfish left Milford Reservoir through the upper or lower connections to the Republican River. In the field, 85.4-100.0% of the tagged catfish were detected at least once a month from June-November in both years. All tagged Blue Catfish moved throughout the reservoir and were detected at an average of 6-10 receivers.
No differences in tagged Blue Catfish distribution were observed across dawn, day, dusk, night. Distribution changed across seasons with a subset of tagged fish moving to the deeper lower part of Milford Reservoir in the fall. Individual fish did not behave the

same. Specifically, based on the results of a cluster analysis that used the amount of time tagged fish spent at each receiver, groups of fish differed in their space use and movement patterns. These multiple clusters illustrate different types of behavior within a single population. Although all tagged fish moved on a regular basis, the majority of fish spent most of their time in the middle portion of the reservoir.

This research resulted in M.S. degrees for Kayla Gerber and Zachary Peterson through the Division of Biology at Kansas State University (May, 2015). Their theses are described below.

Kayla Gerber Thesis. ***Tracking Blue Catfish: Quantifying System Wide Distribution of a Mobile Fish Predator Throughout a Large Heterogeneous Reservoir.*** A flexible distribution is an adaptive response that allows animals to take advantage of spatial variation in the fluctuation of resources. Distribution of mobile organisms is complex so multi-metric patterns derived from dynamic distribution trajectories must be deconstructed into simpler components for both individuals and populations. Tagging and tracking fish is a very useful approach for addressing these fisheries research questions, but methodological challenges impede its effectiveness as a research tool. This research project developed and evaluated a high-retention, high-survival tagging methodology for catfish. Then, Team Blue Catfish integrated multiple distribution metrics to identify if sites within an ecosystem function differently for mobile predators. Finally, Kayla and colleagues determined if distinct groups of individuals existed, based on distributional patterns. The research team also tested sources of variation in system-wide detections (i.e., season, diel period, size, and release location) and provided additional details on methods and interpretation of the results. To address these objectives, the study tracked 123 acoustically tagged (VEMCO V9-V13) Blue Catfish (*Ictalurus furcatus* mean: 505.3 mm TL; SE: 12.3 mm; range: 300-1090 mm) from June through November, 2012-2013, in Milford Reservoir, KS. Across the five months, 85.4-100.0% of the tagged Blue Catfish were detected at least once a month by an array of 20 stationary receivers (VR2W), a detection rate much higher than rates reported in the literature for catfish (38%). Blue Catfish were consistently aggregated in the northern portion of the middle region of Milford Reservoir. Using three metrics (population proportion, residence time, and movements), this study found four types of functional sites that included locations with (i) large, active aggregations, (ii) exploratory/transitory functions, (iii) small, sedentary aggregations, and (iv) low use. This study also found that tagged Blue Catfish clustered into three groups of individuals based on distribution. These included (1) seasonal movers, (2) consistent aggregations across seasons, and (3) fish exhibiting site fidelity to Madison Creek. Sites with different functions and groups of individual fish were related but not the same. The approach to looking at multiple responses, functions of sites, and individual

groupings provided new insights into fish ecology that can advance fisheries management of mobile predators.

Zachary Peterson Thesis. ***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.*** Understanding how and why fish distribution is related to specific habitat characteristics underlies many ecological patterns and is crucial for effective research and management. Blue Catfish, *Ictalurus furcatus*, are an important concern for many fisheries agencies. However, lack of information about their distribution and habitat use remains a hindrance to proper management. Here, over all time periods and across months, Team Blue Catfish quantified fish distribution and environmental correlates of distribution in Milford Reservoir, the largest reservoir in Kansas. This research tested relationships among acoustically tagged Blue Catfish and three groups of variables postulated to influence Blue Catfish distribution in the literature (i. localized microhabitat variables, ii. larger-scale mesohabitat variables, iii. biotic variables). Blue Catfish were consistently aggregated in two locations of the reservoir across five months during summer and fall, 2013. Using multiple linear regression and an information theoretic model selection approach, consistent correlates of distribution included localized, microhabitat variables (i.e., dissolved oxygen, slope) larger-scale, mesohabitat variables (i.e., distance to channel, river kilometer from the dam) and a biotic variable (i.e., Secchi depth). This research identified which five of the 12 variables identified in the literature were most influential in determining Blue Catfish distribution. As a guide for future hypothesis generation and research, this study proposes that Blue Catfish distribution was driven by three ecologically-relevant tiers of influence. First, Blue Catfish avoided extremely low dissolved oxygen concentrations that could cause physiological stress. Second, Blue Catfish aggregated near the channel, an area of bathymetric heterogeneity that may offer a foraging advantage. Third, Blue Catfish aggregated near low Secchi depths, shown here to be associated with increased productivity. Building on these results, future research into the distribution and habitat use of Blue Catfish should incorporate aggregated distributions of fish into research designs, focus on how both small and large scale relationships interact to produce patterns of distribution, and explore further the mechanisms, consequences, and interactions among the three tiers of influence identified here.

Products

Thesis

Peterson, Z. 2015. Quantifying patterns and select correlates of the spatially and temporally explicit distribution of a fish predator (blue batfish, *Ictalurus furcatus*) throughout a large reservoir ecosystem. Thesis, Kansas State University, Manhattan.

Gerber, K. 2015. Tracking blue catfish: quantifying system-wide distribution of a mobile fish predator throughout a large heterogeneous reservoir. Thesis, Kansas State University, Manhattan.

Report

Mather, M., K. Gerber, Z. Peterson. 2015. Assessing distribution and movement of blue catfish In Kansas reservoirs. Final Report to Kansas Wildlife, Parks, and Tourism.

Professional Presentations

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.

Peterson, Z., K. Gerber., M. E. Mather, and J. Smith. 2012. Quantifying spatially-explicit patterns in a large reservoir: an approach for determining associations between a top fish predator and physical habitat. Midwest American Fisheries Society Meeting, Wichita, KS. Poster

Peterson, Z.J., M.E. Mather, K.M. Gerber, and J.M. Smith. 2014. Evaluating the adequacy of fish-habitat data for the blue catfish. 144th Annual AFS Conference, Quebec City, Quebec, Canada.

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.

Gerber, K. M., M. E. Mather, Z. Peterson, J. M. Smith, J. Reinke, J. Goeckler. 2012. Where are those $$#@@ fish?; Distribution and movement of a top predator (blue catfish) in a large, highly-variable Midwestern reservoir. Midwest American Fisheries Society Meeting, Wichita, KS.

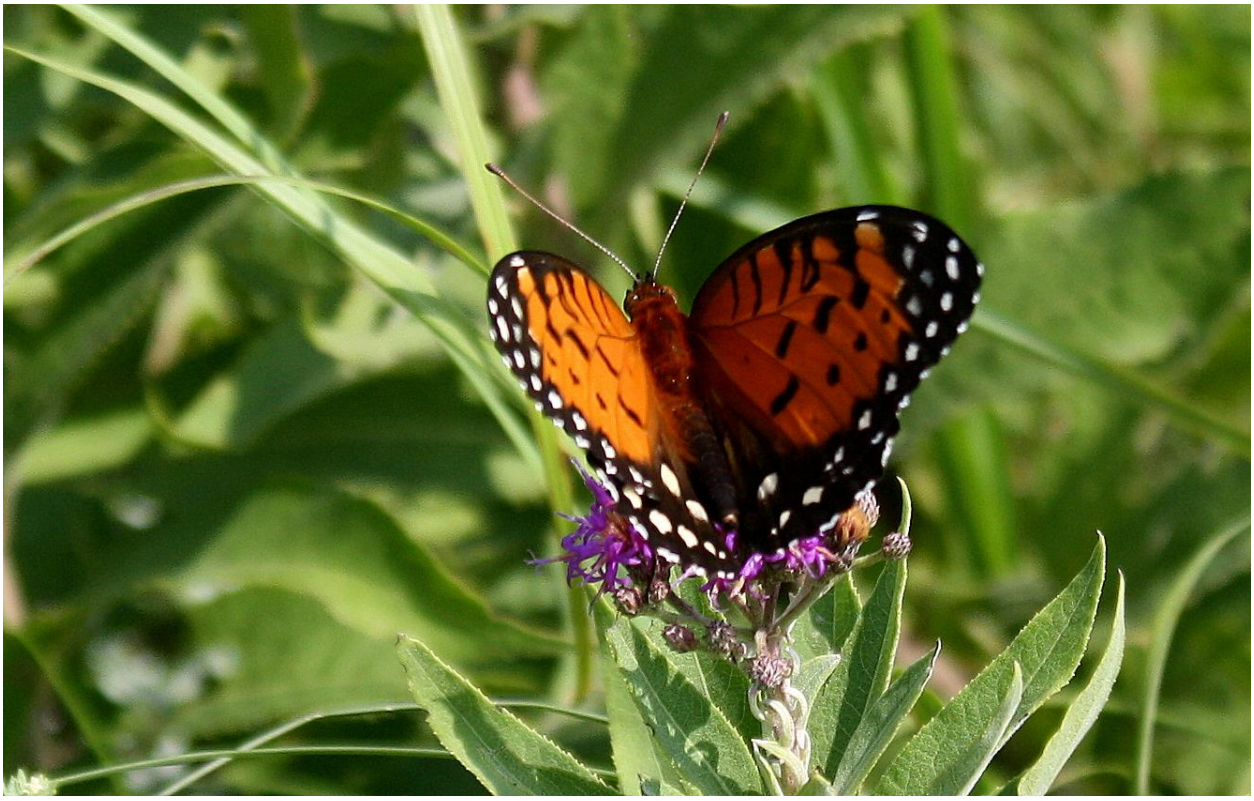
Gerber, K.M. and M.E. Mather. 2015. A high retention methodology for surgically implanting telemetry tags in catfish. Kansas Natural Resource Conference, Wichita, KS.

Gerber, K.M., M.E. Mather, J.M. Smith, and Z. Peterson. 2014. Patterns of variability in the distribution and movement of individual fish predators in a heterogeneous aquatic ecosystem. 144th Annual AFS Conference, Quebec City, Quebec, Canada.

Gerber, K.M., M.E. Mather, J.M. Smith, and Z. Peterson. 2015. Distribution patterns of individual fish predators (Blue Catfish) in a Midwestern reservoir. 75th Midwest Fish and Wildlife Conference, Indianapolis, IN.

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.

Interdisciplinary Projects



Development of Conservation and Climate Adaptation Strategies for Wetlands in the Great Plains LCC Region

Investigators
Dr. Gene Albanese, Post-Doctoral Research Associate

Project Supervisors
Dr. David Haukos
Dr. Susan Skagen

Collaborators
Dr. Mindy Rice
Dr. David Hamilton

Funding
U.S. Geological Survey

Objectives
Conduct a network analysis of playa wetlands

Determine the effect of playa loss on delivery of ecosystem goods and services

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

Completion
Sept 2015

Status Completed

Progress

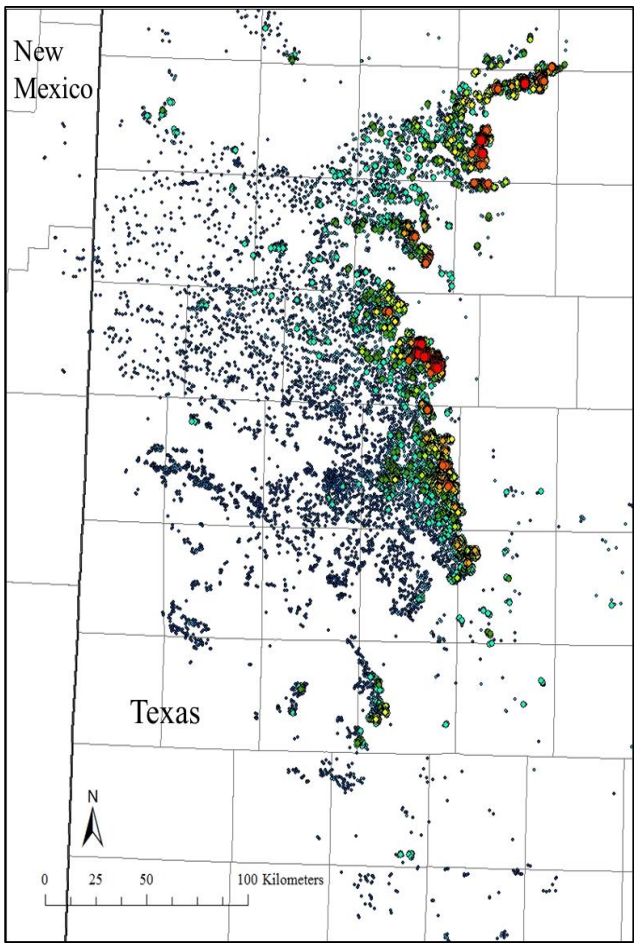
Playa wetlands are the primary habitat for numerous wetland-dependent species in the Southern Great Plains of North America. Plant and wildlife populations that inhabit these wetlands are reciprocally linked through the dispersal of individuals, propagules and ultimately genes among local populations. To develop and implement a framework using network models for conceptualizing, representing and analyzing potential biological flows among 48,981 spatially discrete playa wetlands in the Southern Great Plains. We examined changes in structural and functional connectivity patterns and assessed the relative importance of wetlands to maintaining these patterns by targeting wetlands for removal based on network centrality metrics weighted by estimates of habitat quality and probability of inundation. We identified several distinct, broad-scale sub networks and phase transitions among playa wetlands in the Southern Plains. In particular, for organisms that can disperse $\geq$ 2 km a dense and expansive wetland sub network emerges in the Southern High Plains. This network was characterized by localized, densely connected wetland clusters at link distances (h) > 2 km but < 5 km and was most sensitive to changes in wetland availability (p) and configuration when h = 4 km, and p = Δ0.2 - 0.4. It transitioned to a single, large connected wetland system at broader spatial scales even when the proportion of inundated wetland was relatively low (p = 0.2). Our findings suggest that redundancy in broad and fine-scale connectivity patterns insulate this system from damage and facilitate system-wide connectivity among populations with different dispersal capacities.

Products
Publications
Albanese, G., and D. Haukos. 2017. 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.

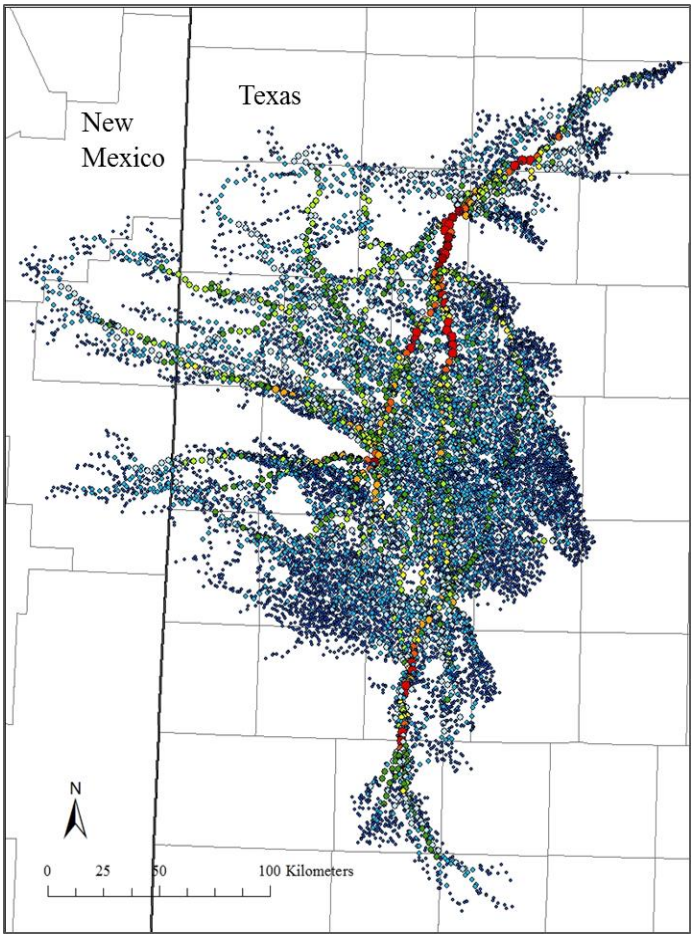
Albanese, G., and D.A. Haukos. 2016. A network model framework for prioritizing wetland conservation in the Great Plains. Landscape Ecology In Press

Report
Albanese, G. 2015. Development of conservation and climate adaptation strategies for wetlands in the Great Plains LCC region, Final Report. GP LCC, USFWS. 135pp.

Professional Presentations
Albanese, G., and D. Haukos. 2015. A framework for understanding connections within dense broad-scale habitat networks: prioritizing wetlands for conservation within a dynamic landscape. Annual meeting of the Society of Wetland Scientists, Providence, RI. (Invited speaker)



Weighted Degree Centrality



Weighted Betweeness Centrality

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

Student Investigator:
Richard Lehrter

Professional Colleagues:
Dr. Melinda Daniels
Dr. Marcellus Caldas
Dr. J. Heier Stamm
Dr. Jason Bergtold
Dr. Aleksey Sheshukov
Dr. Matthew Sanderson
Dr. Dave 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 2017

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 coevolved animal community that inhabit naturally-connected dendritic ecosystems that 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.

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 will be combined with human surveys of use and value to advance science and increase the efficiency of conservation efforts.

Graduate Research

Ricky Lehrter's MS thesis entitled "***Links between anthropogenic disturbance and aquatic biodiversity in the Smoky Hill River, KS"*** examines how anthropogenic effects of land and water use influence fish biodiversity in the Smoky Hill River, KS. The original overarching question for this project is: *"What are the drivers of freshwater fish biodiversity that maintain resilience and sustain freshwater ecosystems in the face of human impacts and climate change?"* The three approaches used to link fish biodiversity to environmental disturbance are to compare: (1) present and past samples at the same site (historical approach), (2) present more-impacted and present less-impacted sites within the Smoky Hill watershed (present time gradient approach), and (3) more impacted Smoky Hill watershed samples and a less-impacted Neosho watershed samples (across basin approach).

Thus far (a) a literature review of drivers, fish biodiversity responses, and analysis methods is underway (b) fish guilds are being summarized for the Smoky Hill River. (c) We have also acquired all historical Kansas fish data to date (201 samples for the Smoky Hill watershed). Historical samples were split into time categories (pre-reservoir (1954), post-reservoir to 1969, 1970- 1989, 1990-1999, and 2000-2015. Repeated samples per time period have been identified: pre-reservoir (3), post-reservoir (16), 1970-1989 (22), 1990-1999 (59), and 2000-2015 (86). (d) During 30 fish sampling days within the summer of 2015, we collected fish at 53 Smoky Hill River sites that span a longitudinal gradient and include tributary-mainstem comparisons.

Products

Professional Presentations

Lehrter, R., M. E. Mather, M. Daniels. 2015. Fish biodiversity as a component of ecosystem function and indicator of environmental degradation in a Great Plains river. Governor's Water Conference, Poster.

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 On-going

Progress and Results

Playa wetlands are unique and complex ecological systems crucial to the ecology of the western Great Plains of North America. Playas offer a variety of ecological goods and services including flood water retention, water quality improvement, aquifer recharge, and provide critical habitat for a unique assemblage of resident and migratory biota. Anthropogenic changes to the land alter the function and presence of playa wetlands and the current estimates of the number of playas does not take the recent loss of playas into account, giving a false representation of the correct number of functional and existing playa wetlands. Landscape changes threaten the function and existence of playas, primarily through sediment accumulation in the playa wetland, which decreases the function, size, and hydroperiod of the playas. Legal protection against modifying a playa is not effective and results in continuing physical or functional loss of the playa. My objective was to determine the correct number of existing playa wetlands in the Smoky Hill River Watershed and compare to prior estimates. Using a Geographical Information System, I randomly selected 20% of the playa wetlands in the watershed for presence on the landscape and anthropogenic effects (n = 608). There were 3,310 polygons representing probable playas in the watershed. In the Smoky Hill River watershed, 22% of the randomly selected playa wetlands have been lost to the landscape (n = 134). Of the playa wetlands still present on the landscape, merely 5.1% (n = 31) were not impacted by landscape changes or anthropogenic effects. These results indicate that the current estimate of playa wetlands is incorrect. Furthermore, the current estimate of playa wetlands can be considered a threat to the future quantity and quality of wetlands.

Hydrology is the ecological driver of playa wetlands and greatly influenced by the surrounding Land-Use/Land-Cover. Avian and floral diversity has been known to be a key indicator of ecological function and will provide a quantitative measurement of playa functionality. My objective was to determine the relationship of surrounding land use (native grassland, cropland, Conservation Reserve Program) on avian use of playa wetlands in the dry ecological state. I conducted breeding bird surveys in >25 playa wetlands with differing watersheds to record occupancy, relative abundance, and species richness. Species diversity was derived using Simpson's index. Similar surveys were conducted in paired, non-playa habitats. Results reveal avian diversity is 7% greater in playa wetlands than non-playa areas. Further, avian diversity is greatest in grassland playas, with a 20% greater diversity index than the cropland playas, which had the lowest diversity. Plant species

richness is 73% greater in grassland playas than cropland playas. Vegetative surveys confirm that playa wetlands offer a greater plant species richness than the floral community found in cropland playas or surrounding watershed.

Products

Professional Presentations

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 Kansas Ornithological Society, Emporia, KS

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., 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.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.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.

Wildlife Projects

Ongoing Wildlife Projects

Vegetation Structure Characteristics Across Land Cover Types and Lesser Prairie Chicken Habitat Selection, Response to Grazing Strategies and Predator Communities in Western Kansas

Investigators
John Kraft, M.S. Student

Project Supervisor
Dr. David Haukos

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

Cooperators
Kansas Department of Wildlife, Parks and Tourism
Natural Resources Conservation Service
The Nature Conservancy
Kansas State University

Objectives

Quantify the relative vegetation structure differences across land cover types

Investigate habitat selection across ecological sites for various ecological periods (e.g. lekking, nesting , brooding) of LEPC hens

Investigate the influence of landscape composition and configuration on LEPC

Status On-going

Progress and Results

Habitat and its influence on wildlife species is an important subject for research and management. Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*; hereafter LEPC) management often revolves around manipulating small- and large-scale habitat characteristics to better suit LEPC ecological needs. At large scales, the composition and configuration of land cover types (e.g. grasslands, croplands, and Conservation Reserve Program [CRP]) may be influential on the presence or absence of LEPC populations. As the scale compresses, more detailed land cover types (e.g., ecological sites) and vegetation characteristics (species composition and vegetation structure) become influential on processes (e.g., ecological periods) defined by small temporal scales. Understanding the influence of this multi-scale habitat continuum on LEPC habitat selection and demographics is important for creating landscapes suitable for viable populations. Furthermore, understanding the influence of land use practices on small-scale vegetation structure and composition is also important to creating land use strategies. Results thus far indicate that at larger scales (i.e., annual home range), as the total amount of grasslands (excluding CRP) and the continuity of those grasslands increases the probability of home range establishment increases as well. At smaller scales, ecological sites and microhabitat characteristics (e.g., visual obstruction, grass cover, litter cover, and bare ground cover) influence LEPC habitat selection through the various ecological periods. The most robust vegetation is selected during nesting periods while sites with greater bare ground cover and forb cover are selected during brooding periods. In the Northwest study site, land cover types consistently selected include CRP tracts and the Sandy ecological sites and selection of Limy Upland and Loamy Upland increased during brooding. When CRP was not significantly available within a study site, as was the case in the Redhills and Clark sites, the selected cover types changed. In the Redhills site, Loamy and Limy Upland sites are selected consistently and selection of Sandy sites increased during the brooding periods. However, presence of trees at lower elevations may be driving this selection of upland habitats. At the Clark study site Sandy, Saline Subirrigated and Sandy Lowland sites were selected consistently across ecological periods. When the influence of livestock grazing strategies was included into habitat selection analyses the influence of land cover types diminished. From a livestock management stand point, we observed the greatest levels of habitat selection in pastures that exhibited the greatest area (>400

home range establishment

Investigate vegetation and habitat selection and demographic response of LEPC to livestock grazing strategies used in western Kansas
Investigate the influence of predator communities on LEPC habitat selection

Location:
Throughout Kansas and Eastern Colorado

Completion
October 2016

ha), relatively lower stocking densities (i.e., result of larger pasture sizes), and moderate levels of growing season deferment (50-90 days). Greater pasture size also increases annual survival of adults and daily nest survival. We believe the vegetation response to these grazing strategies explain LEPC habitat selection results. Mean visual obstruction and grass cover was found to be greater in larger pastures. Also, larger pastures also led to greater heterogeneity of grass and forb ground cover. This increased heterogeneity of vegetation structure likely provides areas suitable for a wider range of LEPC ecological needs. Future research will include more investigation into vegetation response to grazing practices (deferment and stocking densities) and the link between vegetation response and LEPC habitat selection. Furthermore, we will investigate the influence of predator (mammal and avian) communities on LEPC habitat selection and survival by analyzing abundance indices of predators created using camera trap and point count surveys.

Products

Professional Presentations

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, 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. 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., 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., 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.

Landscape Demography, Distribution, and Foraging of Lesser Prairie-Chickens in Kansas and Colorado

Investigator
Dan Sullins, Ph.D Student

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
Determine the relative influence of vital rates on population rate of change.

Examine the influence of various

Status
In Progress

Progress and Results
Much research has identified, and reconfirmed, the importance of large contiguous grasslands for lesser prairie-chicken (LEPC) occurrence and persistence. This knowledge has been strongly engrained in LEPC management and research. However, recent land cover change analyses have shown that the amount of grasslands and contiguity of those grasslands within the LEPC range has not changed considerably since the 1950s while population estimates have revealed long-term declines over the same time period. Further, it is well known that LEPC need heterogeneous grassland patches to fulfill lekking, nesting, brooding, and nonbreeding needs. The need of large contiguous grasslands may be an oversimplification of the true processes resulting in a decline in the quality of existing grasslands for LEPC. To improve our understanding of habitat quality we seek to identify both emerging small-scale factors, such as available forage, and large scale factors that constrain LEPC distribution and demography among all life stages. To do so, we have identified life stages exerting the greatest influence on the finite rate of population growth (λ) and important foods used during these life stages. We have also estimated demographic variability among 4 study areas in Kansas and Colorado and the population level benefits of CRP grassland to LEPC. Finally, efforts to estimate the distribution of LEPC in Kansas and Colorado are ongoing.

Landscape Demography
A sensitivity analysis was conducted first to identify life stages exerting the greatest influences on population growth rates among all 4 study areas. Then, we examined how vital rates varied among study areas using a life table response experiment. Finally, we explicitly evaluated the demographic consequences of CRP on LEPC in Northwest Kansas using a population matrix model.

We examined variables for which the population rate of change may be sensitive, or elastic, and used life-stage simulation analysis to identify vital rates explaining the most influence on the finite rate of population change (λ), given their estimated variance. Juvenile survival (August to March of first year), nonbreeding survival, and chick survival exerted the greatest influence on λ. Conservation of the species may be best achieved by managing for brood habitat and connectivity across fragmented habitats.

We estimated the finite rate of population growth using a two age-class population matrix model for each study area then conducted a retrospective analysis of matrix elements using a fixed effects life table response experiment. Adult survival contributed the most to differences in λ among study areas. There was an apparent fecundity/survival tradeoff among study areas, and there was greater fecundity but lower survival in more fragmented but heterogeneous landscapes of NW Kansas.

landscape level habitat and demographic variables on the total population of lesser prairie-chickens.

Location: Kansas and eastern Colorado

Completion: May 2017

The establishment of the Conservation Reserve Program (CRP) and seeding of forbs into existing CRP fields may have increased the abundance and range of lesser prairie-chickens in northwestern Kansas since the late 1990s. An increase in abundance may have resulted from greater fecundity and/or survival rates by individuals that use CRP. Alternatively, the increase in abundance could simply have been a response to the conversion of agricultural lands back into grassland habitat in the region. We used an aged-based matrix modelling approach to estimate and compare the finite rate of population change for lesser prairie chickens that (1) occupied and (2) did not occupy CRP to identify potential demographic benefits incurred by individuals using CRP. Overall, population growth rates did not differ among birds that used CRP (λ =0.55, SE = 0.08) and those that used native working grasslands (λ= 0.44, SE = 0.08). However, at a population level nesting densities were 2X greater in CRP grasslands compared to native working grasslands, therefore, landscapes with a greater CRP component had greater reproductive output. Use of CRP as nesting habitat increase during years of more severe drought. Populations may have expanded into NW Kansas due to the increased reliability of nesting habitat provided by CRP among wet and dry years.

Table 1. Finite rate of population growth estimates and 95% confidence intervals for each site.

Site	λ	95% CI
NW	0.485	0.335 - 0.674
Clark	0.678	0.464 - 0.910
CO*	0.667	0.412 - 0.897
RH	0.665	0.491 - 0.855
All Sites	0.571	0.439 - 0.734

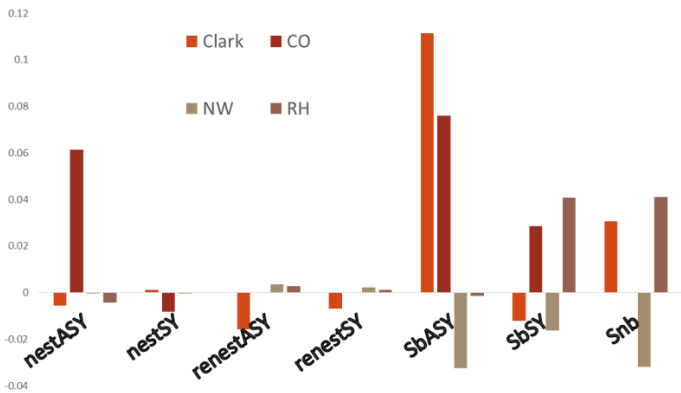


Figure 1. Bar graph displaying contributions of life stages to positive and negative population growth estimates among the Clark, Northwestern Kansas, Red Hills, and Colorado study areas.

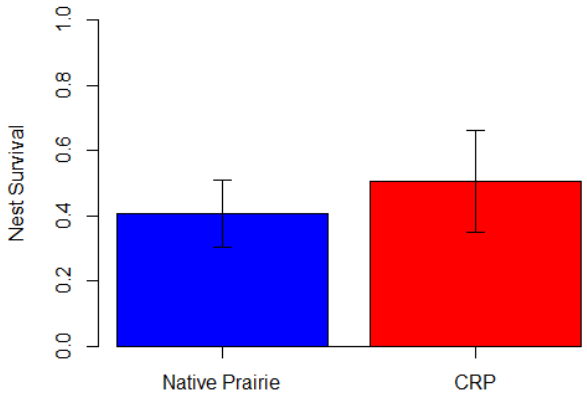


Figure 2. Nest survival estimates for LEPC nests in CRP grasslands (n=33) and native prairie (n=69) in Gove and Logan County, Kansas.

Distribution

Prior to estimating the distribution of LEPC, we first examined important predictors of LEPC habitat using a logistic regression. We then used that information when selecting remotely sensed data sets providing broad and detailed cover of variables within and outside of the 4 study areas in Kansas and Colorado. Future efforts seek to relate important habitat variables from the logistic regression model to remotely sensed data sets to predict LEPC occurrence throughout the northern extent of their range.

We estimated the relative importance of habitat variables (visual obstruction, percent forbs, and litter depth) with the probability of use by LPC among multiple study areas in Kansas and Colorado. Logistic regression was used to estimate effect size for explaining habitat use between variables measured at used (n = 4,325) and available points (n = 3,688). The predictive power of variables related to cover, nesting, and food suitability were assessed in separate model groups. Of each grouping, the quadratic relationship of forbs was the best supported food variable, and overall best univariate predictor of LPC use, litter depth was an informative nesting variable, and the quadratic relationship of vegetation height (dm) at which 25% visual obstruction occurs was the best supported cover variable. All were positively related with LPC use and had 95% confidence intervals that did not overlap zero. Best supported single variable models were combined to assess multivariate predictors. Overall, the additive model including food, nesting, and cover variables was the best predictor of LPC occupancy.

We assessed the utility of a random forest model that included phenometric, soil, and topography related data to predict LEPC occurrence in Clark County, KS. The model showed strong predictive power assessed by its fit and validation and proves to be a strong tool for use in the appropriate conditions. Estimating the distribution and the amount of available habitat for LEPC is an initial and most important task for halting their long term declines with strategic conservation planning. Although the Random Forest model showed strong predictive power in

this study, we were still restricted to the extent of our data collection and the current model lacks power outside of the ranches we intensely sampled in Clark County. Figure 5 shows a strong clustering of optimal habitat at the locations where LEPC were present but not on similar cover types outside of this area. To overcome these issues, we plan to use the random forest model to predict the distribution of areas matching the vegetative requisites for nesting, brooding, and winter habitat.

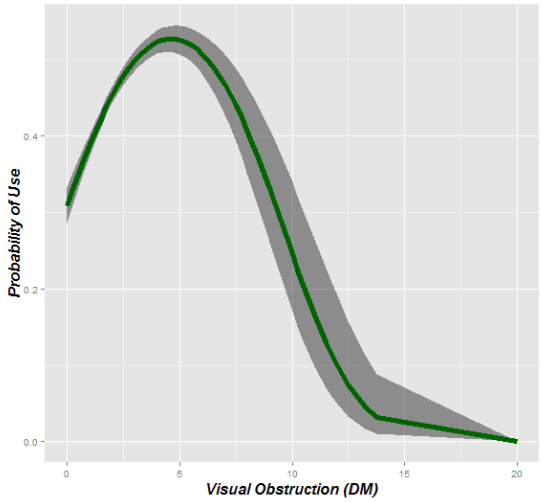


Figure 3. Probability of use by LPC based on Visual obstruction (DM).

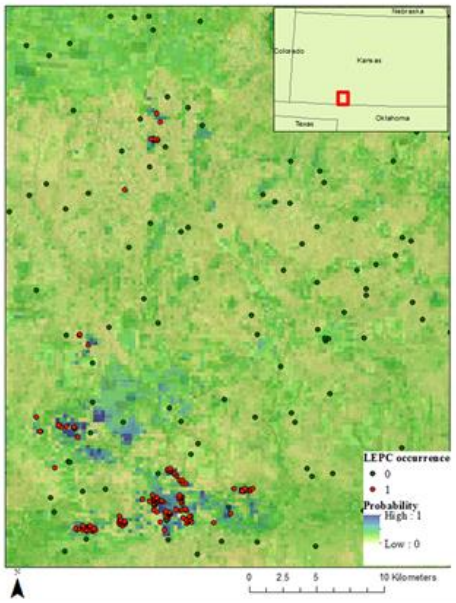


Figure 4. Clark County study area and lesser prairie-chicken distribution model predictions for the 2014 breeding season.

Foraging

During the brooding period, rapidly growing lesser prairie-chicken (LEPC, *Tympanuchus pallidicinctus*) chicks have high calorie demands and are restricted to foodstuffs within their immediate surroundings. During cold winters, meeting thermoregulatory demands on available food items of limited nutrient content may be challenging. To learn more about the diets of LEPC during these critical periods we used a DNA barcoding approach to identify animal and plant components of LEPC diets among native prairie, cropland, and Conservation Reserve Program (CRP) fields in Kansas and Colorado. LEPC fecal samples (n = 314) were collected during the summer of 2014 and winter of 2014–2015 and DNA was extracted. Sequences were classified to Order for invertebrates and Genus for plants based on the best matching barcode. Among 80 readable fecal samples for invertebrates, 35% of the sequences were from Lepidoptera, 26% from Orthoptera, 14% from Araneae, and 13% from Hemiptera. Plant sequences from 137 fecal samples were comprised of *Ambrosia* spp. (28%) followed by species in genera similar to *Symphyotrichum* (10%), *Medicago* (6%), and *Triticum* (5%). The predominant use of Lepidopteran prey contrasts with past research for which Orthopterans were the main dietary component.

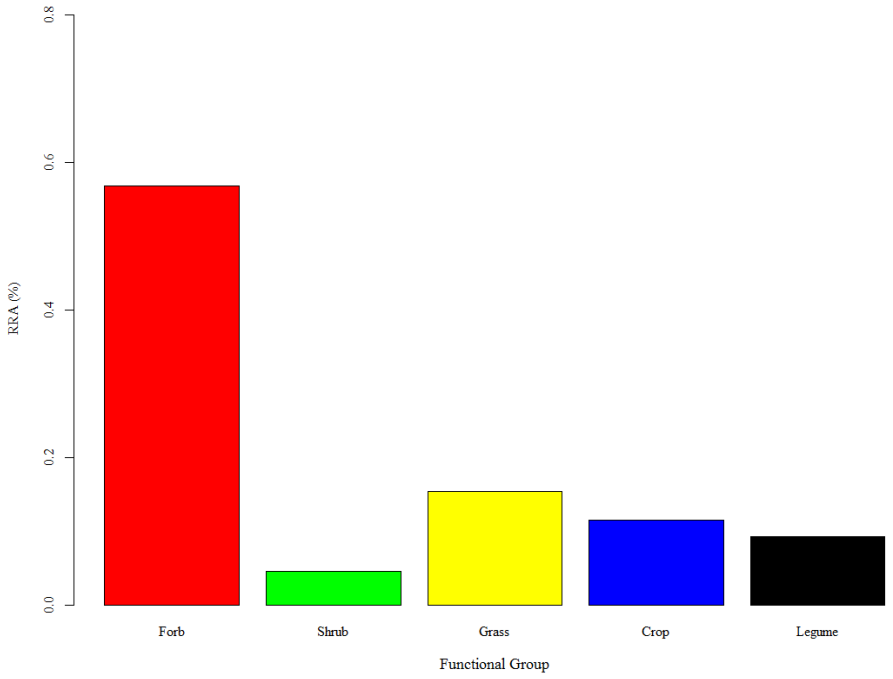


Figure 3. Plant foods consumed by marked female LEPC among 4 study areas in Kansas and Colorado during the winter of 2014.

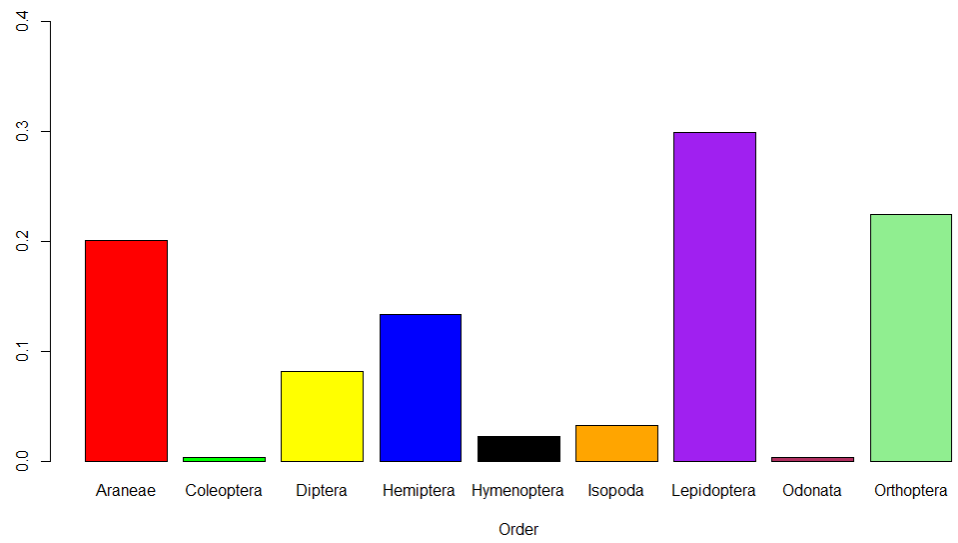


Figure 4. Animal foods consumed by marked female LEPC among 4 study areas in Kansas and Colorado during summer brood rearing in 2014.

Products

Professional Presentations

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., 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., and D.A. Haukos. 2016. Impacts of Conservation Reserve Program Grasslands on lesser prairie-chicken populations in the northern extent of their range. Kansas Natural Resources Conference, Wichita, Kansas.

Sullins, D.S., and D.A. Haukos. 2016. Lesser prairie-chicken foraging in native and CRP grasslands of Kansas and Colorado. Kansas Natural Resources Conference, Wichita, Kansas.

Sullins, D.S., and D.A. Haukos. 2016. Lesser prairie-chicken foraging in native and CRP grasslands of Kansas and Colorado. Managing imperiled landscapes and threatened species through private land conservation symposium. Society of Range Management Conference. Corpus Christi, Texas.

Sullins, D.S., and D.A. Haukos. 2015. Lesser prairie-chicken diets in Kansas and Colorado. Kansas Ornithological Society meeting.

Sullins, D.S., D.A. Haukos, and B.K. Sandercock. 2015. Lesser prairie-chicken regional demographic variability in Kansas and Colorado. Meeting of the Prairie Grouse Technical Council. Nevada, Missouri.

Sullins, D.S., D.A. Haukos, and B.K. Sandercock. 2015. Lesser prairie-chicken regional demographic variability in Kansas and Colorado. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society. Kansas State University, Manhattan, Kansas.

Sullins, D.S., D.A. Haukos, and B.K. Sandercock. 2015. Demographic sensitivity of the threatened lesser prairie-chicken. American Ornithologists' Union (133rd Meeting) and Cooper Ornithological Society (85th Meeting). University of Oklahoma, Norman, Oklahoma.

Sullins, D.S., and J.D. Kraft, J.M. Lautenbach, R.T. Plumb, S.G. Robinson, J.D. Lautenbach, and D.A. Haukos. 2015. Basic ecological considerations for the effective management of lesser prairie-chickens in Kansas and Colorado. Natural Resources Conservation Services Rangeland Specialists Meeting, Salina, KS,

Sullins, D.S., and D.A. Haukos. 2014. Identifying optimal lesser prairie-chicken habitat in Kansas and Colorado. Kansas Natural Resources Conference, Wichita, Kansas.

Sullins, D.S., and D.A. Haukos. 2014. Habitat use of lesser prairie-chickens in Kansas and Colorado. Kansas Ornithological Society meeting.

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

Investigators:
Jonathan Lautenbach, M.S. Student

Project Supervisor:
Dr. David A. Haukos

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

Cooperators
Kansas Department of Wildlife, Parks and Tourism
Natural Resources Conservation Service
Kansas State University
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 lesser prairie-chickens.

Status
On-going

Progress and Results

There are many threats to the lesser prairie-chicken population across their range. Some of these threats are specific to certain portions of their range and others are found across their entire range. One specific threat to the eastern portion of the lesser prairie-chicken population is the invasion of trees, especially eastern redcedars (*Juniperus virginiana*). Historically, fires burned across much of this area every 3-10 years, preventing trees from encroaching on the prairie. After settlement, fire was suppressed in this area, allowing eastern redcedars and other trees to expand into a virtually treeless landscape. This is a major issue for lesser prairie-chickens, as they have been shown to avoid areas with greater than 2 trees per ha. One proposed solution to maintain treeless prairie has been to reintroduce fire to the system. However, since fire has been removed from this system, limited research is available on how fire will impact lesser prairie-chicken habitat selection and habitat. Part of the goal of this research is to identify how lesser prairie-chickens and their habitat respond to prescribed fire. We evaluated the effects of prescribed fire implemented in a patch-burn grazing system on lesser prairie-chicken habitat selection. We measured vegetation characteristics and female lesser prairie-chicken habitat selection during different life history stages across a time since fire gradient (year-of-fire, 1 year post-fire, and >3 years post-fire). We found that vegetation characteristics varied by time-since-fire, with year-of-fire patches having the greatest amount of bare ground and litter cover while >3 years post-fire patches had the most grass cover and the least bare ground. Additionally, we found that >3 years post-fire patches had 2x taller vegetation than year-of-fire patches. Space use of female lesser prairie-chickens also varied by time-since-fire and life history stage. Females selected >3 years post-fire patches that offered the most cover when compared to other time-since-fire patches for nesting more frequently than available. Females led their broods to year-of-fire patches and 1 year post-fire patches more than >3 years post-fire patches, suggesting that these patches are beneficial for brooding. These preliminary data suggest that burning complete pastures to control eastern redcedars would eliminate lesser prairie-chicken nesting habitat and negatively impact the species. However, when prescribed fire is implemented in a patch-burn grazing system it retains nesting habitat, has the ability to control eastern redcedar, and generates brood rearing habitat for lesser prairie-chickens. An additional threat to the lesser prairie-chicken is

Location:
Kansas

Completion:
Fall 2016

an increase in overall temperature and an increase in the intensity and frequency of heat waves across much of the range of the lesser prairie-chicken. Gallinaceous birds have been shown to be negatively impacted by heat waves by limiting nesting attempts, cause chick and egg mortality, and direct bird mortality. Because of this, identifying areas of thermal refugia for lesser prairie-chickens is going to be important as the intensity and frequency of these events increases as it will help guide land managers and agency staff on the best way to provide these areas for lesser prairie-chickens. To identify these areas we have attached VHF radio transmitters and satellite transmitters to female lesser prairie-chickens to identify areas that they frequent during heat waves. To determine landscape and vegetation characteristics at these location we are in the process of generating GIS layers based on topography, soils, time-since-fire, and vegetation characteristics. Once specific areas have been identified that lesser prairie-chickens select during heat waves we will deploy iButtons (nickel sized temperature and humidity data loggers) to determine if why these areas are selected.

Products

Professional Presentations

Lautenbach, J.D., J.M. Lautenbach, D.A. Haukos, R.T. Plumb, J.C. Pitman, and C.A. Hagen. 2016. Using Patch-burn Grazing to Maintain Prairie for Lesser Prairie-Chickens. Kansas Natural Resources Conference, Wichita, KS.

Lautenbach, J.D., J.M. Lautenbach, D.A. Haukos, R.T. Plumb, J.C. Pitman, and C.A. Hagen. 2016. Killing Trees and Maintaining Prairie for Lesser Prairie-Chickens through Patch-Burn Grazing. Society for Range Management Annual Meeting, Corpus Christi, TX.

Lautenbach, J.D., and D. A. Haukos. 2016. Response of Lesser Prairie-Chicken Habitat and Habitat Use to Patch-Burn Grazing. Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Lautenbach, J.D., J.M. Lautenbach, and D.A. Haukos. 2016. Effect of Patch-Burn Grazing on Vegetation Composition in the Eastern Portion of the Lesser Prairie-chicken Range. Prairie-Grouse Technical Council, Nevada, MO.


4x4

Re-Thinking Regal Fritillary Conservation and Management: Habitat Characteristics and the Impact of Disturbance Regime on an Imperiled Grassland Butterfly

Investigators:
Kelsey McCullough, M.S. Student
Caroline Skidmore, Undergraduate

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

Status
On-going

Progress and Results

The regal fritillary (*Speyeria idalia*) was once an abundant butterfly species of North American prairie communities with a range extending from the Canadian border to Oklahoma and east to the Atlantic coast. However, populations have declined by approximately 99% in the prairie region and the species is nearly extirpated in the eastern portion of its former range largely due to habitat loss, fragmentation, and the subsequent breakdown of metapopulation dynamics. Populations that remain are restricted to remnant tracts of native prairie. The overall objective of this research is to assess the effects of habitat features and management practices on the distribution and density of regal fritillary and their larval host plants. To meet the objectives, we surveyed remnant tracts of prairie in north-central Kansas for regal fritillary host plants, larvae and adults. We applied these data to a novel gradient habitat model framework. This framework facilitated the spatially explicit modeling of the distribution and relative density patterns of regal fritillary larvae, adults, and host plants as a continuous function of multiple resources and environmental conditions across multiple scales. Our results indicate that greater host plant density and short fire return intervals are important to the occurrence of late-instar larvae and despite current management recommendations, larvae may be negatively impacted by a lack of fire. Preliminary analysis of adult data suggests that adult density was greater in areas that were grazed and had a 3-5 year fire return interval. The conservation management implications of these results to the persistence of regal fritillary populations within the region may require a re-thinking of previous assumptions.

Products
Professional Presentations
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., Albanese, G., and Haukos, D.A. 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 Resources Conference, Wichita, KS

environmental features associated with the occurrence, distribution, 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

McCullough, K. E., Albanese, G., and Haukos, D.A. 2015. Gradient Habitat Modeling of Regal Fritillary (*Speyeria idalia*) and Larval Host Plant Using a Distribution Modeling Approach with Notes on Life History Attributes, Central Mountains and Plains Section of The Wildlife Society, Manhattan, KS

McCullough, K. E., Albanese, G., and Haukos, D.A. 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, Omaha, NE

McCullough, K. E., Albanese, G., and Haukos, D.A. 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 Conference, Wichita, KS

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.

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

Investigators
Mike Whitson, M.S. Student
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
On-going

Progress and Results

The overriding goal for this research is to quantify variation in vegetation species response, biomass production, invertebrate availability and waterfowl use as related to early, mid and late flooding dates in moist soil managed fallow rice fields on the upper Texas coast. This research will provide federal, state, private land managers and conservation agencies with viable wetland management techniques to enhance habit conditions, wetland mitigation, and assist in reducing migratory waterfowl and residential mottled duck populations to exposure of areas with high lead contamination. Specific objectives include estimate existing seed bank composition and variation in biomass production, seed production, above ground plant community composition in areas under varying temporal implementation regimes and treatment conditions. We will also determine, compare and characterize bird use and behavior among treatments to estimate moist soil management practices that drive waterfowl habitat selection and use.

Products
Professional 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.

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

Investigators
Sarah Ogden, M.S. Student

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 On-going

Progress and Results

Sericea lespedeza (*Lespedeza cuneata*) is an invasive forb that reduces the abundance of native grasses and forbs in tall-grass prairie by up to 92%. The spread into the Flint Hills is problematic for the ranching community because the plant's high levels of condensed tannins, which cause it to be unpalatable to cattle, ultimately reduces cattle weight gain on invaded pastures. Traditional land management tools in the Flint Hills (i.e., spring prescribed fire, cattle grazing, and herbicide use) are ineffective against sericea lespedeza but there is encouraging evidence that late-growing season prescribed fire and grazing by tannin tolerant herbivores are effective at controlling the invasion. Before promoting these practices, however, it is important to determine the effects they have on the native tall-grass prairie wildlife communities.

A 50-ha study site in Geary County, KS was established and divided into 9 patches, each randomly assigned to one of three treatments: mid-April burn (spring fire), early August burn (mid-summer fire), or early September burn (late summer fire). Data from 2015 indicate that abundance of grassland nesting passerines is similar among all treatments and grasshopper sparrows (*Ammodramus savannarum*) display a trend of being more abundant in mid- and late summer fire treatments compared to spring fire treatments. Butterfly diversity and density are similar among all treatments.

A 250-ha study site in Woodson County, KS has been established and divided into 8 pastures, each randomly assigned to one of two treatments: steer grazing followed by sheep grazing (steer + sheep grazed) or steer grazing followed by rest (steer grazed). Data from 2015 indicate that abundance of grassland nesting passerines is similar among all treatments and grasshopper sparrows show a trend of being more abundant in steer + sheep grazed pastures than in steer grazed pastures. Butterfly diversity is higher in steer grazed pastures than in steer + sheep grazed pastures, whereas butterfly density is higher in steer + sheep grazed pastures than in steer grazed pastures.

Future analyses will incorporate data collected during the 2016 field season. Additionally, nest survival and reproductive success will be estimated for grassland nesting passerines within each of the treatments. The information regarding the native tall-grass prairie bird and butterfly communities will help land and wildlife managers determine whether it is responsible to promote the use of summer prescribed fire and/or grazing by tannin-tolerant herbivores to control sericea lespedeza.

Products

Professional Presentations

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.B., D.A. Haukos, K. Olson, J. Lemmon, J. Alexander. February 2016. Sericea Lespedeza Control: Short- and Long-Term Outlooks on the Effects on Prairie Butterflies. Kansas Natural Resources Conference. Wichita, KS.

Ogden, S.B., D.A. Haukos, K. Olson, J. Lemmon, J. Alexander. February 2016. Sericea Lespedeza Control: Short- and Long-Term Outlooks on the Effects of Grassland Birds. Society for Range Management Annual Conference. Corpus Christi, TX.

Ogden, S.B., D.A. Haukos, K. Olson, J. Lemmon, J. Alexander. January 2016. Sericea Lespedeza Control: Short- and Long-Term Outlooks on the Effects of Grassland Birds. Midwest Fish and Wildlife Conference. Grand Rapids, MI.

Ogden, S.B., D.A. Haukos, K. Olson, J. Lemmon, J. Alexander. October 2015. Species-Specific Responses of Grassland Birds to Sericea Lespedeza Control using Fire and Grazing. Kansas Ornithological Society. Emporia, KS.

Ogden, S.B., D.A. Haukos, K. Olson, J. Lemmon, J. Alexander. August 2015. Grassland Bird Response to Sericea Lespedeza Control using Fire and Grazing. The Wildlife Society Central Mountains and Plains Section Annual Conference. Manhattan, KS.

Ogden, S.B., D.A. Haukos, K. Olson, J. Lemmon, J. Alexander. July 2015. Grassland Bird Response to Sericea Lespedeza Control using Fire and Grazing. American Ornithologists Union/Cooper Ornithological Society Annual Meeting. Norman, OK.

Completed Wildlife Projects

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

Investigators
Samantha Robinson, M.S.

Project Supervisor
Dr. David Haukos

Funding
Kansas Department of Wildlife, Parks and Tourism

Cooperators
Christian Hagen
Kansas Department of Wildlife, Parks & Tourism
Kansas State University
USDA NRCS
USDA FSA

Objectives

Determine the effect of fragmentation on survival.

Estimate non-breeding season survival, measure non-breeding season movements, home range and habitat use.

Understand the link between free-water use and egg development.

Assess the risk of fence collision across the northern distribution.

Location:
Throughout Kansas and Eastern Colorado

Status
Completed

Results

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) has experienced range-wide population declines and range contraction since European settlement. Due to ongoing declines, lesser prairie-chickens were listed as threatened under the Endangered Species Act in 2014; however, uncertainty regarding the legal status of the species has developed following a judicial decision to vacate the listing in September 2015. Regardless, new research is required for conservation planning, especially for understudied portions and temporal periods of the occupied range. I evaluated nonbreeding lesser prairie-chicken survival using known-fate models, and tested for the influence of environmental, landscape and predator effects on weekly survival. I estimated nonbreeding home-range size using fixed kernel density estimators and Brownian Bridge movement models for VHF and Satellite tagged lesser prairie-chickens, and measured habitat use during the 6-month nonbreeding period (16 September – 14 March) following the breeding seasons of 2013, 2014 and 2015. I also determined the influence of lek location on space use intensity within home ranges using resource utilization functions. Female survival was high (0.73; 95% CI = 0.65-0.81) and consistent across nonbreeding seasons, but not explainable by selected variables. Mean home range size for birds with GPS transmitters ($\bar{x}$ = 997 ha) increased 181% relative to the breeding season and home range size was smaller in the 2013-2014 season ($\bar{x}$ = 494.7 ha) than the 2014-2015 ($\bar{x}$ = 1290.1 ha) and 2015-2016 ($\bar{x}$ = 1158.1 ha) seasons. Home range size of birds with GPS transmitters were 249% larger than for individuals with VHF transmitters ($\bar{x}$ =285.7 ha). Males and females were tied to leks throughout the nonbreeding season, and this relationship was not variable across the months of the nonbreeding season. Proportions of habitat used differed among study sites, but temporal trends were not evident. Lesser prairie-chickens exhibited consistency among ecoregions for home-range, space use, and survival; however, with differing habitat use among regions, management should be on the regional scale.

Agriculture and energy development have caused fragmentation of the landscape where lesser prairie-chickens evolved. I used known fate survival models to test if landscape composition or configuration within sites caused survival to differ by site, as well as within home ranges to determine if functional relationships exist between weekly survival and landscape configuration or composition. I used Andersen-Gill models to test whether distance to anthropogenic features affected hazard rates. Differences in

Completion
December 2015

survival rates between sites, with survival rates 50% greater in Clark County, Kansas compared to Northwestern, Kansas, corresponded to differences in the amount of grassland habitat on the landscape, but study-site configuration was not measurably different. Increasing the number of patch types within home ranges increased survival, indicating positive effects of heterogeneity. In addition, as distance to fences decreased, lesser prairie-chickens experienced greater risk. Overall, further breakup of grassland landscapes that lesser prairie-chickens occupy should be avoided, to avoid habitat loss and fragmentation thresholds that could further affect survival rates. Additionally, fences should be removed or avoided around active leks.

Products

Thesis

Robinson, S. 2015. Landscape ecology, survival and space use of lesser prairie-chickens. Thesis, Kansas State University, Manhattan.

Publications

Robinson, S.G., D.A. Haukos, R.T. Plumb, C.A. Hagen, J.C. Pitman, J.M. Lautenbach, D.S. Sullins, J.D. Kraft, J.D. Lautenbach. 2016. Lesser prairie-chicken fence collision risk across its northern distribution. Journal of Wildlife Management doi:10.1002/jwmg.1073

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 *in press*.

Professional Presentations

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.

Robinson, S., R. Plumb, D. Haukos, S. Carleton, A. Meyers, and J. Reitz. 2015. There is no space like home:space use of nonbreeding lesser prairie-chickens. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Robinson, S., R. Plumb, J. Lautenbach, D. Haukos, and J. Pitman. 2014. Nonbreeding season movement and habitat use of lesser prairie-chickens in Kansas. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado.

Robinson, S., R.T. Plumb, J.M. Lautenbach, D.S. Sullins, J.D. Kraft, and D.A. Haukos. 2015. Attributing landscape characteristics to lesser prairie-chicken survival in Kansas and Colorado. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Robinson, S., R.T. Plumb, J.M. Lautenbach, D.S. Sullins, J.D. Kraft, D.A. Haukos, C.A. Hagen, and J.C. Pitman. 2015. Functional relationships among lesser prairie-chicken survival, habitat type, and landscape fragmentation. International Grouse Symposium, Reykjavik, Iceland.

Robinson, S.G., and D.A. Haukos. 2015. The influence of habitat composition and configuration on lesser prairie-chicken survival rates in Kansas. Annual Meeting of the Kansas Ornithological Society, Emporia, KS

Robinson, S.G., D.A. Haukos, and J.C. Pitman. 2015. Nonbreeding season movement and space use of lesser prairie-chickens in Kansas. Kansas Natural Resource Conference, Wichita.

Robinson, S.G., R.T. Plumb, J.M. Lautenbach, D.A. Haukos, S. Carleton, A. Meyers, and J. Reitz. 2015. Space use by nonbreeding lesser prairie-chickens. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

Lesser Prairie-Chicken Reproductive Success, Habitat Selection, and Response to Trees

Investigators
Joseph Lautenbach M.S.

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

Funding
Kansas Department of Wildlife, Parks, and Tourism
Colorado Department of Wildlife and Parks
U.S. Fish and Wildlife Service
NRCS USDA
FSA USDA
U.S. Geological Survey
Great Plains LCC

Cooperators
Jeff Prendergast
TNC
Kansas State University

Objectives

Investigate the nesting ecology of LEPCs in Kansas and eastern Colorado by measuring nesting propensity, nest site selection, nest site vegetation variables, and nest survival.

Evaluate the relative influence of variables affecting LEPC brood habitat use and survival.

Measure the LEPC response to the removal of woody vegetation (eastern red cedar).

Status
Complete

Results
The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is a species of prairie grouse native to the southwest Great Plains. Population declines and threats to populations of lesser prairie-chickens led U.S. Fish and Wildlife Service to list the species as "threatened" under the protection of the Endangered Species Act in May 2014. Lesser prairie-chickens are found within three distinct ecoregions of Kansas and Colorado and portions of the species' range are affected by tree encroachment into grasslands. The effect of trees on lesser prairie-chickens is poorly understood. I evaluated habitat selection and reproductive success and across the northern portion of the species' range. I captured female lesser prairie-chickens within the three different ecoregions in Kansas and Colorado to track nest and brood survival and measure nest and brood habitat. My findings show that there are regional and annual variations in nest and brood survival. Mean nest survival during 2013 and 2014 was estimated to be 0.388 (95% CI = 0.343 – 0.433) for a 35-day exposure period. Brood survival during 2013 and 2014 was estimated to be 0.316 (95% CI = 0.184 – 0.457) for 56 days. Chick survival was the lowest during the first week of life and is probably a limiting factor for population growth. Chick and brood survival decreased as Julian hatch date increased. Across the northern portion of the species' range, females consistently select visual obstruction between 2-3 dm. Vegetation at the nest changes between regions and years to reflect environmental and regional conditions. Broods consistently selected habitats with greater percent cover of forbs than was expected at random across all study sites. Broods also selected against areas of bare ground. The threshold of lesser prairie-chicken use was 2 trees/ha throughout the year. No nests were located within areas with greater densities. Lesser prairie-chickens had a greater probability of use at greater distances from trees and at lower tree densities. To provide adequate nesting habitat managers should provide 2-3 dm of visual obstruction. Providing forb cover with visual obstruction between 2.5-5 dm near nesting areas should provide adequate habitat for broods. Removing trees in core habitats and expand removal efforts outward should expand potential habitat for lesser prairie-chickens.

Products
Thesis
Lautenbach, J. 2015. Lesser prairie-chicken reproductive success, habitat selection, and response to trees. Thesis, Kansas State University, Manhattan.

Location:
Throughout Kansas, eastern Colorado

Completion: December 2014

Publications

Lautenbach, J.M., R.T. Plumb, S.G. Robinson, D.A. Haukos, J.C. Pitman, and C.A. Hagen. 2016. Lesser prairie-chicken avoidance of trees in a grassland landscape. Rangeland Ecology and Management (Special Issue) In Press

Professional Presentations

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2013. Regional variation in nest success of lesser prairie-chickens in Kansas and Colorado. Biennial meeting of the Prairie Grouse Technical Council, Crookston, MN.

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2013. Factors affecting brood and chick survival of lesser prairie-chickens in Kansas and Colorado. Biennial meeting of the Prairie Grouse Technical Council, Crookston, MN.

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2014. Impacts of tree encroachment on lesser prairie-chickens. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2014. Survival and habitat selection of lesser prairie-chicken chicks and broods. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado.

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2014. Differences in successful and unsuccessful nests of lesser prairie-chickens in Kansas and Colorado. Kansas Natural Resource Conference, Wichita, Kansas.

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2014. Nest site location by lesser prairie-chickens in Kansas and Colorado. Midwest Fish and Wildlife Conference, Kansas City, MO.

Lautenbach, J. R. Plumb, D. Haukos, J. Pitman, and C. Hagen. 2016. The impacts of trees on lesser prairie-chickens. Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Lesser Prairie-Chicken Movement, Space Use, Survival, and Response to Anthropogenic Structures in Kansas and Colorado

Investigators
Reid Plumb, M.S.

Project Supervisor
Dr. David Haukos
Jim Pitman

Funding
Kansas Department of Wildlife, Parks, and Tourism
Colorado Department of Wildlife and Parks
U.S. Fish and Wildlife Service
NRCS USDA
FSA USDA
U.S. Geological Survey

Cooperators
Christian Hagen
Jeff Prendergast
TNC
CGC

Objectives

Quantify breeding season survival of lesser prairie-chicken (LPCH) populations in Kansas and Colorado.

Quantify breeding season movement and space use of adult female LPCH in Kansas and Colorado.

Identify LPCH habitat patch use during the breeding season.

Compare vital rates and drivers among populations.

Status Completed

Results

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is an endemic North American prairie grouse once widely distributed in the southwestern Great Plains. Recent population declines and continued threats to lesser prairie-chicken populations prompted the U.S. Fish and Wildlife Service to list the species as "threatened" under the protection of the Endangered Species Act of 1973 in May 2014. The northern extent of the species range in Kansas and Colorado supports 2/3 of the remaining range-wide population of lesser prairie-chickens, but has thus far been relatively understudied. Concern for species viability has created a need to fill current knowledge gaps in lesser prairie-chicken ecology, provide more recent demographic information, and develop appropriate conservation actions. I evaluated female survival, movement, space use, and effects of anthropogenic features during the breeding seasons of 2013 and 2014. I captured and radio-tagged 201 females with satellite GPS (N = 114) and VHF (N = 82) transmitters within the three ecoregions of Kansas and Colorado. Mean daily movement varied by region, year, and breeding season period but the amount of space used was consistent between ecoregions and years. On average, females moved 1352 m $\pm$ 12 [SE] per day. Females moved the greatest distances during the lekking period of the breeding season with females moving 2074 m $\pm$ 36 per day. Females were most sedentary during the brooding period moving only 780 m $\pm$ 14 per day. Mean breeding season home range size was estimated to be 340 ha $\pm$ 27. The lekking period had the greatest amount of movement as a result of females visiting leks to find mates, copulate, and search for nest locations. Female's movements were reduced during the brooding period because of physical limitations of the brood mobility. Variation in movement between ecoregions was most likely a product of fragmentation as females moved 10-30% more in northwest Kansas compared to the study sites, which was characterized by northwest Kansas having the greatest degree of fragmentation. Survival varied by ecoregion with females in northwest Kansas having the lowest probability of surviving the 6-month breeding season compared to other ecoregions. Estimated 6-month breeding season survival during 2013 and 2014 was 0.455 (95% CI = 0.38 – 0.53). Survival was lowest during the nesting period, which claimed 59.5% of all observed mortalities. Survival increased from 2013 to 2014 in northwest Kansas as grassland habitats recovered from extreme drought conditions in 2013. Drought was less severe in south-central Kansas and survival rates remained fairly consistent across years. Avian and mammalian predators caused 45.7% and 34.3% of breeding season mortalities, respectively. Other mortalities were either cause by snakes or were

Identify the effects of habitat patch size, composition, and fragmentation on vital rates of LPCH populations.

Location:
Kansas and Colorado

Completion: February 2015

unknown (5.7%, 14.3%). Overhead cover may have been limited from drought conditions causing nesting females to be more visible to avian predators during incubation. When pooled across years and ecoregions, rump-mounted GPS transmitters did not adversely affect female survival when compared to commonly used necklace style VHF transmitter (VHF: 0.48 95% CI = 0.39 – 0.58; GPS: 0.50 95% CI = 0.38 – 0.64). Distance to distribution power lines and lek were significant predictors of female space use within their home range with females behaviorally avoiding distribution power lines and using space closer to leks. Space use decreased with increasing oil well density. Females avoided areas that had well densities of 23 wells/250 ha. Observed female locations were further from anthropogenic features but closer to leks on average than at random. Avoidance behavior of anthropogenic features may result in functional habitat loss and reduce the amount of suitable habitat available; compounding previously fragmented landscapes. Anthropogenic features may limit movement by acting as barriers on the landscape and potentially disrupt population connectivity. Furthermore, habitats selected for nesting and brooding may result in potential ecological traps because of reduce breeding success when impacted by increased occurrence and densities of anthropogenic features. Reduced breeding success can have significant negative impacts on population persistence. Average home range size across all ecoregions indicated that female lesser prairie-chickens need at least 340 ha of habitat to fulfill her life-history requirements during the breeding season. Brooding habitats need to be in close proximity ($\leq$ 750 m) to nesting cover to reduce distance traversed by newly hatched broods. Reducing grazing pressure will ensure that sufficient vertical habitat structure is available during the nesting period and increase female survival; especially in times of drought. Mangers should restrict construction of anthropogenic features near or within suitable lesser prairie-chicken habitat with emphasis on distribution power lines. Well densities should not exceed 1 well/60 acres (11 wells/section) for a >10% probability of use. However, because the affect that density of wells has on demographic rates of lesser prairie-chickens has yet to be determined, a conservative approach where well densities in or adjacent to grassland patches should be minimized as much as possible is best.

Products

Thesis

Plumb, R. 2015. Lesser prairie-chicken movement, space use, survival, and response to anthropogenic structures in Kansas and Colorado. Thesis, Kansas State University, Manhattan.

Professional Presentations

Plum, R., Lautenbach, J., R. Plumb, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Nest site location by lesser prairie-chickens in Kansas and Colorado. Midwest Fish and Wildlife Conference, Kansas City, MO.

Plum, R., Lautenbach, J., R. Plumb, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Effects of habitat patch selection on breeding season survivorship of lesser prairie-chickens in Kansas and Colorado. Midwest Fish and Wildlife Conference, Kansas City, MO.

Plumb, R., J. Lautenbach, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2013. Adult female survival of lesser prairie-chickens in Kansas and Colorado. Biennial Prairie Grouse Technical Council Meeting, Crookston, MN

Plumb, R., J. Lautenbach, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2013. Breeding season movements of adult female lesser prairie-chickens in Kansas and Colorado. Biennial Prairie Grouse Technical Council Meeting, Crookston, MN

Plumb, R.R., J.M. Lautenbach, S.G. Robinson, J.D. Kraft, D. Sullins, D.A. Haukos, J.C. Pitman, C.A. Hagen, and D. Dahlgren. 2015. Lesser prairie-chicken space use response to anthropogenic structures among landscapes. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Plumb, R.R., J.M. Lautenbach, S.G. Robinson, J.D. Kraft, D. Sullins, D.A. Haukos, J.C. Pitman, C.A. Hagen, and D. Dahlgren. 2015. Lesser prairie-chicken space use response to anthropogenic structures. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, and D. Dahlgren. 2014. Breeding season habitat patch use by female lesser prairie-chickens in Kansas and Colorado. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado.

Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, and D. Dahlgren. 2014. Effects of habitat patch use on breeding season survivorship of lesser prairie-chickens in Kansas and Colorado. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado.

Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Breeding season space use dynamics of female lesser prairie-chickens in Kansas and Colorado. Symposium on Animal Movement and the Environment, Raleigh, North Carolina.

Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Past, Present, and Future: using historical and information to guide conservation decisions for an iconic prairie grouse of the southwestern Great Plains. Regional Pheasants Forever and Quail Unlimited Conference, Wichita, Kansas.

Plumb, R.T., J. Lautenbach, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Breeding season home-range characteristics of female lesser prairie-chickens in Kansas and Colorado. Kansas Natural Resource Conference, Wichita, Kansas.

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)

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

Investigators
Dr. Beth Ross, postdoctoral research associate

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

Status Completed

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. 2016. The relative contribution of variation in climate to changes in lesser prairie-chicken abundance. Ecosphere 7(6):e01323.

management strategies for CRP and other USDA conservation programs.

Location:
Throughout Kansas and Eastern Colorado

Completion
March 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.

Professional Presentations

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, C. Hagen, and J. Pitman. October 2015. The relative influence of climate variability and landscape change on Lesser Prairie-Chicken populations. The Wildlife Society. Winnipeg, Manitoba, Canada.

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

Ross, B.E., D. Haukos, C. Hagen, and J. Pitman. July 2015. Combining multiple data sources to determine drought and land-use impacts on lesser prairie-chickens. American Ornithologists' Union. Norman, Oklahoma.

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

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

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

Ross, B.E., D. Haukos, C. Hagen, and J. Pitman. January 2014. Changes in lesser prairie-chicken abundance in Kansas. Midwest Fish and Wildlife Conference. Kansas City, Missouri.

A Historical Record of Land Cover Change of the Lesser Prairie-Chicken Range in Kansas

Investigators
David Spencer, M.S., Geography

Project Supervisor
Dr. David Haukos
Dr. Melinda Daniels

Funding
USDA
NRCS
FSA

Objectives
Create land cover maps of the LEPC range for each decade between 1950-2013

Document changes in areal extent and connectivity of land cover classes

Quantify effects of conservation practices on land cover with LEPC range

Location:
LEPC range in Kansas; Western Kansas

Status
Completed

Results

The Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) is a prairie grouse of conservation concern in the Southern Great Plains. In response to declining population numbers and ongoing threats to its habitat, the Lesser Prairie-Chicken was listed as threatened under the Endangered Species Act in May 2014. In western Kansas, the Lesser Prairie-Chicken occupies the Sand Sagebrush Prairie, Mixed-grass Prairie, and Short-grass/CRP Mosaic Ecoregions. Since the beginning of the 20th century, the overall range and population has declined by 92% and 97% respectively. Much of this decline is attributed to the loss and fragmentation of native grasslands throughout the Lesser Prairie-Chicken range. Whereas much of the loss and degradation of native grassland have been attributed to anthropogenic activities such as conversion of grassland to cropland and energy exploration, federal legislation since the 1980s to convert cropland on highly erodible soils to perennial grasses through the U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP) may curtail or reverse these trends. My objective was to document changes in the areal extent and connectivity of grasslands in the identified Lesser Prairie-Chicken range in Kansas from the 1950s to 2013 using remotely sensed data. I hypothesized that the total amount of grassland decreased between the 1950's and 2013 because of an increase in agricultural practices, but predicted an increase of grassland between 1985 and 2013 in response to the CRP. To document changes in grassland, land cover maps were generated through spectral classification of LANDSAT images and visual analysis of aerial photographs from the Army Map Service and USDA Farm Service Agency. Landscape composition and configuration were assessed using FRAGSTATS to compute a variety of landscape metrics measuring changes in the amount of grassland present as well as changes in the size and configuration of grassland patches. Since 1985, the amount of grassland in the Lesser Prairie-Chicken range in Kansas has increased by 210,9963.3 ha, a rise of 11.9%, while the mean patch size and area-weighted mean patch size of grassland increased 18.2% and 23.0% respectively, indicating grassland has become more connected during this time in response to the CRP. Prior to the implementation of CRP, the amount of grassland had been decreasing since 1950, as 66,722.0 ha of grassland was converted to croplands. The loss of grassland had a considerable effect on the patch size of grasslands, as mean patch size and area-weighted mean patch size decreased by 8.8% and 11.1% respectively. The primary driver of grassland loss between 1950 and 1985 was the emergence of center pivot irrigation, which had its greatest impact in western and southwestern parts of the range in Kansas. In particular, while the amount of grassland in Range 5, a region of the Lesser Prairie-Chicken range found in southwest Kansas, has increased overall since the 1950s by 4.7%, the area-weighted mean patch size has decreased by 53.0% in response to center pivot irrigation fragmenting the landscape. While the CRP has been successful in increasing and connecting

Completion:
August 2014

grassland throughout the Lesser Prairie-Chicken range to offset the loss of grassland since the 1950s, continuation of the CRP faces an uncertain future in the face of rising commodity prices, energy development, and reduction in program scope leaving open the possibility that these areas that have created habitat for Lesser Prairie-Chickens could be lost. As time progresses, a reduction in the scope of the CRP would reduce the amount of habitat available to Lesser Prairie-Chickens, threatening the persistence of their population.

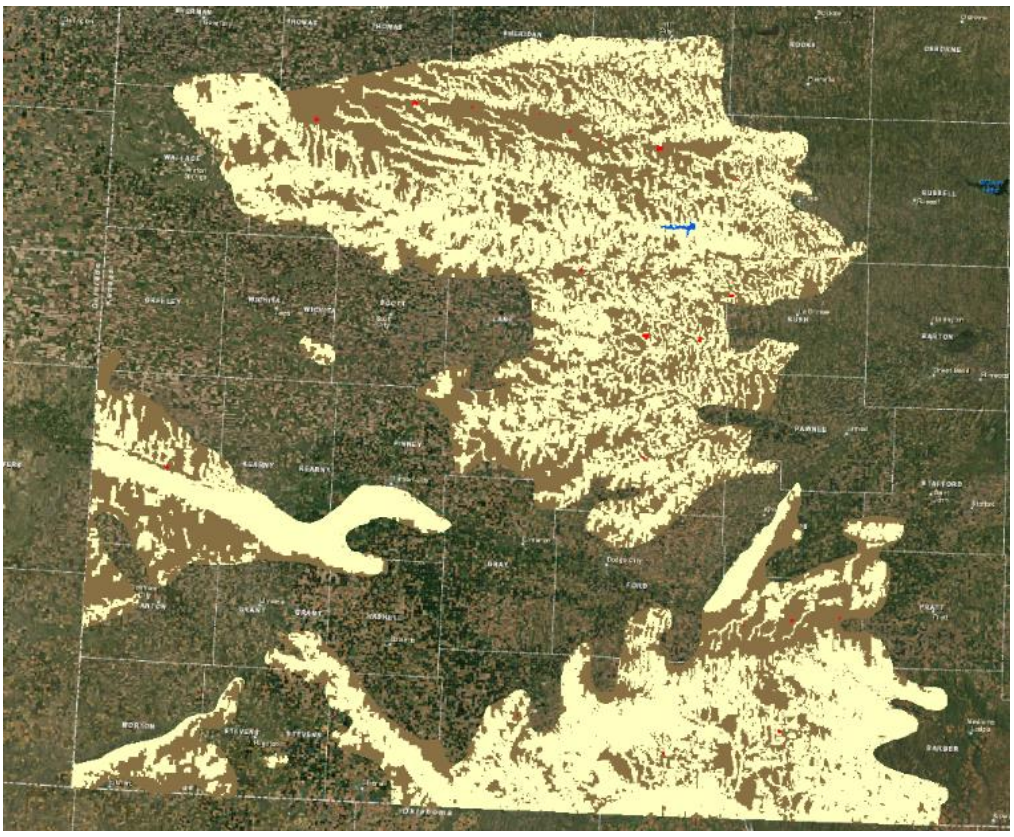
Products

Thesis

Spencer, D. 2014. Historical changes in landscapes occupied by lesser prairie-chickens in Kansas. Thesis, Kansas State University, Manhattan

Professional Presentations

Spencer, D., M. Daniels, and D. Haukos. 2014. A historical record of land cover change of the lesser prairie-chicken range in Kansas. Midwest Fish and Wildlife Conference, Kansas City, MO.



Risk Assessment of Lead Exposure by Mottled Ducks on the Upper Texas Gulf Coast

Investigators
Brian Kearns, Ph.D
Dr. Jena Moon
Stephen McDowell, M.S.

Project Supervisor
Dr. David Haukos

Funding
USFWS, USGS, Stephen F. Austin State University

Cooperators
Dr. Warren Conway
USFWS
Kansas State University

Objectives
Develop body condition and fat indices for Texas Gulf Coast mottled ducks

Determine ratios of Pb isotopes in bone and blood tissue from mottled ducks, and examine environmental ratios of Pb isotopes from vegetation and soil samples to determine contamination sources, potential bioavailability, and exposure pathways.

Create a predictive surface for high risk areas of Pb contamination in the Texas Chenier Plain and Midcoast NWR Complexes using spatial interpolation techniques.

Use Species Distribution Modeling

Status Completed

Results

The mottled duck (*Anas fulvigula*) is a dabbling waterfowl species native to coastal wetlands of the Gulf of Mexico of the United States and Mexico. Although closely related to common waterfowl species such as the mallard (*A. platyrhynchos*) and American black duck (*A. rubripes*), the mottled duck exhibits unique behavior, mainly in its life history as a non-migratory species. As such, because of population declines caused by predation, habitat destruction, and environmental contaminants, this species requires specialized conservation concerns and species-specific management to protect population numbers. The goal of this study was to assess the ongoing effect of observed lead (Pb) contamination and exposure issues in mottled ducks and their habitats, which I achieved by conducting assessments that will provide managers habitat and organism level metrics to detect and mitigate Pb in mottled ducks and their environments.

Field data were gathered at the Texas Chenier Plain National Wildlife Refuge Complex (TCPC), which was the area of greatest mottled duck density on the Texas Coast. First, a body condition index was created to provide managers a tool to monitor population health, and a proxy for Pb exposure and avian health without destructively sampling individuals. Presence-only maximum entropy (MaxENT) and multivariate statistical modeling procedures were then used in conjunction with mottled duck movement data to elucidate sets of habitat conditions that were conducive to predicting the occurrence of mottled ducks and environmental Pb "hot spots". MaxENT analyses suggested that Pb in the top portion of the soil column is similarly related to all environmental variables considered, may be increasingly available after large-scale environmental disturbances. Lack of variation in coarse-scale habitat use between breeding and non-breeding seasons may further point to a food-based exposure pathway for Pb as mottled ducks switch from an invertebrate to plant diet, either as a result of changing age classes or normal adult phenology, during the period of increased Pb exposure.

Using stable isotope ratio analysis, I then tested environmental samples of soil and vegetation as well as mottled duck blood to determine isotopic signatures that were consistent with particular sources of Pb deposition (e.g., Pb shot pellets, leaded fossil fuel combustion, industrial effluents). Comparisons suggested a great deal of similarity to Pb shot reference values in vegetation and blood samples, especially in blood samples with higher concentrations of Pb present.

Last, I conducted a formal Ecological Risk Assessment (ERA) procedure to quantify the risk to mottled ducks from Pb exposure in their current habitat and direct managers towards

(SDM) technology to create distribution maps of mottled ducks at an ecosystem scale for the Texas Chenier Plain NWR complex, and assess potential effects Pb contamination on habitat use.

Develop a formal Environmental Risk Assessment report for risk of exposure to environmental Pb for mottled ducks and other waterbirds on the Upper Texas Gulf Coast.

Location
Texas Chenier Plain NWR Complex

Completion
May 2015

effective mitigation and habitat management strategies to reduce future exposure. One scenario suggested that mottled ducks were at greatest risk from eating an invertebrate-based diet, but Pb content values at the TCPC suggest that a plant-based diet may provide a higher Pb exposure risk for mottled ducks, depending on true levels of bioavailability in environmental media.

Overall, I determined that mottled ducks experience greatest Pb exposure risk from Pb shot pellets on the TCPC or in nearby habitat, while potentially also experiencing low levels of exposure from several other sources. Additionally, management strategies such as phytoremediation that focus on plants that do not provide food resources for mottled ducks as a potential environmental sink for Pb contamination may prove effective in reducing the overall Pb load from historical activities that likely deposited much of the Pb in this ecosystem.

Products

Dissertation

Kearns, B. 2015. Risk assessment of lead exposure by mottled ducks on the upper Texas Gulf Coast. Dissertation, Kansas State University, Manhattan.

Publications

Kearns B.V., Walther, P., Conway, W., Haukos, D.A. 2015. Factors affecting fat content in mottled ducks on the Upper Texas Gulf Coast. Journal of the Southeastern Association of Fish and Wildlife Agencies 2:274-280.

McDowell, P.K., W.C. Conway, D.A. Haukos, J.A. Moon, C.E. Comer, and I.K. Hung. 2015. Blood lead exposure concentrations in mottled ducks (*Anas fulvigula*) on the upper Texas coast. Journal of the Southeastern Association of Fish and Game Agencies 2:221-228.

Professional Presentations

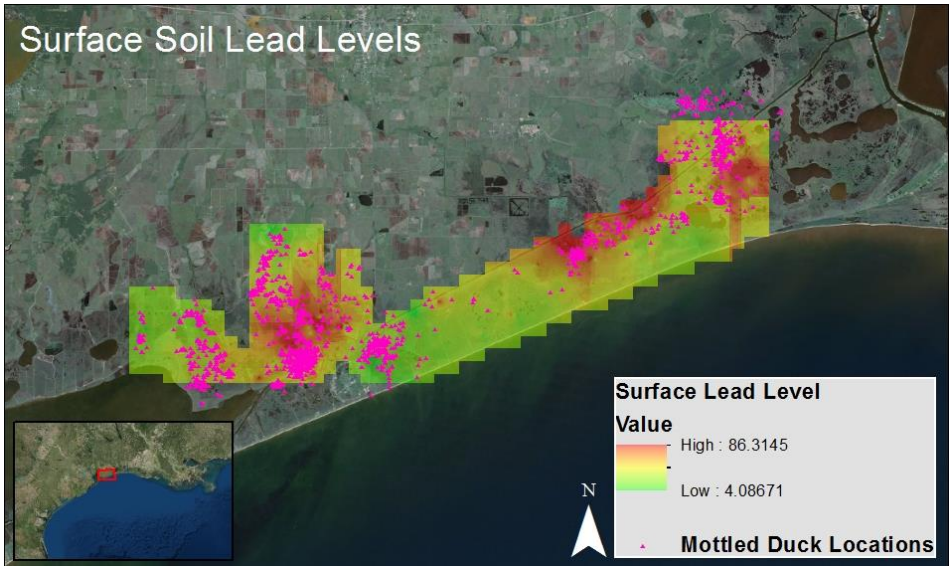
Kearns, B., D. Haukos, J. Moon, and E. Rigby. 2013. Species distribution in environmental decision-making: characterizing the efficacy of different models for use in habitat and wildlife management. Annual Meeting of the Society for Conservation GIS. Monterey, California.

Kearns, B., P. Walther, and D. Haukos. 2014. Developing a body condition index for mottled ducks on the upper Texas Gulf Coast. Annual meeting of the Texas Chapter of The Wildlife Society, Austin, TX.

Kearns, B., P. Walther. W. Conway, and D. Haukos. 2014. A body condition index for non-breeding mottled ducks on the upper Texas Gulf Coast. Mottled Duck Symposium, Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, Florida.

Kearns, B., S. McDowell, J. Moon, and D. Haukos. 2013. Spatial analysis and ecological risk assessment for lead exposure in Gulf Coast waterfowl: does environmental lead represent an ecological trap? Annual Meeting of the Ecological Society of America. Minneapolis, Minnesota.

Kearns, B., S. McDowell, J. Moon, W. Conway, and D. Haukos. 2014. The legacy of lead: developing new methods for assessing lead contamination and wildlife exposure risks in Gulf Coast wetland habitats. Annual meeting of the Texas Chapter of The Wildlife Society, Austin, TX.



Mottled duck (*Anas fulvigula*) Ecology in the Texas Chenier Plain Region

Investigators
Jena Moon, Ph.D.
Stephen F. Austin State University

Project Supervisor
Dr. David Haukos
Dr. Warren Conway

Funding
U.S. Fish and Wildlife Service

Cooperators
Patrick Walther
Dr. Dan Collins

Objectives

Determine movements of adult female mottled ducks during all major life stages, climatic events, high disturbance periods, and landscape habitat changes

Document course and fine scale habitat use during all major life stages

Model survival rates in relation to breeding periods, hunt periods, molting periods, and climatic events

Determine home range size for adult female mottled ducks

Location
Chenier Plain of the upper Texas and western Louisiana Gulf Coast

Completion
May 2014

Status Complete

Results

Many studies and plans have outlined the importance of the Chenier Plain Region of the Western Gulf Coast (WGC) to resident mottled ducks (*Anas fulvigula*), including the Mottled Duck Conservation Plan and the Chenier Plain Initiative for the Gulf Coast Joint Venture. The Chenier Plain Region historically, and currently, has the greatest density of mottled ducks in the WGC Population. Loss and degradation of mottled duck coastal habitats is the leading cause for mottled duck decline in the Chenier Plain Region (Stutzenbaker 1988). Urbanization, erosion, subsidence, conversion to agriculture, saltwater intrusion, invasive plant and animal establishment, loss of natural disturbance, sea level rise, and heavy metal accumulation all have played a role in the decline of quantity and quality habitats available to mottled ducks (Stutzenbaker 1988, Wilson 2007). However, the over-riding limiting factor affecting the species recovery lies within altered hydrology of the Chenier Plain Region. The mottled duck (*Anas fulgivula*) has been established as an indicator species to coastal marsh health and function (Stutzenbaker 1988, USFWS 2011). Currently, biologists have a relatively poor understanding of mottled duck habitat use, regional movements, response to habitat management, and movements. This information is needed to assist in strategic habitat conservation planning and to inform conservation for the species.

We captured mottled ducks via night lighting from airboats during summer 2009, 2010, and 2011. Upon capture, we sorted mottled ducks based on sex, age, and mass. To each adult female >740 g, we fitted a Model 100 solar/satellite backpack PTT with a custom fitted Teflon ribbon harness. We attached satellite radio transmitters to 15, 30, and 45 adult female mottled ducks in 2009, 2010, and 2011, respectively. PTTs were deployed with a duty cycle of 10 hours active and 72 inactive. We used the Argos system to collect data on date, time, latitude, longitude, and location class of each tagged female. Mortalities were assessed through a series temperature and movement sensors in association with ARGOS collected data.

Factors limiting survival of WGC mottled ducks potentially include harvest, lead exposure, disturbance, habitat loss or degradation, predators, and variations in climate patterns (Stutzenbaker 1988, Wilson 2007). Several studies have attempted to measure annual and periodic survival rates of WGC mottled duck populations. Historical banding data from 1965-1971 suggested annual survival rates of mottled ducks at 57.5% (Stutzenbaker 1988). Wilson et al. (2003) estimated annual survival rates to be 55.9% for male and 50.2% for female mottled ducks in the WGC population. More recent studies have estimated breeding season survival rates range from 63.3%-87.2% on Anahuac National Wildlife Refuge. Preliminary analyses from a telemetry study conducted by the Gulf Coast Joint Venture estimated annual survival rates to be 41% for after hatch-year (AHY) females and 48% for hatch-year females in Texas and Louisiana (HY). Compared with common waterfowl

species these estimates are low (Wilson 2007). Johnson (2009) also concluded that survival rates of mottled ducks estimated from band-recovery data were low compared to those of most dabbling ducks, and Florida populations of mottled ducks (Varner et al. 2014). We established the encounter interval for survival analyses as 1 week and the experimental unit for survival was each radio-tagged bird. We estimated cumulative weekly survival which allowed us to further define periods of relative high and low mortality, which will enabled us to compare our survival estimates to previous and ongoing studies.

We employed known fate modeling in program MARK to assess the influence of potential mortality factors affecting mottled duck survival. Models tested included the following predictors: (1) time, (2) hunting and non-hunting periods, (3) biological time periods; individual covariate of (4) mass at time of capture was also incorporated. We used adjusted Akaike's Information Criterion (AIC_c) scores and weights to rank and assess models. Analyses indicate that survival rates remain below average for mottled ducks (12-38% annual rate of survival), when compared with other waterfowl species inhabiting the Gulf Coast. Primary periods of mortality included all periods of hunting and the molt biological time period. Drought conditions during 2011 also had negative impacts on overall survival rates of transmittered females.

Conservation of quality coastal habitats remains a high priority to potentially offset current survival rates of mottled ducks.
Because of recent tropical climatic events and continual saltwater intrusion, current estimates of habitat use and selection by mottled ducks are unavailable for Texas and Louisiana Gulf Coast. Previous studies of habitat use by mottled ducks focused on specific biological time periods, did not consider effects of numerous anthropogenic alterations in the region, and occurred prior to the recent tropical events that caused major alterations in mottled duck habitats within the Texas Chenier Plain Region. Mottled duck habitat use has been documented to be highly variable by past studies, with varied wetland types, land management practices and salinity regimes being documented (Stutzenbaker 1988). Managers need to have a better understanding of the role of habitat selection by mottled ducks to improve population management. We measured use and habitat selection based on habitat availability within the Texas Chenier Plain Region at fine, intermediate, and landscape scales. Our specific objectives include: 1) quantifying habitat use based on year and biological period (pairing, breeding, brood rearing, molt); 2) determining habitat selection for the Texas Chenier Plain Region; 3) comparing site- specific habitat metrics among locations across biological time periods; and 4) evaluating the effect of scale on habitat selection.

Habitat use was measured by taking values for land cover and salinity from within the buffered areas (250 m) surrounding used points. Habitat use data were analyzed using an analysis of variance to assess differences among marsh type for year, time of day, and month. Habitat selection analyses were completed using a generalized linear mixed modeling approach in R. Habitats considered locally available were limited to a 95% kernel density estimate for each individual, and landscape scale availability was merged home ranges

for all individuals. Habitat use was closely tied to marsh type, with intermediate and brackish marsh being selected for the majority of locations (fresh marsh < 3%, intermediate marsh 29%, brackish marsh 46%, and 22% saline marsh. Mottled ducks also selected for grass dominated marshes with some use of emergent marsh. Freshwater habitats were available on the landscape; however, with drought conditions more freshwater wetlands were located farther inland than during normal or above average rainfall years. Habitat use was tied to salinity regime and water availability on the landscape with coastal marshes being selected for over adjacent ephemeral waters (e.g., stock tanks). Seasonal habitat selection varied based on average salinity and vegetative class within home ranges, with greatest sensitivity to salinity during breeding and brooding periods. Within season habitat use was extrapolated to identify potential high quality habitats based on local-scale selection patterns in the Texas Chenier Plain Region.

Habitat quality/quantity and disturbance were hypothesized to be important factors dictating mottled duck movements both spatially and temporally. Distance traveled, habitats used, and timing of movements by mottled ducks are widely unknown. Response to disturbance by mottled ducks inhabiting the upper Texas coast is also unknown. Because information on mottled duck movements is still widely unavailable, we documented weekly and seasonal movements of mottled ducks. In addition, we related variation in movement timing and distance with landscape habitat conditions (i.e., wetland availability), and disturbance. Specific study objectives were to 1) assess movement patterns among years, weeks, and biological time periods (fall, pairing, breeding, brood rearing, molt); 2) evaluate movements in relation to available habitat at the landscape level; 3) quantify movement patterns in association with high disturbance periods (e.g., periods of hunting); and 4) determine if changes in salinity regime or other habitat quality measure dictates movement patterns. To assess mottled duck movements, ArcGIS was employed to measure distances traveled weekly. Distances traveled were assessed using analysis of variance comparing among models containing independent variables of year, month, time of day, biological time period, season, and their respective interactions. Home range for each individual was also estimated and plotted using ArcGIS. Minimum convex polygons (95%) and kernel density estimators (50% and 90%) home ranges were also estimated. Analyses indicate that distances traveled by mottled ducks are short relative to other waterfowl <5,000 m on average. Movement occurrence, duration, and distance were linked to biological season, salinity regime, and habitat conditions on the landscape (i.e., available wetlands). Home ranges were small with an average size of 1516 ha and 6566 hectares for 50% and 95% KDE home ranges, respectively.

To project the potential implications of climate change to the WGC population of mottled ducks. Home ranges were then overlaid by the Sea Level Affecting Marshes Model (SLAMM; USFWS 2011*b*), which predicts availability of future habitat types based on predicted sea level rise. We compared composition of habitat types within home ranges of individual mottled ducks (i.e., 2005) to expected available habitat types in 2050 and 2100. Overall, proportion of habitat classes differed among years, and there are

substantive changes in available habitat projected. Under current SLAMM predictions mottled ducks are poised to lose over one half of their preferred habitat type, which will likely result in further population declines for this species by the 22nd Century.

The culmination of this research was development of a population demography model that spans the WGC Population of mottled ducks. An important concern in most ecological fields is determining factors singularly, concomitant, or synergistically operating as limiting factors constraining populations of interest (Peterson et al. 1998). The development of sophisticated system dynamics modeling software, has facilitated the use of this approach in ecological modeling (Faust et al. 2003*a*). Through the use of STELLA 10.0.0 a seasonal conceptual demographic model was constructed and parameterized with much of the data currently available on mottled ducks. The model was then evaluated based on available demographic rates (including data collected from this study). Following model validation, the relative importance/relatedness of various vital rates to the total population of WGC mottled ducks was assessed, and population persistence rates were calculated using IUCN criteria. Model simulations indicate that the probability of persistence to 100 years was 46%, with an average $\lambda = 0.383$. Eighty of the 140 simulations reached quasi-extinction rates of > 2500 individuals, and 77% of simulations met some IUCN criteria for the species to be listed as threatened, endangered or critically endangered. The model was sensitive to variation in all breeding parameters, which can be influenced by quality habitat management practices. As future population projections for the species are not improving and substantial habitat restoration efforts are needed to sustain and improve production for mottled ducks within the WGC Population. The model presented herein, assumes constant habitat conditions across time and does not incorporate future degradation of habitats. There are many additional exogenous factors that are not included in this model that should provide additional concern for the persistence of the WGC mottled duck population (e.g., sea-level rise, further declines in rice farming, declines in water available for habitat management

Products

Dissertation

Moon, J. 2014. Mottled Duck (*Anas fulvigula*) ecology in the Texas Chenier Plain Region. Ph.D Dissertation, Stephen F. Austin State University, Nacogdoches, TX.

Publications

Moon, J.A., D.A. Haukos, and W.C. Conway. 2015. Mottled duck (*Anas fulvigula*) movements in the Texas Chenier Plain Region. Journal of the Southeastern Association of Fish and Game Agencies 2:255-261.

Professional Presentations

Moon, J., D. Haukos, W. Conway, and P. Walther. 2011. Habitat use and movements of adult mottled ducks on the Texas Chenier Plain. Annual Meeting of The Texas Chapter of The Wildlife Society, San Antonio, Texas.

Moon, J., D. Haukos, W. Conway, and S. Lehnen. 2014. Habitat selection of adult female mottled ducks in the Texas Chenier Plain Region. Annual meeting of the Texas Chapter of The Wildlife Society, Austin, TX.

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.

Moon, J.A., D.A. Haukos, and W. Conway. 2012. Potential climate change impacts to mottled ducks on the Chenier Plain Region of Texas. Texas Chapter of The Wildlife Society, Fort Worth, Texas.

Moon, J.A., D.A. Haukos, and W.C. Conway. 2014. Habitat selection by mottled ducks on the upper Texas Gulf Coast. Mottled Duck Symposium, Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, Florida.

Moon, J.A., D.A. Haukos, and W.C. Conway. 2014. Movements by mottled ducks on the upper Texas Gulf Coast. Mottled Duck Symposium, Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, Florida.

Moon, J.A., D.A. Haukos, W. Conway, and P. Walther. 2013. Movements of mottled ducks in the Texas Chenier Plain Region. 6th North American Duck Symposium, Memphis, Tennessee.

Moon, J.A., D.A. Haukos, W. Conway, and P. Walther. 2013. Habitat selection of mottled ducks in the Texas Chenier Plain. 6th North American Duck Symposium, Memphis, Tennessee.

Nest-Site Selection, Duckling Survival, and Blood Parasite Prevalence of Lesser Scaup Nesting on Red Rocks Lake National Wildlife Refuge, Montana

Investigators
Andrew Stetter, M.S.

Project Supervisor
Dr. David Haukos

Funding
U.S. Fish and Wildlife Service
U.S. Geological Survey
Kansas State University

Cooperators
Red Rocks Lake NWR
Jeff Warren, USFWS

Objectives:
Determine factors that influence LESC duckling survival.

Investigate spatio-temporal factors affecting nest site patch selection and nest success for LESC.

Provide baseline information on LESC health and blood parasite prevalence, and relate this to body condition and breeding status in females.

Location:
Red Rocks Lakes NWR

Completion: August 2014

Status
Completed

Results

Lesser scaup (LESC) populations have been experiencing continent-wide decline since the 1980s. In order to identify factors that may be responsible for recent declines, it is important to have complete understanding of the critical factors influencing population growth/decline (e.g., duckling survival, nesting success, and fitness). We conducted a duckling capture-mark-recapture study using Cormack-Jolly-Seber models in Program MARK to compute apparent daily survival and recapture probabilities for a total of 3,256 individually marked ducklings with 620 recaptures during 2010 to 2013. The most parsimonious model based on *a priori* hypotheses found that JHATCH2 (Julian hatch date squared) was the most significant predictor of survival and was consistent through all four years. Weight at hatch also was significant as a quadratic effect. Survival was estimated out to time of fledge (i.e., 47 days). During this study, stabilizing selection played a significant role in duckling survival, which indicates that there is trade-off for selection of an optimal timing of hatch on survival and a cost associated with hatching to early or too late.

A large component of breeding success can be attributed to the type of habitat birds choose to nest in. There is a hierarchical process of behavioral and environmental processes that influence habitat selection, which inherently influences the survival and fitness of that individual. I investigated spatial attributes and all relationships between high and low-water levels with habitat attributes of nests using GLM models in SAS, *t*-tests in R, and Hot Spot Analysis in ArcGIS of 481 nests over eight years. In low-water years, successful nests were on average both 209 m farther from upland and 49 m closer to conspecific nests than unsuccessful nests. Clusters of Hot Spots for nest success overlapped with clusters of nests initiated later in low-water levels and the reverse was true for clusters of Cold Spots for nest failure nests initiated earlier. This relationship of spatial clustering based on the timing of nest initiation and nest success/failure was evident in both water levels. Density-dependence seems to be a factor affecting late-nesting

LESC females that are cuing in on the reproductive performance of conspecifics when determining where to nest.

Blood parasites, *per se*, do not lead to mortality, but instead reduces an individual's health, which may ultimately lead to lower fitness. Blood was drawn from 112 individual adult LESC captured and sampled from 2011-2012via spotlighting and drive-trapping. Parasite prevalence was determined (Table 4), a size-adjusted relative body condition (BCIndex) was calculated for each individual and compared with heterophile:lymphocyte ratio (a proxy for health, hereafter H:LRatio) and JDATE of capture). H:LRatio was also compared with JDATE of capture. Blood parasites were not an issue for LESC, and individuals in poor health were in poor condition, and BCIndex and H:LRatio decreased seasonally.

Products

Thesis

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. Kansas State University

Professional Presentations

Stetter, A., D. Haukos, and J. Warren. 2013. Parasitemia, health, and reproduction in lesser scaup at Red Rock Lakes National Wildlife Refuge. 6th North American Duck Symposium, Memphis, Tennessee.

Stetter, A., J. Warren, and D. Haukos. 2014. Duckling survival at the edge of scaup range in Montana. Midwest Fish and Wildlife Conference, Kansas City, MO.

Stetter, A., J. Warren, and D. Haukos. 2014. Nest-site selection by scaup at Red Rock Lakes National Wildlife Refuge. Midwest Fish and Wildlife Conference, Kansas City, MO.

Stetter, A., J. Warren, and D. Haukos. 2013. Duckling survival at the edge of scaup range in Montana. Annual Meeting of The Wildlife Society, Milwaukee, Wisconsin.

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

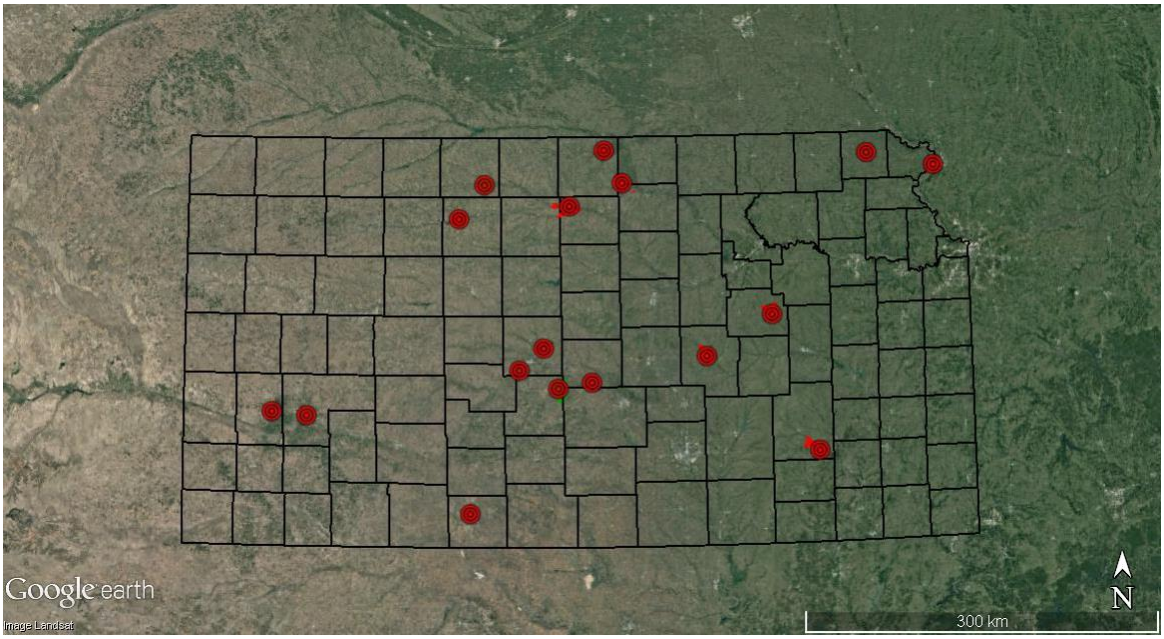
Results
There is a wide variety of diseases that affect wild migratory birds. Occurrence, causes, and impacts of disease outbreaks in wild bird populations are rarely studied beyond documentation of large epizootic events. Interfaces among wildlife, livestock, and humans are rapidly developing closer 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
Thesis
Becker, T. 2016. Retrospective review of avian diseases in Kansas. Thesis, Kansas State University, Manhattan.

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

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.



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

Estimating Inundation Frequency of Playa Wetlands and Saline Lakes Using Landsat Data: Did Irrigation Practices Artificially Increase Frequency and Longevity of Landscape Wetness?

Investigators
Brandon Weihs, Ph.D. Student, Geography

Project Supervisor
Dr. David Haukos

Funding
U.S. Fish and Wildlife Service

Cooperators
Bill Johnson, USFWS
Dr. Steve Sensie, USFWS
Dr. Grant Harris, USFWS

Objectives
Development of an accurate spatial remote sensing model to document hydrological condition of playas in the Texas High Plains.

Assess accuracy of results from Landsat analyses.

Construct trends of hydrological conditions of playas and saline lakes since the 1970s.

Test competing models containing available landscape level data to determine if differences between the 1970s and 2000s are due to changes climatic conditions, watershed conditions, or perhaps due to other factors (e.g., irrigation).

Location:
Southern High Plains, Texas and New Mexico

Completion: December 2014

Status
Completed

Progress and Results
A primary objective of the North American Waterfowl Management Plan is to maintain (and restore) continental waterfowl populations at 1970s numbers. Playas are the dominant wetland feature in the Southern High Plains (SHP)(see Figure 1). A small number of saline lakes (discharge playa) also exist in the SHP, which are important to wildlife as well. Historical U.S. Department of Agriculture soil survey maps suggest there are more than 20,500 playas in this region. Although playas average only 6.3 ha in size and account for only 2% of the SHP landscape, they provide ecological functions critical to the persistence of nearly all flora and fauna in the region. Timing and duration of playa hydroperiods drive both plant and invertebrate production. Playas are vital migratory stop-over and wintering sites for migratory birds. Although current playa conditions, in terms of availability during midwinter due to natural flooding events, are increasingly understood, little is known about playa conditions during the 1970s through 1990s. Historically, playas were actually incorporated into many furrow irrigation systems, either as catchment basins or as tailwater recovery basins. Thus, the landscape during the 1970s may have been artificially wet due to irrigation. If average annual habitat availability, in terms of the percent of inundated playas, was enhanced due to irrigation runoff, then using waterfowl numbers during this decade may result in habitat objectives that are simply not reasonable under natural and current conditions. This project has aimed to understand and explain the spatio-temporal inundation patterns of playa wetlands (n=18922) and saline lakes (n=42) for the SHP using remote sensing and GIS techniques. In general, Landsat scenes from all sensors (1,2,3,4,5,7) were acquired for the study area, from 1972 to 2011 during January, March, April, June, July, and October (n=1923). These scenes (430 fully processed to date) were classified (supervised) based on the presence of water, then modeled in a GIS. Model outputs are then stored and added to the master dataset, to be used for the final statistics involving climate data, and landuse data acquired and processed as buffers around playas. Figure 2 is a small sample of model outputs from the larger

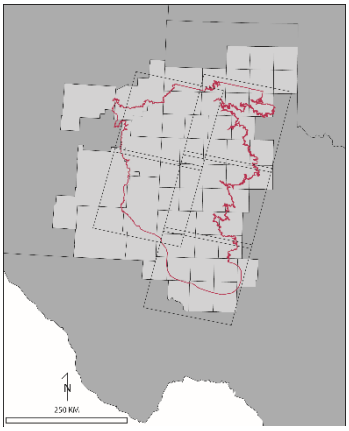


Figure 1. Study area showing SHP extent (red line), counties (light grey), and Landsat path/rows used (black line, no-fill polygons).

dataset which shows the frequencies of inundation for the months of January, June, and October for Landsat sensors path/row 30-36. The regression lines for these three months have negative slopes showing a decline in the percent of inundated playas from the 1970's to 2011. Of the other sampled path/rows for these months, only three (n=15) had positive slopes, and these were fairly flat (Jan 31-36, Jan & June 31-37). These path/rows are located to the west where less precipitation and cultivation occur. Though this study is not complete, it does provide results that suggest that playa inundation rates across space and time in the SHP are declining. Whether these declines are related to climate, landuse, or both is yet to come from our final analyses. These results should provide reasonable estimates of the annual availability and duration of inundated playas for this period and better inform regional waterfowl population goals.

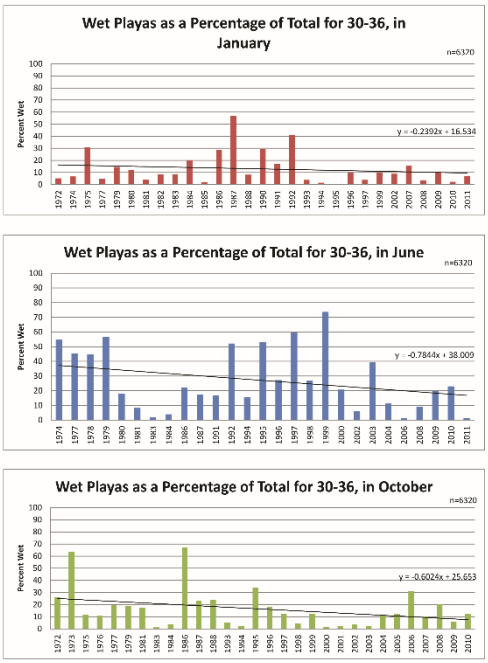


Figure 2. Wet Playas as a Percentage of Total Playas in January, June, and October for Path/Row

Products

Report

Weihs, B.J. 2014. Spatio-temporal inundation patterns of playa wetlands and saline lakes in the Southern High Plains, USA. Final Report, USFWS, Region 2, I&M Program, NWR System, Albuquerque, NM.

Verifying Ground-based Habitat Quality Monitoring and Micro-Habitat Selection by Lesser Prairie-Chickens (*Tympanuchus pallidicinctus*) with Remote Sensing Technology

Investigators
Stephane Manes
Matt Bain
Kevin Price

Project Supervisor
Dr. David Haukos

Funding
Playa Lakes Joint Venture
U.S. Geological Survey
The Nature Conservancy
CommonGround Capital

Cooperators
AgPixel

Objectives
Test the feasibility of modeling vegetation characteristics associated with Lesser Prairie Chicken nesting habitat using image data captured by airborne sensors at multiple resolutions.

Compare the efficacy of image data collected via UAS platforms to image data collected by manned aircraft.

Location:
Throughout Kansas

Completion: July 2016

Status Complete

Results
Vegetation characteristics associated with Lesser Prairie-Chicken nesting habitat, such as plant height, can be successfully modeled using image data captured by airborne sensors at multiple resolutions. This study shows that field data points with similar vegetation parameter measurements can be successfully clustered (i.e., classified) using NDVI spatial variability extracted from image data. For Gardiner Ranch, statistically significant differences were found among the clusters for ten of 13 field parameters, with seven at $p \leq 0.05$, and three at $p \leq 0.1$. For the Hoeme Ranch, statistically significant differences at $p \leq 0.05$, were found among the clusters for nine of 12 field parameters for which data were available. Although the results for Hashknife Ranch were not on par with Gardiner and Hoeme, statistically significant differences at $p \leq 0.5$ were found for two of 13 parameters and at $p \leq 0.10$ for four of 13 parameters. It is worth noting that for all three ranches, Robel Pole 100% data, Highest cm, and Point Center PC Vegetation Height, were statistically significant at $p \leq 0.10$, with most tests resulting in statistical significance at $p \leq 0.5$. This indicates that the methodology developed successfully classifies field data points with regard to vegetation height parameters. For all study areas for which 2015 nest data were available, nest sites were found to be significantly different statistically from random points, in each case at $p \leq 0.001$. Additionally, for nest sites, the amount of spatial variability, as measured by NDVI variance, generally fell within a relatively narrow range of values. NDVI variance patterns for nest sites suggest that the birds prefer somewhat, but not completely homogeneous, vegetation conditions at nest sites.
Ultra-fine resolution image data collected via manned aircraft platforms appears to be optimal for modeling LPC nesting habitat. The methodology developed was successful using imagery with 5.0 to 10.0 cm pixel resolution. The results suggest that currently, for the purposes outlined here, there is little to be gained by collecting UAS data at resolutions finer than 5.0 cm. Although the efficacy of 3 D modeling of vegetation characteristics within the study areas was hampered by the vegetation characteristics and limits of the technology, as technological advances are made, continued research will likely yield better results.
The logical next step in this research will be to adapt and refine the methodology developed here to map larger study areas with regard to vegetation characteristics associated with preferred Lesser Prairie- Chicken habitat. To accomplish this, a formal aerial and field data collection protocol can be developed jointly by the research partners. Adequate lead time and good planning will save resources and will insure that adequate data resolution and optimal

field parameter measurements are collected concurrently and in a manner that optimizes the accuracy and success of the research undertaken.

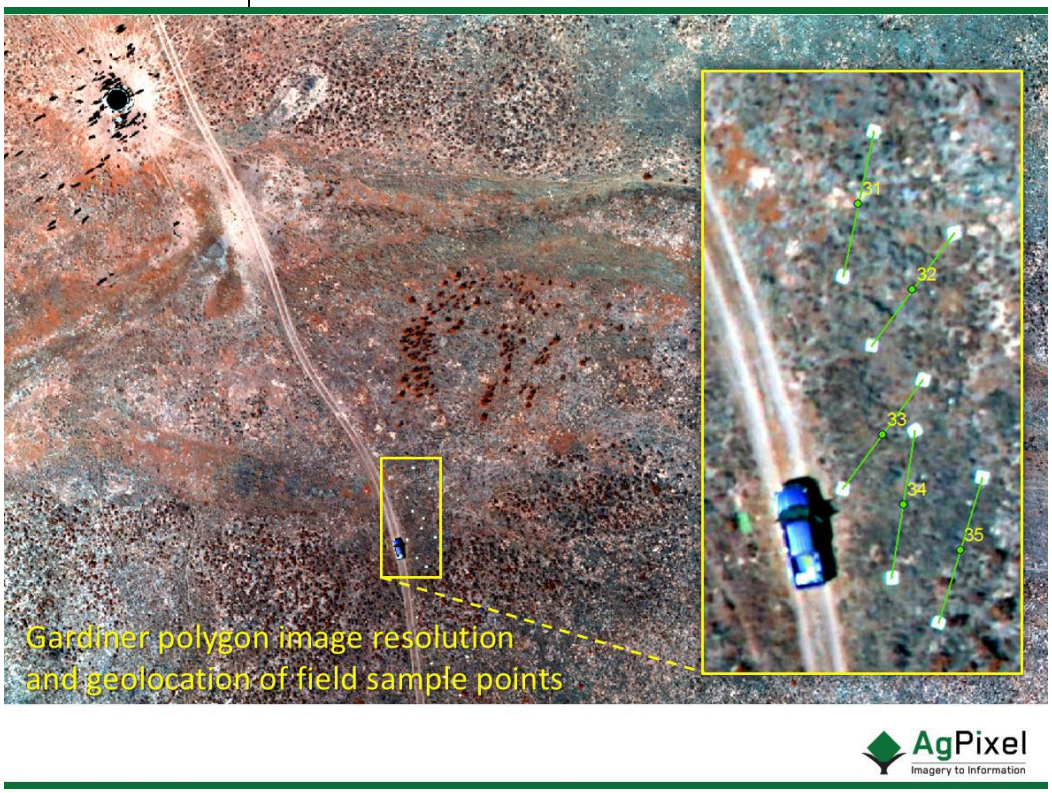
Additionally, analyzing nest data and field parameters, not just by discrete study areas (i.e., by ranch), but also as a consolidated dataset may yield additional useful information. Locating additional confirmed nest sites would be helpful in building confidence in the ability to map preferred nesting habitat. It might also be informative to analyze nest data to determine if survival is greater at sites exhibiting consistent NDVI variance patterns.

In summary, analyses of ultra-high spatial resolution image data, based on the methodology described in this report, can greatly assist in meeting the challenges associated with preservation of Lesser Prairie-Chicken habitat.

Products

Report

Price, K.P., L. Brien, D. Burchfield, and J. Bryant. 2015. Lesser prairie-chicken habitat mapping project: final report. Submitted to the Playa Lakes Joint Venture, Lafayette, Colorado



List of Scientific, Peer Reviewed Publications: 2014-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. 2017. 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.

Hitchman, S.M. 2014. Freshwater Drum In M.E. Eberle and D. Edds (Eds.), Kansas Fishes (pp. 557-559). University Press of Kansas. Lawrence, KS.

Fencl, J.S. 2014. Rock Bass. Pp. 358-359 in Eberle, M.E. and D. Edds (editors), Kansas Fishes. University Press of Kansas, Lawrence.

Fencl, J.S. 2014. Slender Madtom. Pp. 287-288 in Eberle, M.E. and D. Edds (editors), Kansas Fishes. University Press of Kansas, Lawrence.

Peer Reviewed Journal Articles

Albanese, G., and C. A. Davis. 2015. Characteristics within and around stopover wetlands used by migratory shorebirds: Is the neighborhood important? Condor: Ornithological Applications 117:328-340.

Albanese, G., and D.A. Haukos. 2016. A network model framework for prioritizing wetland conservation in the Great Plains. Landscape Ecology In Press

Andersson, K., C.A. Davis, G. Harris, and D. Haukos. 2015. An assessment of nonbreeding waterfowl surveys on National Wildlife Refuges in the Central Flyway. Wildlife Society Bulletin 39:79-86.

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

Clark, R., K. Guynn, D. Haukos, J. Fleskes, J. Austin, and M. Miller. 2014. Northern Pintail (Anas acuta), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology

Daniel, D.W., L.M. Smith, D.A. Haukos, L.A. Johnson, and S.T. McMurry. 2014. Land use and Conservation Reserve Program effects on the persistence of playa wetlands in the High Plains. Environmental Science and Technology 48:4282-4288.

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 In Press

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

Fritts, S.R., B.A. Grisham, R.D. Cox, C.W. Boal, C.A. Hagen, D.A. Haukos, P. McDaniel, and A.N. Erickson. 2016. Influence of vegetation structure and composition on lesser prairie-chicken demographics following an intense drought. Rangeland Ecology and Management In Press

Grisham, B.A., A.J. Godar, C.W. Boal, and D.A. Haukos. 2016. An assessment of lesser prairie-chicken nest microclimate and nest survival among three ecoregions. Condor In Press

Grisham, B.A., C.W. Boal, N.R. Mitchell, T.S. Gicklhorn, P.K. Borsdorf, D.A. Haukos, and C. Dixon. 2015. Evaluation of capture techniques on lesser prairie-chicken trap injury and survival. Journal of Fish and Wildlife Management 6:318-326.

Hagy, H.M., S.C. Yaich, D.A. Haukos, W.C. Johnson, C.R. Loesch, F. Reid, J. Simpson, S. Stephens, R.W. Tiner, B. Werner, and G. Yarris. 2014. Wetland issues affecting waterfowl conservation in North America. Wildfowl Special Issue 4:343-367

Haukos, D.A. 2015. Estimates of annual survival of mottled ducks from band-recovery data in the Western Gulf Coast population. Journal of the Southeastern Association of Fish and Game Agencies 2:214-220.

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 In Press

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

Kearns, B., P. Walther, W. Conway, and D. Haukos. 2015. Factors affecting fat content in mottled ducks on upper Texas Gulf Coast. Journal of the Southeastern Association of Fish and Game Agencies 2:274-280.

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. 10.1002/ecs2.1226.

Lautenbach, J.M., R.T. Plumb, S.G. Robinson, D.A. Haukos, J.C. Pitman, and C.A. Hagen. 2016. Lesser prairie-chicken avoidance of trees in a grassland landscape. Rangeland Ecology and Management (Special Issue) In Press

Mapes, R.L., M.R. DuFour, J.J. Pritt, C.M. Mayer. 2015. Larval fish assemblage recovery: A reflection of environmental change in a large degraded river. Restoration Ecology 23:85-93.

McDowell, P.K., W.C. Conway, D.A. Haukos, J.A. Moon, C.E. Comer, and I.K. Hung. 2015. Blood lead exposure concentrations in mottled ducks (Anas fulvigula) on the upper Texas coast. Journal of the Southeastern Association of Fish and Game Agencies 2:221-228.

Moon, J.A., D.A. Haukos, and W.C. Conway. 2015. Mottled duck (Anas fulvigula) movements in the Texas Chenier Plain Region. Journal of the Southeastern Association of Fish and Game Agencies 2:255-261.

Riecke, T.V., W. C. Conway, C.E. Comer, D.A. Haukos, and J.A. Moon. 2014. Red imported fire ants *Solenopsis invicta* cause black-necked stilt *Himantopus mexicanus* nest abandonment. Wader Study Group Bulletin 121:52-53

Riecke, T.V., W.C. Conway, D.A. Haukos, J.A. Moon, and C.E. Comer. 2015. Baseline blood Pb levels of black-necked stilts on the upper Texas coast. Bulletin of Environmental Contamination 95:465-469.

Rigby, E., and D.A. Haukos. 2014. A matrix model for mottled ducks (*Anas fulvigula*) on the western Gulf Coast of Texas. Southeastern Naturalist 13(Special Issue 5):26-40.

Rigby, E.A., and D.A. Haukos. 2015. Duckling survival, fecundity, and habitat selection of mottled duck broods on the upper Texas Gulf Coast. Journal of the Southeastern Association of Fish and Game Agencies 2:156-163.

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 In Press

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 In Press

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.

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.

Ross, B.E., M. Hooten, J.M. DeVink, and D.N. Koons. 2015. Combined effects of climate, predations, and density dependence on greater and lesser scaup population dynamics. Ecological Applications 25:1606-1617.

Smith, J. M., S. P. Wells, M. E. Mather, and R. M. Muth. 2014. Fish biodiversity sampling in stream ecosystems: a process for evaluating the appropriate types and amount of gear. Aquatic Conservation: Marine and Freshwater Ecosystems 34:338-350.

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.

Trentman M.T., Dodds W.K., Fencl J.S., Gerber K.M., Guarneri J., Hitchman S.M., Peterson Z., Ruegg J. 2015. Quantifying ambient nutrient uptake and functional relationships in streams: a comparison of stable isotope, pulse, and plateau approaches. Biogeochemistry 125:65-79

Waldman, J., K. Wilson, M. E. Mather, N. P. Snyder. 2016. Can resilience theory help guide restoration of anadromous fishes? Fisheries 41:3, 116-126.

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.

Technical Publications

Albanese, G. 2015. Development of conservation and climate adaptation strategies for wetlands in the Great Plains LCC region, Final Report. GP LCC, USFWS. 135pp.

Boal, C.W., Grisham, B.G., Haukos, D.A., Zavaleta, J.C., and Dixon, Charles, 2014, Lesser prairie-chicken nest site selection, microclimate, and nest survival in association with vegetation response to a grassland restoration program: U.S. Geological Survey Open-File Report 2013–1235, 35 p.

Theses and Dissertations

Hannah Ashbaugh (M.S. 2016; 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; 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

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

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 batfish, *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 (GIS Specialist, Ducks Unlimited, Inc.)

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. (Biologist, U.S. Forest Service)

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

Jena Moon (Ph.D. 2014; advisor Conway/Haukos) –Mottled Duck (*Anas fulvigula*) ecology in the Texas Chenier Plain Region. Stephen F. Austin State University (I&M Biologist, R2, USFWS)

Stephen McDowell (M.S. 2014; Conway/Haukos) – Environmental availability and lead exposure to mottled ducks (*Anas fulvigula*) in the Texas Chenier Plains region. Stephen F. Austin State University (Kansas Wildlife, Parks, and Tourism)

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

Andrew Stetter (M.S. 2014; advisor Haukos). Nest site selection, duckling survival, and blood parasite prevalence of Lesser Scaup nesting on Red Rock Lakes National Wildlife Refuge. Kansas State University (Wildlife Biologist, Crab Orchard NWR)

Thomas Riecke (M.S. 2013; advisor Conway/Haukos) – Lead exposure and nesting ecology of black-necked stilts (*Himantopus mexicanus*) on the Upper Texas Coast. Stephen F. Austin State University (Ph.D Student University of Nevada – Reno).

Research Experience for Undergraduates (REU)

- **2011 – Judith Patterson (Mather)**

  Can a mobile consumer affect ecosystem function in streams at the Konza Prairie: exploring crayfish movements using PIT tags and mobile and stationary antennas.

- **2012 – Nervalis Medina-Echevarria (Albanese, Haukos)**

  Adult Regal Fritillary (*Speyeria idalia*) density among fire and grazing regimes at Konza Prairie with notes on the occurrence patterns of its host plant, Prairie Violet (*Viola pedatifida*).

- **2013 – Casie Lee (Martha Mather, Zach Peterson, Kayla Gerber)**

  Developing and testing a standard protocol for field estimates of short term growth in fish predators.

- **2014 – Robert Harris III (McCullough, Albanese, Haukos)**

  Sex ratios of Regal Fritillary and Monarch butterflies as influences by vegetation and management regime.

- **2015 – Lindsey Arick (Martha Mather, Ryland Taylor)**

  Survivorship and Detection Patterns of Acoustic Tagged Striped Bass

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

  Spatial Variation in Diets of Striped Bass

List of Presentations 2014-present

Albanese, G., and D. Haukos. 2015. A framework for understanding connections within dense broad-scale habitat networks: prioritizing wetlands for conservation within a dynamic landscape. Annual meeting of the Society of Wetland Scientists, Providence, RI. (Invited speaker)

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.

Ashbaugh, H.M., W.C. Conway, D.P. Collins, D.A. Haukos, and D. Klein. 2015. Snowy plover exposure to metals in sediment and water from saline lakes of the Southern Great Plains. Annual meeting of the Texas Chapter of The Wildlife Society, Corpus Christi, TX.

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

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.

Catchcart, C.N., J. Brant, R. Mathews, G. Zurschmeide, M Troia, C. Ruffing and S.M. Hitchman. 2014. Long term fish community diversity and abundance in a Kansas River oxbow lake. Midwest Fish and Wildlife Conference. Kansas City, MO.

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. 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.

Duffie, L.E., W.C. Conway, C.E. Comer, D.A. Haukos, D.P. Collins, S.T. Saalfeld, and H.M. Ashbaugh. 2015. The potential roles of primary molt and parasite loads in declining snowy plovers in the Southern Great Plains. Annual Meeting of the New Mexico Ornithological Society, Roswell, NM.

Duffie, L.E., W.C. Conway, C.E. Comer, H.M. Ashbaugh, D.A. Haukos, and D.P. Collins. 2015. Primary feather molt in incubating snowy plovers in the Southern High Plains. Annual meeting of the Texas Chapter of The Wildlife Society, Corpus Christi, TX.

Fencl, J.S., Mather M.E., Smith J.M., and S.M. Hitchman. 2015. Quantifying river fragmentation: impacts of low-head dams on geomorphology and fish biodiversity in the Neosho River, Kansas. 75th Midwest Fish and Wildlife Conference; Indianapolis, Indiana.

Fencl, J.S., K.H. Costigan, M.E. Mather and S.M. Hitchman. 2014. How long is a dam footprint?: Applying methodology that quantifies the geomorphic extent of low-head dams in the Neosho River Basin, KS, 7th Kansas Natural Resources Conference, Wichita, KS (poster)

Fencl, J.S., M.E. Mather, S.M. Hitchman and J.M. Smith. 2014. Quantifying impacts of river fragmentation: How low-head dams alter geomorphology, fish biodiversity, and habitat in the Neosho River, Kansas, American Fisheries Society Meeting, Quebec, Canada

Fritts, S.F., B.A. Grisham, C.W. Boal, D.A. Haukos, M.A. Patten, C.E. Dixon, and W.R. Heck. 2015. Lesser prairie-chicken nest site selection and nest survival at two spatial scales in a cattle-dominated landscape. Annual Meeting of The Wildlife Society, Winnipeg, Manitoba.

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.

Fritts, S.R., B.A. Grisham, R.D. Cox, C.W. Boal, D.A. Haukos, and P. McDaniel. 2015. Hierarchical modeling of lesser prairie-chicken lek attendance, survival, and recruitment, in response to grazing and weather. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Gerber, K.M. and M.E. Mather. 2015. A high retention methodology for surgically implanting telemetry tags in catfish. Kansas Natural Resource Conference, Wichita, KS.

Gerber, K.M., M.E. Mather, J.M. Smith, and Z. Peterson. 2014. Patterns of variability in the distribution and movement of individual fish predators in a heterogeneous aquatic ecosystem. 144th Annual AFS Conference, Quebec City, Quebec, Canada.

Gerber, K.M., M.E. Mather, J.M. Smith, and Z. Peterson. 2015. Distribution patterns of individual fish predators (Blue Catfish) in a Midwestern reservoir. 75th Midwest Fish and Wildlife Conference, Indianapolis, IN.

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.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., B.A. Grisham, C.W. Boal, and D.A. Haukos. 2015. Does microclimate explain regional variation in lesser prairie-chicken nest survival? Annual meeting of the Texas Chapter of The Wildlife Society, Corpus Christi, TX.

Godar, A.J., B.A. Grisham, C.W. Boal, and D.A. Haukos. 2015. Does microclimate explain regional variation in lesser prairie-chicken nest survival? Kansas Natural Resource Conference, Wichita.

Godar, A.J., C.P. Griffin, S.R. Fritts, B.A. Grisham, C.W. Boal, D.A. Haukos, J.C. Pitman, and C.A. Hagen. 2015. The influence of weather parameters on lesser prairie-chicken nest survival. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Griffin, C.P., A.J. Godar, B.A. Grisham, C.W. Boal, and D.A. Haukos. 2015. Does weather influence lesser prairie-chicken demographic parameters disproportionately in the sand shinnery oak prairie compared to the sand sagebrush prairie? Joint Annual Meeting of the AZ/NM American NM Wildlife Societies, Las Cruces, NM.

Griffin, C.P., A.J. Godar, B.A. Grisham, C.W. Boal, D.A. Haukos, J.C. Pitman, and C.A. Hagen. 2015. A range-wide assessment of the influence of weather on lesser prairie-chicken demographic parameters. Annual meeting of the Texas Chapter of The Wildlife Society, Corpus Christi, TX.

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, B.A. Grisham, C.W. Boal, D.A. Haukos, and J.C. Pitman. 2015. A range-wide assessment of the influence of anthropogenic features on lesser prairie-chicken lek attendance. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

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.

Grisham, B., J. Lautenbach, R. Plumb, J. Kraft, J. Reitz, D. Sullins, C. Conring, A. Godar, C. Griffin, C. Boal, and D. Haukos. 2014. Does microclimate explain spatial variation in lesser prairie-chicken nest survival. Annual meeting of the Texas Chapter of The Wildlife Society, Austin, TX.

Grisham, B.A., A.J. Godar, C.W. Boal, and D.A. Haukos. 2015. An assessment of lesser prairie-chicken nest microclimate and nest survival among three ecoregions. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Haukos, D. Annual survival, recovery rates, and movements of mottled ducks banded on the western Gulf Coast. 2014. Mottled Duck Symposium, Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, Florida.

Haukos, D. Summary of science behind impacts of wind power development on lesser prairie-chickens. 2014. Lesser Prairie-Chicken and Wind Energy: Pathways to Conservation & Compliance, American Wind Wildlife Institute, Broomfield, Colorado (Invited)

Haukos, D., C. Boal, S. Carleton, and B. Grisham. 2015. Roles of Cooperative Research Units in contemporary conservation of natural resources. North American Wildlife & Natural Resources Conference, Omaha, NE. (Invited)

Haukos, D.A. 2015. History and function of the Cooperative Research Unit system. National Military Fish and Wildlife Association, North American Wildlife & Natural Resources Conference, Omaha, NE (Invited)

Haukos, D.A. 2015. History and function of the Cooperative Research Unit system. National Military Fish and Wildlife Association, North American Wildlife & Natural Resources Conference, Omaha, NE

Haukos, D.A. 2015. Use of network analysis to identify wetlands critical to the playa system: prioritizing wetlands for conservation within a dynamic wetland landscape. Natural Resources and Environmental Sciences, Seminar Series, Kansas State University, Manhattan, KS (Invited)

Haukos, D.A. and G. Albanese. 2014. Conservation of Playa Wetlands at the Appropriate Scale - Using Networks to Identify Critical Playas. Department of Natural Resources Management Seminar, Texas Tech University (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)

Hitchman, S.M., M.E. Mather, J.M. Smith and J.S. Fencl. 2014. Do FRAGSTATS sink or swim? Calculating metrics of heterogeneity for aquatic macrohabitat within the Neosho River, KS. Kansas Natural Resource Conference. Wichita, KS.

Hitchman, S.M., M.E. Mather, J.M. Smith and J.S. Fencl. 2014. Does heterogeneity in habitat type, size, and arrangement influence patterns of fish biodiversity in the Neosho River, Kansas? American Fisheries Society. Quebec City, Quebec, Canada.

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, Oregon.

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.

Kearns, B., P. Walther, and D. Haukos. 2014. Developing a body condition index for mottled ducks on the upper Texas Gulf Coast. Annual meeting of the Texas Chapter of The Wildlife Society, Austin, TX.

Kearns, B., P. Walther. W. Conway, and D. Haukos. 2014. A body condition index for non-breeding mottled ducks on the upper Texas Gulf Coast. Mottled Duck Symposium, Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, Florida.

Kearns, B., S. McDowell, J. Moon, W. Conway, and D. Haukos. 2014. The legacy of lead: developing new methods for assessing lead contamination and wildlife exposure risks in Gulf Coast wetland habitats. Annual meeting of the Texas Chapter of The Wildlife Society, Austin, TX.

Kearns, B., S. McDowell, J. Moon, E. Rigby, and D. Haukos. 2014. Identifying landscape-level indicators of environmental contaminants that affect wildlife: a species distribution approach. Midwest Fish and Wildlife Conference, Kansas City, MO.

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, 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. 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., 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., 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.

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.

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., 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, 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. 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., R. Plumb, D. Haukos, and J. Pitman. 2014. Differences in successful and unsuccessful nests of lesser prairie-chickens in Kansas and Colorado. Kansas Natural Resource Conference, Wichita, Kansas.

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2014. Impacts of tree encroachment on lesser prairie-chickens. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2014. Nest site location by lesser prairie-chickens in Kansas and Colorado. Midwest Fish and Wildlife Conference, Kansas City, MO.

Lautenbach, J., R. Plumb, D. Haukos, and J. Pitman. 2014. Survival and habitat selection of lesser prairie-chicken chicks and broods. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado.

Lautenbach, J., R. Plumb, D. Haukos, J. Pitman, and C. Hagen. 2015. Effects of tree encroachment on lesser prairie-chickens. Annual Meeting of The Wildlife Society, Winnipeg, Manitoba.

Lehrter, R., M. E. Mather, M. Daniels. 2015. Fish biodiversity as a component of ecosystem function and indicator of environmental degradation in a Great Plains river. Governor's Water Conference, Poster.

Lipp, T., A. Gregory, and D. Haukos. 2015. Influence of sound on nest placement and success of the lesser prairie-chicken. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

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., 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. 2015. The influence of watershed condition on avian use and diversity of playa wetlands in western Kansas. Annual Meeting of the Kansas Ornithological Society, Emporia, KS

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., 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.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.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.

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

Mapes, R.L. and M.E. Mather. 2015. Habitat and resource use of age-0 largemouth bass in a Great Plains reservoir. Lake Erie Center Brown Bag Seminar. University of Toledo – Lake Erie Center.

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

Mapes. R. L., 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. Midwest Fish and Wildlife Meeting, Indianapolis, IN.

Mather, M., , R. Taylor, C. Kennedy, J. Smith, L. Deegan, J. Finn, K. 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.

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

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 attributes. 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.

McDowell, S., W. Conway, C. Comer, D. Haukos, and J. Moon. 2014. Lead exposure concentrations in the blood of mottled ducks (*Anas fulvigula*) on the Texas Chenier Plains National Wildlife Refuge Complex. Mottled Duck Symposium, Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, Florida.

Mitchell, N., P. Borsdorf, C. Dixon, B. Grisham, D. Haukos, and C. Boal. 2014. Evaluation of capture techniques on lesser prairie-chicken trap injury. Annual meeting of the Texas Chapter of The Wildlife Society, Austin, TX.

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.

Moon, J.A., D.A. Haukos, and W.C. Conway. 2014. Habitat selection by mottled ducks on the upper Texas Gulf Coast. Mottled Duck Symposium, Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, Florida.

Moon, J.A., D.A. Haukos, and W.C. Conway. 2014. Movements by mottled ducks on the upper Texas Gulf Coast. Mottled Duck Symposium, Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Destin, Florida.

Nichter, A., T. Lipp, D. Haukos, and A. Gregory. 2015. Effects of anthropogenic noise on male lesser prairie-chicken lek attendance. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

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. 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, 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. 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. 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.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

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.

Plum, R., Lautenbach, J., R. Plumb, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Nest site location by lesser prairie-chickens in Kansas and Colorado. Midwest Fish and Wildlife Conference, Kansas City, MO.

Plum, R., Lautenbach, J., R. Plumb, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Effects of habitat patch selection on breeding season survivorship of lesser prairie-chickens in Kansas and Colorado. Midwest Fish and Wildlife Conference, Kansas City, MO.

Plumb, R.R., J.M. Lautenbach, S.G. Robinson, J.D. Kraft, D. Sullins, D.A. Haukos, J.C. Pitman, C.A. Hagen, and D. Dahlgren. 2015. Lesser prairie-chicken space use response to anthropogenic structures among landscapes. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Plumb, R.R., J.M. Lautenbach, S.G. Robinson, J.D. Kraft, D. Sullins, D.A. Haukos, J.C. Pitman, C.A. Hagen, and D. Dahlgren. 2015. Lesser prairie-chicken space use response to anthropogenic structures. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, and D. Dahlgren. 2014. Breeding season habitat patch use by female lesser prairie-chickens in Kansas and Colorado. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado.

Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, and D. Dahlgren. 2014. Effects of habitat patch use on breeding season survivorship of lesser prairie-chickens in Kansas and Colorado. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado.

Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Breeding season space use dynamics of female lesser prairie-chickens in Kansas and Colorado. Symposium on Animal Movement and the Environment, Raleigh, North Carolina.

Plumb, R.T., J. Lautenbach, B. Ross, D. Spencer, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Past, Present, and Future: using historical and information to guide conservation decisions for an iconic prairie grouse of the southwestern Great Plains. Regional Pheasants Forever and Quail Unlimited Conference, Wichita, Kansas.

Plumb, R.T., J. Lautenbach, D. Haukos, J. Pitman, J. Augustine, K. Oxenrider, and D. Dahlgren. 2014. Breeding season home-range characteristics of female lesser prairie-chickens in Kansas and Colorado. Kansas Natural Resource Conference, Wichita, Kansas.

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)

Riecke, T.V., J.A. Moon, D.A. Haukos, J.S. Sedinger, W.C. Conway, and P.S. Walther. 2015. An integrated population model for mottled ducks in Texas: harvest, habitat, and survival. Annual meeting of the Western Section of the Wildlife Society, Santa Rosa, CA.

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.

Robinson, S., R. Plumb, D. Haukos, S. Carleton, A. Meyers, and J. Reitz. 2015. There is no space like home:space use of nonbreeding lesser prairie-chickens. Annual meeting of the Central Mountains and Plains Section of The Wildlife Society, Manhattan, Kansas.

Robinson, S., R. Plumb, J. Lautenbach, D. Haukos, and J. Pitman. 2014. Nonbreeding season movement and habitat use of lesser prairie-chickens in Kansas. Joint meeting of American Ornithologists' Union, Cooper Ornithological Society, and Society of Canadian Ornithologists, Estes Park, Colorado.

Robinson, S., R.T. Plumb, J.M. Lautenbach, D.S. Sullins, J.D. Kraft, and D.A. Haukos. 2015. Attributing landscape characteristics to lesser prairie-chicken survival in Kansas and Colorado. Biennial meeting of the Prairie Grouse Technical Council, Nevada, Missouri.

Robinson, S., R.T. Plumb, J.M. Lautenbach, D.S. Sullins, J.D. Kraft, D.A. Haukos, C.A. Hagen, and J.C. Pitman. 2015. Functional relationships among lesser prairie-chicken survival, habitat type, and landscape fragmentation. International Grouse Symposium, Reykjavik, Iceland.

Robinson, S.G., and D.A. Haukos. 2015. The influence of habitat composition and configuration on lesser prairie-chicken survival rates in Kansas. Annual Meeting of the Kansas Ornithological Society, Emporia, KS

Robinson, S.G., D.A. Haukos, and J.C. Pitman. 2015. Nonbreeding season movement and space use of lesser prairie-chickens in Kansas. Kansas Natural Resource Conference, Wichita.

Robinson, S.G., R.T. Plumb, J.M. Lautenbach, D.A. Haukos, S. Carleton, A. Meyers, and J. Reitz. 2015. Space use by nonbreeding lesser prairie-chickens. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

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, Pittsburgh, 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. Quantifying drivers of wildlife population dynamics. July 2015. Early Career Researcher Symposium. American Ornithologists' Union. Norman, Oklahoma.

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.

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 Hitchman, S.M. 2016. Operationalizing riverscapes. American Fisheries Society. Kansas City, MO.

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.

Spencer, D., M. Daniels, and D. Haukos. 2014. A historical record of land cover change of the lesser prairie-chicken range in Kansas. Midwest Fish and Wildlife Conference, Kansas City, MO.

Stetter, A., J. Warren, and D. Haukos. 2014. Duckling survival at the edge of scaup range in Montana. Midwest Fish and Wildlife Conference, Kansas City, MO.

Stetter, A., J. Warren, and D. Haukos. 2014. Nest-site selection by scaup at Red Rock Lakes National Wildlife Refuge. Midwest Fish and Wildlife Conference, Kansas City, MO.

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., 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. 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., 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., W.C. Conway, D.A. Haukos, K.A. Hobson, L.I. Wassenaar, and C.E. Comer. 2015. American woodcock migratory connectivity as indicated by hydrogen isotopes. Joint meeting of American Ornithologists' Union and Cooper Ornithological Society, Norman, OK.

Taylor, R., M. Mather, C. Kennedy, J. Smith, and K. Gerber. 2015. Confluence network dynamics can create a spatial mosaic of predator interactions. Annual Meeting of the Ecological Society of America, Baltimore, 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. 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
2014-present

Gene Albanese

- Landscape spatial pattern analysis for categorical map data. Invited workshop instructor. The Wildlife Society, Central Plains and Mountains Section Annual Meeting, 2015

Emily Ball (GRA)

- Teaching Assistant, Principles of Biology BIOL 198 (Spring 2014, Fall 2014)

Jane Fencl (GRA)

- Teaching Assistant, Principles of Biology BIOL 198 (Spring 2014) Organismic Biology BIOL 201 (Fall 2014, Spring 2015)
- Welcoming Committee Chair, Biology Graduate Student Association (BGSA), September 2013 – August 2014
- Treasurer, American Fisheries Society – Kansas State University subchapter, Jan 2014 – 2015
- Docent Konza Environmental Education Program 2014-2015

Kayla Gerber (GRA, Graduated August 2015)

- Teaching Assistant, Organismic Biology BIOL 201 (Spring 2014, Fall 2014, Spring 2015)
- Biology Graduate Student Association - Secretary 2014

David Haukos

- Editor-in-Chief, The Wildlife Society, Wildlife Society Bulletin 2016-2017
- Member, Great Plains LCC Science Team
- Member, Playa Lakes Joint Venture Science Advisory Team
- Associate Editor, Wildlife Society Bulletin 2001-2015
- 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
- Adjunct Professor, Oklahoma State University
- Research Grade Evaluation Panelist, US Geological Survey 2014
- Western Association of Fish and Wildlife Agencies – Lesser Prairie-Chicken Science Work Group 2014-Current
- Central Mountains and Plains Section of The Wildlife Society – Planning Committee for 2015 Annual Meeting
- Served on NSF Review Panel – Macrosystems and Early NEON 2016

Sean Hitchman (GRA)

- Teaching Assistant, Organismal Biology BIOL 201 (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
- Symposium organizer, American Fisheries Society, Kansas City (2016)
- Moderator for national American Fisheries Society Conference (2014-2016)

Brian Kearns (GRA Graduated May 2015)

- Teaching Assistant, Principles of Biology (Spring 2014, Summer 2014)

John Kraft (GRA)

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

Jonathan Lautenbach (GRA)

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

Joseph Lautenbach (GRA)

- Teaching Assistant, Principles of Biology (Spring 2014, Fall 2014)

Richard Lehrter (GRA)

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

Willow Malone (GRA)

- 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)
- Biology Graduate Student Association – T-shirt Committee 2014-2016
- Biology Graduate Student Association – Welcoming Committee

Robert Mapes (GRA)

- 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

Martha Mather

- Subject Editor, Wetlands Ecology and Management 2013-current
- President's Committee on Improving Fisheries Education, American Fisheries Society 2013-2016
- National Science Foundation Proposal Review Panel Population and Communities Ecology (PCE) November 2014
- Expert Working Group - River Herring 2014-2015
- American Fisheries Society Committee of Special Educational Requirements 2013-2015
- Kansas Chapter, American Fisheries Society, Membership Committee 2012-2016

- Division of Biology, Seminar Committee 2014-2015
- Organizer - FRAGSTATS Workshop January 2015
- National Science Foundation proposal review panel (Population and community ecology) 2016

Kelsey McCullough (GRA)

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

Sarah Ogden (GRA)

- 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

Zach Peterson (GRA)

- Teaching Assistant, Principles of Biology BIOL 198 (Spring 2014, Fall 2014, Spring 2015)

Reid Plumb (GRA Graduated May 2015)

- Teaching Assistant, Principals of Biology (Spring 2014, Fall 2014)

Samantha Robinson (GRA)

- Teaching Assistant Principals of Biology (Spring 2014, Fall 2014, Summer 2015)

Dan Sullins (GTA)

- Teaching Assistant, Principals of Biology (Summer 2014, Fall 2014 [2 sections], Spring 2015, Fall 2015, Summer 2016)
- Teaching Assistant, Wildlife Management and Techniques Lab (Spring 2016)

Andrew Stetter (GRA)

- Teaching Assistant, Principles of Biology (Spring 2014)

Ryland Taylor (GRA)

- Teaching Assistant Principals of Biology (Fall 2014, Spring 2015 [2 sections])
- Biology Graduate Student Association – Welcoming Committee 2014-2016.

Awards and Recognition
2014-present

Jane Fencl

- Kansas State University College of Arts and Sciences Travel Award, 2014, $1000
- Biology Graduate Students Association Travel Grant, 2014, $500
- Quality Docent, Konza Environmental Education Program 2014

Kayla Gerber

- Kansas State University Arts & Sciences Graduate Student Research Travel Award, 2014 $1000
- Kansas State University Graduate Student Council Travel Award, 2014 $750
- Biology Graduate Student Association Travel Award, 2014 $500
- Kansas State University Arts & Sciences Graduate Student Research Travel Award, 2015 $800

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
- Hamerstrom Award – Prairie Grouse Technical Council, 2015 for contributions to conservations of prairie grouse.
- Biology Graduate Student Association, Kansas State University, 2015 Outstanding Graduate Faculty Award, Division of Biology
- USGS- Cooperative Research Units, 2015 Excellence in Science Award – Individual
- The Texas Chapter of The Wildlife Society, Significant Contribution to Wildlife Literature – Scientific Publication Category for Grisham, B.A., C.W. Boal, D.A. Haukos, D.M. Davis, K.K. Boydston, C. Dixon, and W.R. Heck. 2013. The predicted influence of climate change on lesser prairie-chicken reproductive parameters. PLoS ONE 8(7): e68225. doi:10.1371/journal.pone.0068225, February 2014.

Sean Hitchman

- Kansas State University College of Arts and Sciences Travel Award- 2014 ($1000)
- Kansas State University Graduate Student Council Travel Award- 2014 ($750)
- Kansas State University College of Arts and Sciences Travel Award- 2015 ($1000)
- Kansas State University Graduate Student Council Travel Award- 2015 ($500)
- Biology Graduate Students Association Travel Award – 2015 ($500)
- Kansas State University College of Arts and Sciences Travel Award- 2016 ($1000)
- Kansas State University Graduate Student Council Travel Award- 2016 ($500)

Brian Kearns

- College of Arts and Sciences Graduate Research Travel Award, Kansas State University, April 2014, $1000

John Kraft

- Graduate Student Council Travel Award, Kansas State University 2015 ($750)
- College of Arts and Sciences Graduate Research Travel Award, Kansas State University, 2015 ($800)
- Biology Graduate Student Association Travel Award 2014 ($500)
- Best KNRC Student Presentation Award 2015

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)

Joseph Lautenbach

- Robert J. Robel Award for Outstanding Graduate Student Research in Wildlife Biology and Ecology, Division of Biology, Kansas State University 2014

Robert Mapes

- College of Arts and Sciences Graduate Research Travel Award, Kansas State University, 2014 $1000
- College of Arts and Sciences Graduate Research Travel Award, Kansas State University, 2015 $1000
- College of Arts and Sciences Graduate Research Travel Award, Kansas State University, 2016 $1000

Kelsey McCullough

- Undergraduate Research Scholarship, College of Arts and Sciences, Kansas State University 2014 $1,250

Sarah Ogden

- Celia Markum Award from Kansas Ornithological Society, Emporia, KS, October 2015
- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2016 $400

Zach Peterson

- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2014 $1000
- Kansas State University - Graduate Student Council Travel Award, 2014 $750

Reid Plumb

- The Wildlife Society: Kansas State Chapter Travel Grant - $100
- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2014 $1000

Samantha Robinson

- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2014 $1000
- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2015 $1000
- Kansas State University Graduate Student Council Travel Award, 2015 $750

Beth Ross

- American Ornithologist's Union Travel Grant – 2015 $350

Andrew Stetter

- Wisconsin Waterfowl Hunters' Conference Scholarship - $1,000.00 2014
- Janice Lee Fenske Memorial Scholarship Finalist at the Midwest Fish & Wildlife Conference. Spring 2014.

Dan Sullins

- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2016 $750

Ryland Taylor

- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2015 $800
- Kansas State University Arts and Sciences Graduate Student Research Travel Award, 2016 $1000

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

2014

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

Kansas State University Degrees Completed 1996 – 2016

2016

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.